

Invitations to Problem Solving with Story Boxes

Kindergarten

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This book is dedicated to

the children who teach us

and

the hard working, dedicated teachers
who attend our workshops and challenge us.

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Preface

Back in the mid-1980's, we developed a set of materials based on Mary Baratta-Lorton's *Workjobs*, called Story Boxes. In this collection, there were eighteen boxes, each containing eight picture boards and seventy to eighty small counters to be used in conjunction with the boards. There were such scenes as meadows with butterfly counters, ponds with miniature frogs, beaches with tiny shells, and fields with lima bean lady bugs. Our idea was that kindergartners could begin to understand the processes of counting, adding, and subtracting, as well as how these processes were symbolized, by moving counters around their boards in response to such stories as:

"The little girl collected seven shiny shells. Can you show the shells she collected on your board?"

"Three frogs were playing in the pond. Two more came to join them. How many in all?"

"I made five valentines and put three into the mailbox. How many do I have left to deliver?"

We intended that children would also tell their own story problems, using the counters and boards to prompt language that might otherwise be difficult. We used the Story Boxes extensively in our own classrooms and included them in our teachers' guides and seminars. Teachers frequently chose

to make them during workshops, but sometimes found they weren't quite sure how to use them back in their classrooms.

In the summer of 1992 we decided to write a more comprehensive guide to the Story Boxes, incorporating some of the changes mandated by the new NCTM Curriculum Standards; changes dictated both by research and by thoughtful classroom practice. Was there a way to capitalize on the informal mathematical understandings most of our young students seemed to bring with them from home? Although they didn't yet speak or write the formal language of mathematics, we knew that many of them were coming to school with some definite ideas about comparing, combining and separating sets. If we displayed two trains of Unifix cubes, one made up of four cubes and the other made up of six, most students would tell us without hesitation which train was longer, though not necessarily by counting the cubes. If we asked pairs of children to share six crackers, most ended up with three each, some by using the "one for you, one for me method", others by making two sets that looked the same. Somehow they were able to determine how many more cups we needed for snack time and tell us that there were too many kids in the playhouse. However, in our rush to help students read, write, and understand numbers and operations, we often seemed to underestimate their ability to think mathematically while pushing them too quickly toward formal mathematical notation.

Was there a way, we wondered, to help children make connections between the considerable understandings they already possessed and the world of school mathematics? What would happen if we moved away from teaching traditional skills into the realm of problem solving? Would such an approach work with *all* of our students, even the children who hardly knew how to count beyond five? Was there a way for them to explain their thinking without the aid of formal mathematical language and notation? Was it possible, furthermore, to help our young students learn to *pose*, as well as solve, interesting and challenging problems?

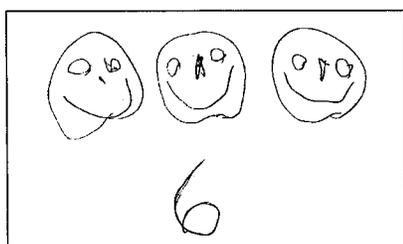
As we wrestled with these questions over a two-year period, we made several discoveries in our own classrooms. The first was a reaffirmation that story problems were an excellent way to help children bridge the gap between home and school mathematics. Students who would have been mystified by the idea of multiplication easily determined that three jack o'lanterns had six eyes altogether. They simply drew the pumpkins, put eyes on them and counted. Some counted by ones, others counted by twos, and some couldn't quite reach six, but most were able to deal with the problem in some fashion. Addition and subtraction, even multiplication and division, were all accessible to our students when placed in the context of familiar real-life stories.

The second discovery, also not new, was that our young students counted to solve problems. With very little encouragement from us, they solved

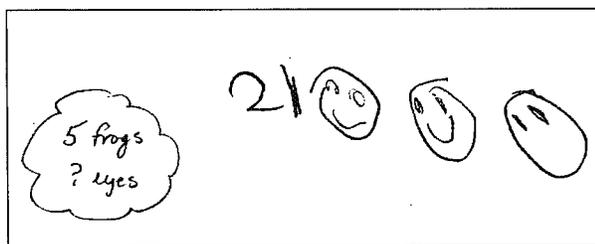
many different kinds of problems by counting beans, counting their fingers, or counting the marks or pictures they made on paper. Counting, in fact, seemed to serve as a way for children to quantify their informal thinking and ultimately to construct enhanced meanings for the numbers themselves. Most could tell that six cubes were more than four because the set of six looked bigger, but in counting the group of four and the group of six, many children noticed the presence of two extra numbers in the counting sequence (the five and the six), and some were eventually able to tell us that six was two more than four.

The third discovery was that our students were able to invent their own notation systems, both to solve problems and to present their thinking to others. Furthermore, their systems grew and changed over the year, often moving from pictures, to pictures accompanied by counting numbers, to pictures with numbers that looked like attempts to show processes.

In October, Lee responded to the problem, "Three pumpkins, how many eyes?" by drawing the pumpkins, counting their eyes, and recording the total—six.

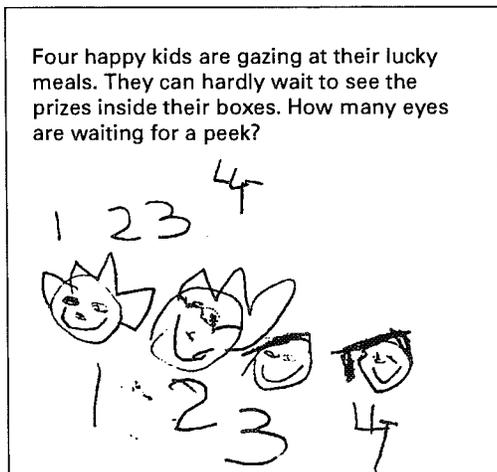


October



December

In December, the problem, "Five frogs, how many eyes?" drew a slightly different response from Lee. He recorded a two to show that he understood that each frog had two eyes, drew a double line to separate the number from his picture, and drew three frogs. After that, he appeared to lose track of



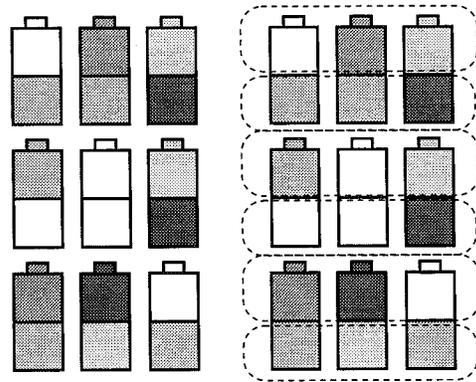
March

what he was doing. Quantities over six seemed difficult for him.

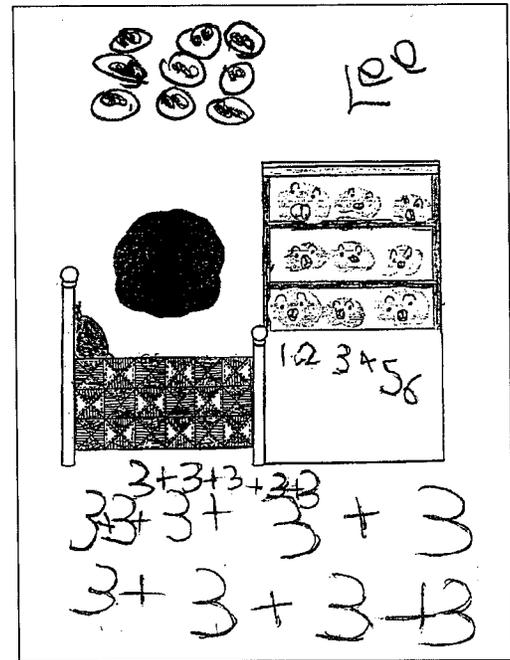
In March, the question of how many eyes on four children elicited a picture of four children accompanied by two sets of numbers from one to four. This was Lee's way of indicating that he understood the number of eyes was double the number of children.

In May, he handled the challenge of determining how many ears on nine bears by getting out the Unifix

cubes. He laid out nine pairs of cubes in a three-by-three array, as shown below. As he looked at it vertically, he noticed that he had six sets of three cubes. Not content to simply count and report a total of eighteen, he tried to record the whole works: $3 + 3 + 3 + 3 + 3 + 3$. There were lots of threes and it was difficult to know when to stop, but his attempt to show the entire process in numbers was evident. The move from counting to addition was not complete, but the impetus was there, fueled by input from teachers, parents, and classmates.



May



Lee's work gave us windows into his growth and development we wouldn't have had in previous years. It was interesting to note that his school skills—counting, one-to-one correspondence, numeral reading, numeral writing, comparing, combining and separating sets—seemed to grow alongside, or in the context of his problem-solving and sharing attempts. His work, along with that of our other students made it apparent to us that it wasn't necessary to teach skills before we could go on to thinking and reasoning. The two could be developed simultaneously.

Asked to approach and respond to many challenging story problems throughout the year, Lee and our other kindergartners were able to build on the skills they brought to school in September, developing number sense along with the more traditional kindergarten arithmetic skills. They left in June validated as mathematical thinkers; aware that there were various ways to solve problems and that they were capable of discovering some of these ways themselves. We are excited to share our new work with you, and hope you find it valuable in your own classrooms.



Introduction

Although there are probably as many different theories about what constitutes good kindergarten teaching as there are kindergarten teachers, most of us pride ourselves on providing young students with language-rich environments. Each fall we hang alphabet letters, color and number words, along with poetry and song charts on our walls. We carefully label the children's cubbies and coat hooks with their names. We treasure our collections of big books, picture books, songs, fingerplays, and poems as much as we would gold and precious jewels. Some books we set out for children to enjoy on their own; others we save for just the right moments—the first colored leaves in autumn, the day after Halloween, our spring trip to the farm, or a child's tears at a lost pet.

Despite the fact that many opportunities to read and write emerge from the children's play, we plan literacy experiences with great care, choosing books to share with our students that will help them appreciate the rhythm and rhyme of our language, learn something new about a topic of interest, or get carried away in the magic and enchantment of an oft-told folk tale. When we read big books to students, we model our own strategies, pointing to the words so that they'll begin to understand that text proceeds from top to bottom and left to right, and that we're reading the words, not the pictures. We teach the names and sounds of alphabet letters in the context of stories and songs. While we don't expect mastery of these concepts, we do ask children

to marshal what they know about print to make signs, leave notes, sign their names, or make daily journal entries as best they can. We do not hesitate to set expectations and pose daily problems in print, knowing that our students may not read and write in any formal sense until first, or perhaps second grade. We are often surprised, in fact, at just how much some of our young students can do.

If our job in the area of literacy is to fill youngsters with language and joy at the written and spoken word, must we not ask ourselves what our job is in mathematics? In the recently published *Guide to Developmentally Appropriate Practice*, the National Association for the Education of Young Children has suggested that it is unwise to address any subject out of context or in isolation. Some practitioners have construed this as permission to give minimal time to mathematics. They reason that the block corner, the construction toys, the dramatic play corner and the water table, along with an occasional number or shape activity should be sufficient. We ask teachers to consider whether or not they would leave their entire *literacy* program to emerge in the context of children's play during choosing time. Is there anyone among us who would willingly stop reading books, writing language experience stories, or exposing children to the sounds and names of alphabet letters? Is there anyone among us who would say that the listening center, the library corner, the paper and felt markers, the puppet theater, and the occasional alphabet game could take care of everything? If not, we are left with the difficult challenge of figuring out the mathematical equivalent of great books and a rich print environment.

Over the past two years, we have discovered that posing problems based on children's experiences may be part of the solution. By *problems*, we mean mathematical questions for which there are no immediate answers to the problem solvers. Although problems can and do emerge spontaneously from children's own activities, we can also design and collect good problems, in much the same way that we gather good books and make decisions about the literacy experiences we provide in class each day. The problems we pose need not always be "real" in the sense that they flow from the moment (we are not always doing things in our classrooms that are inherently mathematical), but they must relate to children's lives in some way, and must be couched in language that makes sense to them. In *Mathematics With Reason*, Sue Atkinson points out that young children often arrive at school with a considerable amount of mathematical knowledge, but that their concrete understandings don't always translate into the language of "school math". She illustrates her point by quoting a conversation between researcher Martin Hughes and a four-year-old boy:

MH: How many is two and one more?

Patrick: Four.

MH: Well, how many is two lollipops and one more?

Patrick: Three.

MH: How many is two elephants and one more?

Patrick: Three.

MH: How many is two giraffes and one more?

Patrick: Three

MH: So how many is two and one more?

Patrick: (Looking Hughes straight in the eye) Six.

The activities in *Invitations to Problem Solving with Story Boxes* are designed to help children develop number and operation sense in the context of such familiar themes as going out to the playground, watching animals, and keeping track of one's possessions. These problems provide challenges for children to tackle in their own ways, drawing on their own mathematical understandings and knowledge. As they work to solve these problems and to pose others for their classmates, they develop many of the skills we've always attempted to teach in kindergarten: counting, one-to-one correspondence, numeral recognition, numeral writing, comparing quantities, and beginning addition and subtraction.

WHAT SKILLS DO KINDERGARTNERS BRING FROM HOME?

Over the past decade, researchers have found that nearly all children under the age of five develop two kinds of mathematical knowledge, apparently through years of informal experience at home. First of all, young children understand a great deal about amounts of things such as blocks, toys, sand, water, cookies, or carrots, as well as relationships among these amounts. If you present most pre-schoolers with two glasses of lemonade, one containing more than the other, they will be able to identify the glass that's holding more. If you show them two unequal plates of cookies, they'll probably be able to tell you which plate has more and which has less, even if they can't count the number of cookies on either plate. These judgements, based on immediate perceptions, form the basis for growing understandings about measurement and numerical comparison of quantity.

Four-year-olds understand that if you pour some more lemonade into one of the glasses, that glass will have more than it had before, and that if someone drinks from one of the glasses, that glass will have less than it had before. That is, they have the ability to interpret change in amount as increasing or decreasing. They also know that the amount stays the same if nothing is added or taken away. These foundations constitute the underpinnings of

addition, subtraction, and conservation.

Most young children also understand that if you cut an apple into pieces and put them back together, you'll still have the same amount of apple, but that if you cut it into pieces and eat some of them you won't have as much apple as when you started. These part/whole understandings provide the framework for some of the concepts that underlie our place value system. These are the early understandings that later permit second graders to add fifty-seven and thirty-four by decomposing and then recomposing the numbers: $57 + 34 = 91$ because $50 + 30 = 80$, $7 + 4 = 11$, and $80 + 11 = 91$.

The second thing most children bring to school is some knowledge about the rules of counting. Many can count to ten or beyond by rote. Researchers also report that children as young as three or four understand that number names must be matched one-for-one with the objects in a set. Furthermore, they understand that the order of number names matters, but the order in which the objects are touched does not (Gelman and Gallistel, 1978).

As powerful as these understandings are, investigators (Sophian, 1987) have shown that many children who know how to count do not do so in order to compare sets (e.g., when asked which pile of blocks has more, they'll choose the pile that "looks bigger"). These studies conclude that counting knowledge and quantitative understandings are separate systems that must become integrated if children are to progress mathematically. The process of integration seems to happen with comparing first. One researcher reports that children as young as four behave as if the sequence of counting words is a kind of "mental number line". Some can quickly identify which of a pair of numbers is more by mentally consulting this number line. (Resnick, 1983).

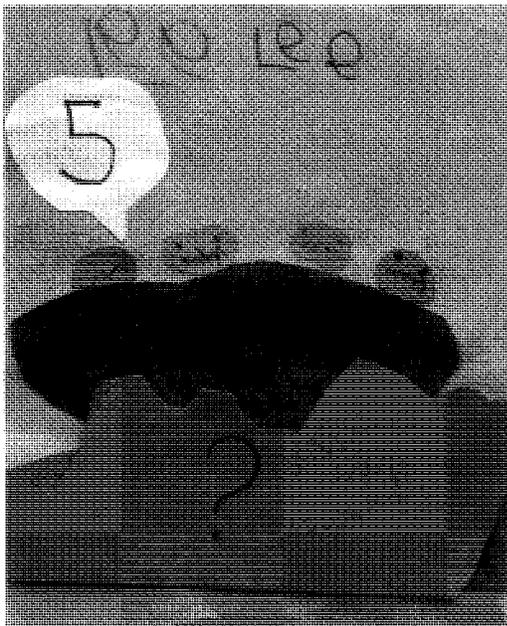
Integration of counting with informal understandings about addition, subtraction, and part/whole relationships comes next and seems to develop as a result of engaging in projects that call for changing and combining quantities, while counting or measuring rather exactly to insure proper results. Household activities such as setting the table, cooking, shopping, and building come to mind. These experiences are especially effective if youngsters work with adults or older children who can provide one-on-one modeling, assistance, and language. While we try to offer similar opportunities at school, we believe that story problems constitute another effective resource for helping young learners integrate counting and intuitive mathematical understandings.

HOW DO STORY PROBLEMS HELP CHILDREN BUILD ON WHAT THEY ALREADY KNOW?

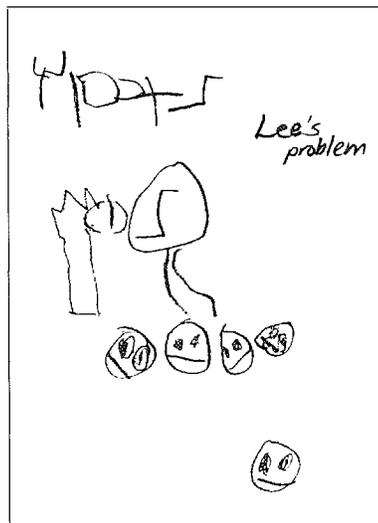
Because story problems require the same understandings many children have started to develop informally (comparing, increasing, decreasing, combining, and taking apart), they seem ideal for helping children link counting

to early knowledge about quantity. As children use their counting skills to solve story problems, they gradually come to treat numbers (rather than objects) as the entities that are mentally compared, increased and decreased, or organized into parts and wholes. We see this in our own kindergarten classes as youngsters move from explaining that there are more blocks in that pile because it looks bigger, to counting both piles and reporting that the bigger pile has nine while the other pile only has four, to telling us that the bigger pile has five more than the other one.

We pose story problems that can be solved by counting, and we actively encourage children to count. Initially, students set out lima bean characters on storyboards to show the action, but before long, we invite them to use their fingers, drawings, and numerals as well. While this contradicts the popular belief that young children should work with manipulatives for many months before writing anything down on paper, we've discovered that many students find it as easy to keep track of story situations by making sketches or writing numbers as moving beans around on their boards, especially if we allow them to invent their own methods of representation. Thus, to solve the following problem:

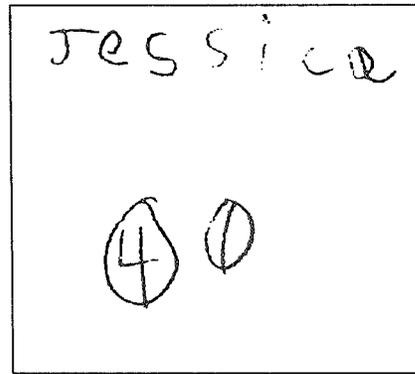


There used to be five frogs on the log but now there are only four. How many jumped in the water?

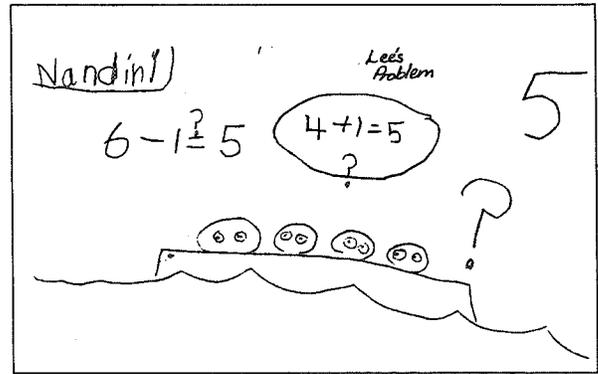


Stacy

Stacy draws a tree and four frogs on an invisible log. She keeps counting to reach a total of five by drawing one more frog in the water. Her drawings serve much the same purpose as beans might, but they don't slip around as much, and she seems more committed to the problem-solving task.



Jessica



Nandini

Jessica shows the numeral four for the frogs on the log, and writes the numeral one for the fifth frog in the water. Does she truly understand that four and one combined make five? We're not sure and since English is her second language she can't really explain, although when asked, she points to the four on the log and holds up one finger as she points to the water.

Nandini, who seems to have reached a stage where the numbers and symbols themselves represent transactions, experiments with ways to portray the action by writing $6 - 1$, then $4 + 1$, and then draws a picture, as if to validate her own thinking.

DO YOU WORRY ABOUT LETTING KINDERGARTNERS INVENT THEIR OWN NOTATION?

This is an interesting question. In years past, we encouraged children to work with their beans for many months to solve story problems. When we were confident that most of our students were beginning to understand the processes of addition and subtraction, we carefully showed them the standard ways to write number sentences and slowly eased them into writing their own, *our* way. We now believe that this kind of instruction, by focusing on specific procedures and special mathematical notation, tends to teach children that what they already know might not be legitimate mathematics. Although there is definitely a time and place to teach standard notation, it probably comes when the children themselves begin to reach for it; when drawings and numbers don't seem adequate anymore. We notice many of our kindergartners heading in that direction by late spring.

To develop children's trust in their own knowledge as mathematicians, we stress the possibility of multiple procedures for solving any problem. We ask them to tell others how they've used their beans to solve problems and invite them to invent their own written expressions. We ask that they explain their work in everyday language and show their thinking using any method that is meaningful to them.

This, to us, seems equivalent to asking kindergartners to write notes,

signs, and stories using whatever form of spelling they're able to invent at the time. In September, many accompany their drawings with squiggles carefully arranged to look like lines of writing. Others use letters in random sequence, and a small handful have begun to connect letters with sounds—"rat" may be spelled "R", and "bunny" may be BE. Later in the year, many more are using letters, though often still in random fashion, while some demonstrate growing awareness of sound/symbol connections. We are confident that nearly every child will pass through these stages of spelling, much as he or she will grow physically and socially.

When we ask kindergartners to invent their own mathematical notation, we see similar stages over a year's time as children like Lee, whose work is shown in the Preface, move from solving problems with simple drawings to representing their thinking in numbers and symbols. If we ask children to display their thinking on paper, we must encourage them to show their solutions in ways that make sense to them, trusting that with time and experience over the primary years, they will pass through these stages and move toward standard notation. In that context, we can offer children problems that involve addition, subtraction, multiplication, and division, operations they have encountered throughout early childhood as they've baked, shared, and eaten cookies; searched for missing shoes, sorted them into pairs; figured out how many toys they have altogether; and performed countless other transactions in their daily lives.

WHY USE STORY BOXES?

They help children see mathematics in relationship to their everyday lives.

In designing the story boxes, we chose themes that were both inherently mathematical and also common to young children's lives. The fantasy of Halloween is so powerful that it inspires tremendous growth in children's language in our own classrooms every October. The appearance, disappearance, and capture of such imaginary creatures as ghosts and goblins, along with the whimsy of bright-eyed pumpkins in the window never fail to spark children's imaginations. We feel that most children have watched pets and even wild animals arrive and depart many times, and have also worked to arrange and keep track of their own possessions. Many popular fast foods restaurants have playgrounds, and few are the children who haven't noted with interest the comings and goings of potential playmates.

Stories about these familiar situations allow young children access to mathematical operations they might not otherwise understand. While the number sentence $5 - ? = 2$ might draw blank stares from most kindergartners, there's not a child we know who hasn't experienced subtraction first hand: *I had five teddy bears in my room yesterday, but I can only find two of*

them today. There were five frogs sitting right on the log, but now there are only two.

One point we want to make about these themes is that we've selected them not only because tracking the comings and goings of people, imaginary creatures, animals, or toys helps students understand mathematics, but also because mathematics helps children understand how to count the frogs, figure out how many ghosts are hiding behind the door, or keep track of the kids on the playground. In the words of the 1992 *California State Mathematics Framework*, "When mathematical ideas help students understand situations, the ideas are not only more interesting and accessible but also easier to remember and use."

Story Boxes give children the support they need to be able to solve and pose a wide variety of story problems.

While older students use visual models or manipulate abstract symbols to solve problems, young children need to act things out. Full dramatization with students serving as the actors might be a good way to begin, but as problems move to quantities much higher than four and complexity greater than counting, small characters moved around on miniature backdrops become a more viable alternative. Lima bean kids and teddy bears can easily be manipulated—hidden behind doors or under beds, placed in several different locations, let in or out of the restaurant, or divided evenly between two shelves. They can also be produced in sufficient quantity that each child can have his or her own to use for problem-solving sessions.

When students begin to pose their own problems, the counters and boards also lend support to the challenging task of developing mathematical stories. The Rainbow Bears board shows shelves and a bed with a lift-up quilt flap, while The Burger Hut board pictures a playground and a restaurant with doors that open and shut. The Spooky House board is a fence and a two-storied house with several windows, while the Frogs and Toads board pictures a log, a tree, a pond, and several lily pads. These are natural prompts for counting, comparing, adding, subtracting, grouping, and partitioning and allow children to pose problems in the form of pictures and symbols, long before they're able to actually write problems.

HOW ARE THE STORY BOX THEMES ORGANIZED?

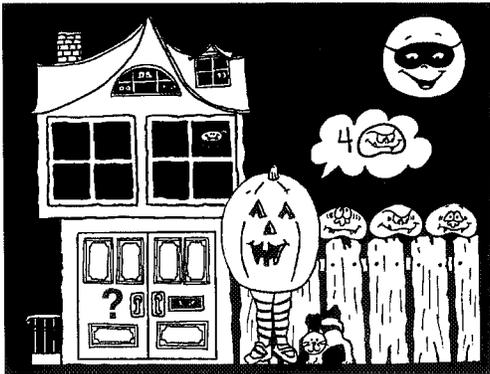
First of all, it's important to understand that *Invitations to Problem Solving with Story Boxes* is not meant to be an entire math program. To do a full job of helping our kindergartners develop skills in patterning, collecting and analyzing data, measuring, number, and geometry, we also use *Box It or Bag It Mathematics* (Burk, Snider, and Symonds, 1988). Other resources we have found particularly useful in working with kindergartners include *Living and*

Learning Mathematics (Whitin, Mills, and O'Keefe, 1990), *Books You Can Count On* (Griffiths and Clyne, 1991), *Maths in Context* (Edwards, 1990), and *Math Excursions K* (Burk, Snider, and Symonds, 1992). The Story Box themes drive so much learning, though, that we spend about seven days a month with them in October, November, January, March, April, and May.

We wait until October to begin Story Box instruction because there's so much to do in math throughout September in terms of developing a sense of community as children explore the many manipulative materials and get to know one another. We want them to feel safe and secure as learners. By mid-October, however, most of our students are ready to turn their attention to the ever-popular subject of Halloween. The Spooky House theme, which revolves around the comings and goings of pumpkins, goblins, and ghosts, provides all kinds of opportunities for youngsters to copy and extend patterns, count, add, subtract, partition, group, and compare quantities in the context of whimsical and interesting problems.

Children start by making their own miniature "spooky houses", which they use along with lima bean pumpkin, goblin, and ghost counters to enact and solve teacher-posed problems. Those who are able explain their strategies or show them on the pocket chart with large paper Halloween characters. There is much watching and imitating of peers' work as students attempt to make sense of these challenges.

After working orally for two sessions, we bring in Spooky House picture problems to share with the students (see examples below).



The little girl was all dressed up for Halloween. When she first walked up to the spooky house, she thought she saw four green goblins sitting on the fence. When she turned around to look again, there were only three. How many of those goblins had disappeared into the house?



His mom had told him there were three wonderful pumpkins hidden behind the windows and doors of the spooky-looking house. How many pumpkin eyes will he see?

Together, we examine the pictures, looking for clues as to what problems are being posed. Then we tell the stories that accompany our pictures and the children use their counters and Spooky House storyboards to solve the

problems. We return to these picture problems the next day, but this time, we ask children to show their strategies and solutions by means of drawings, numbers, and/or words on individual chalkboards. Finally, we ask our students to create their own picture problems. We give them considerable structure and support at first, gradually widening the range of possibilities as the year progresses. Once children have created their own problems, they share them with their classmates, who work together to try to solve them. This instructional sequence, which we've summarized below, is repeated with every theme. With the exception of Days 1 and 6, the lessons last twenty to twenty-five minutes. It often takes children a bit longer to make their storyboards and create their own story problems.

STORY BOX INSTRUCTIONAL SEQUENCE

- | | |
|-----------------------|---|
| Day 1 | <p>Making the Storyboards</p> <ul style="list-style-type: none"> • Students create storyboards for the theme being introduced. |
| Days 2 & 3 | <p>Solving Spoken Story Problems</p> <ul style="list-style-type: none"> • Story problems are posed orally by the teacher. • Students solve problems using storyboards and counters, and share their ideas with the class. |
| Day 4 | <p>Solving Picture Story Problems</p> <ul style="list-style-type: none"> • Teacher presents story problems in picture form. • Students solve these problems using storyboards and counters, and share their ideas with the class. |
| Day 5 | <p>Writing Solutions to Picture Problems</p> <ul style="list-style-type: none"> • Teacher presents story problems in picture form. • Students solve these problems on individual chalkboards, inventing their own notation to show their thinking. Some use drawings, while others use numbers, tally marks, or words. Solutions and strategies are shared with the group. |
| Day 6 | <p>Creating Story Problems</p> <ul style="list-style-type: none"> • Students create their own story problems, using the teacher's Picture Problems for reference. |
| Day 7 + | <p>Solving Student Story Problems</p> <ul style="list-style-type: none"> • Student problems are shared with the class. • Students solve two or three of the problems on paper, by drawing and writing whatever numbers they can to show their thinking. • The remaining problems are shared and solved orally over the next few days. |

Along with the instructional sequence, the problems we pose from month to month remain reasonably constant throughout the year. We recycle each problem type with every theme, knowing that children's understandings will develop at different times. Unlike first and second grade, where we introduce new sorts of problems and significantly more challenging versions of earlier problems as the year progresses, we find that we get more mileage out of posing the same sorts of problems each time to kindergartners. It continues to be most productive to pose problems that involve counting, comparing, adding, subtracting, grouping, and partitioning quantities under twelve for most of the year. What changes are students' counting strategies, their ability to read and write numbers, their sense of quantity and operation, and the ways they are able to express and represent their thinking.

We do have to live with the fact that not all children succeed with all problems. Even when they do, it takes some students a long time to be able to express their thinking with any more than the phrase, "I just knew it". We try to honor all levels of understanding in our own classrooms. If we're not losing at least a few children on some of the problems, we're probably working at a level that is too easy. Even children who don't always "get it" seem to remain more interested and absorbed when we offer real challenges in the form of stories than when we undertake the more routine sorts of drill and practice activities often used to try to build skills.

WHAT KINDS OF MATERIALS WILL I NEED TO IMPLEMENT THESE ACTIVITIES?

You will need to make six story boxes: The Spooky House, The Cat Cottage, Penguins, Frogs and Toads, The Burger Hut, and Rainbow Bears, six sets of picture problems, and six sets of pocket chart materials to teach these lessons. For each story box, you'll need to make three hundred to five hundred forty lima bean counters. (Or purchase colored, punchout cardboard counters from The Math Learning Center, see page 145.) The picture problems and pocket chart materials can be copied directly from the blacklines in this book and require relatively little time to prepare. The sets of lima bean counters are another matter, but once they're made, they'll last for several years.

In addition to the story boxes, picture problems, and pocket chart materials, you'll need individual student chalkboards, erasers, and chalk. Students will also need plain white paper, construction paper, glue, scissors, scotch tape, and other common school supplies to create and solve story problems. You will find complete instructions for making story boxes and picture problems, preparing needed print and pocket chart materials, and ordering student chalkboards at the end of this book under Preparation of Materials.

WHAT KINDS OF ASSESSMENT OPPORTUNITIES DO STORY BOXES PROVIDE?

"(In the 1990's) assessment and instruction will be integrated more effectively. Teachers can raise standards and expectations, asking thoughtful questions that allow for thoughtful (and unexpected) responses....Most important, teachers can learn to...focus on what students know rather than on what they don't know."

"Assessment provides teachers with a window into students' thinking and understanding, as well as into their proficiency with more narrow skills, and reveals the quality of the students' mathematical communication. It also helps teachers evaluate the success of the mathematics program and provides information helpful in making decisions on instruction."

Mathematics Framework for California Public Schools

Given the fragile nature of young children's understandings, assessment is something that must be approached with a great deal of care and humility. In an act akin to catching (but not pinning) butterflies, kindergarten teachers probably have to look and listen more carefully than most others. We have to be adept at following faint trails for long distances, and must be willing to believe that every child's responses have some sort of logic behind them, even if we can't fathom what it is. If you view assessment as a process of discovery, you'll find that the activities in this book provide some wonderful opportunities to learn more about your students.

The very fact that we pose problems and ask children to show or explain their thinking in some way opens windows. While youngsters' explanations of their problem-solving strategies during group work can be difficult to capture, and are often likely to come in the form of demonstrations at the pocket chart accompanied by counting, we can learn much by watching and listening carefully.

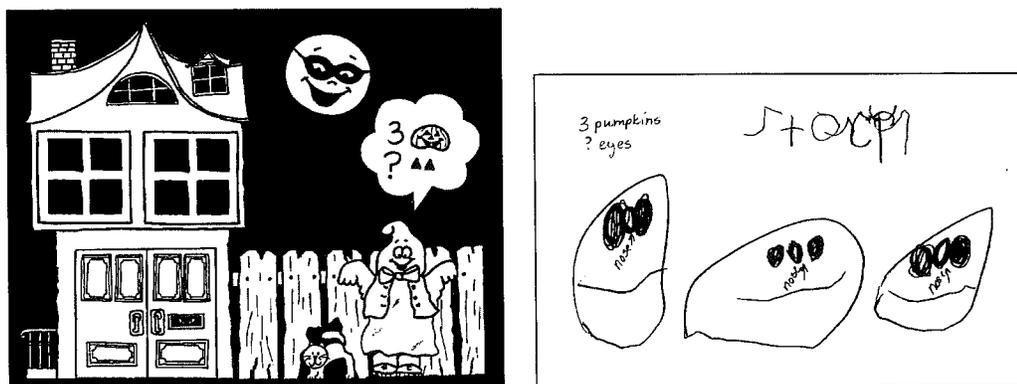
We ask children to figure out how many penguin babies they would find in three nests, if each nest held two babies. They set to work with their beans and boards and soon the answers start flying. "Six! Four! Nine! Six! No, four!", they offer. We wonder at this diversity and ask them to explain. With a look backwards at his storyboard, Joey comes to the pocket chart and sets out two groups of three baby penguins, counting, "One, two, three, four, five, six". Resisting the urge to rearrange the paper cut-outs, we ask Joey why he's chosen to put them in groups of three. He's unable to explain, but counts them again for us. We know he's heard information about three and two—it's clear that he understands something about grouping and is easily able to deal with a quantity of six.

Vicky comes up next and rearranges the six penguins into three groups of two, saying, "Two in a nest, two in a nest, two in a nest". Then she counts them one by one for a total of six. Sheila jumps up and counts the penguins

by twos, pointing to each group in turn—"Two, four, six!" Reflecting on the lesson later, we realize that some children probably interpreted the problem to mean two babies in two nests or three babies in three nests, rather than two babies in three nests. Perhaps that's where the four and the nine perhaps came from—maybe these weren't random responses after all.

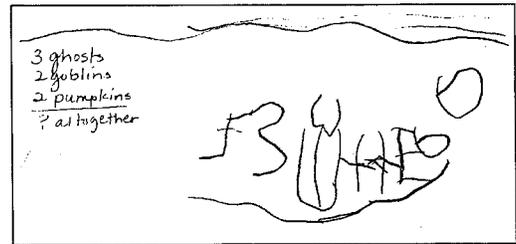
As we pose problems throughout the year, patterns begin to emerge. It becomes clear that some children solve most problems by setting them up on their story boards with counters. Others will make use of their fingers. Still others appear to work mentally at times. Some of them are able to explain their thinking verbally, while others can demonstrate it at the pocket chart or by holding up their fingers. A few can only tell us they "just knew it".

In addition to asking children to work with manipulatives and explain their thinking orally, we also ask them to find ways to solve problems on paper—by means of drawings, numbers, words, or any other representation that works for them. While it's risky to base judgement on any single performance, work samples collected over a long period of time can yield some very interesting insights about students. In October, Stacy responds to the problem "3 pumpkins, how many eyes?" by drawing three pumpkins.

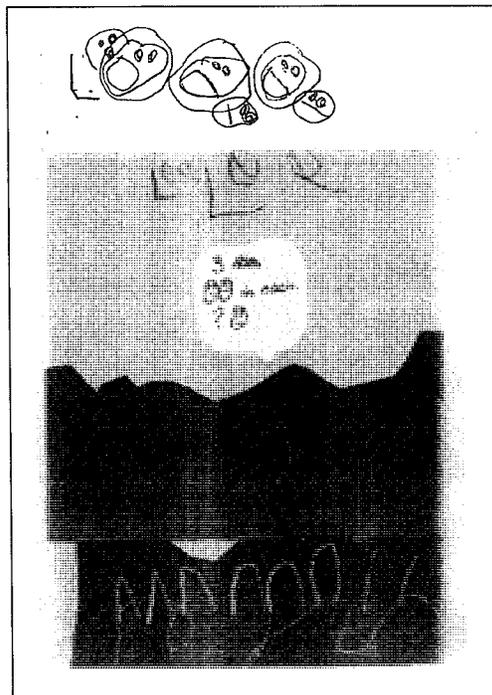


We see what appear to be three eyes on each pumpkin, but when we ask her, she explains that the middle circle on each is a nose. Does she really understand the problem, or has she simply copied our pumpkin three times? We can't be sure, but when we question her, she counts the eyes accurately.

Oddly enough, Stacy responds to the next picture problem by writing numbers rather than making drawings, even though it is hard for her (see following page). We can tell that she'll need lots of opportunities to practice, and when we present her with numeral-writing activities later, she forges ahead with a purpose.

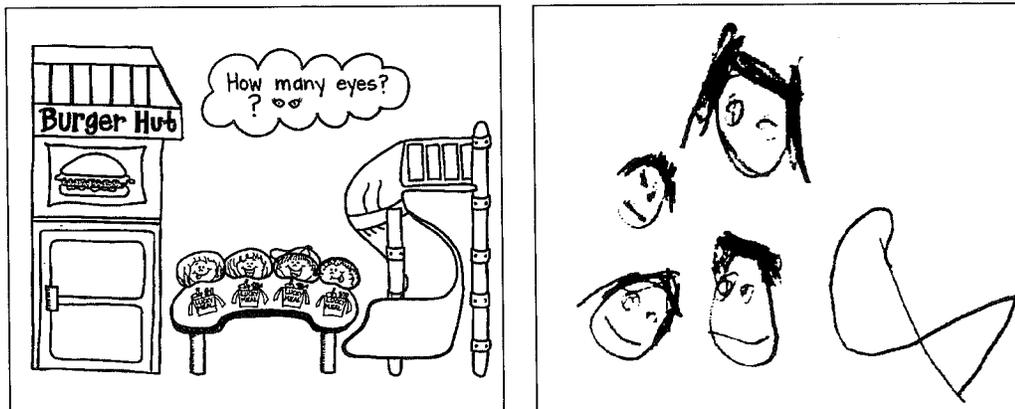


In January, Stacy works with the penguin problems Lee and Kristjiana have posed: "3 nests, 2 penguins in each nest...how many altogether?" and "5 nests, 2 penguins in each nest—how many altogether?". On Lee's problem, she groups each set of two penguins with a loop in a way that demonstrates she understands the idea of two per nest, three nests. On Kristjiana's problem, in conjunction with her growing interest in writing numerals and new confidence in naming them, she first traces the five in the talking bubble and then writes another five beside it. She writes some numerals to the side, but it is her drawings that let us see that Stacy understands the problem even if her use of numbers isn't clear at this time.



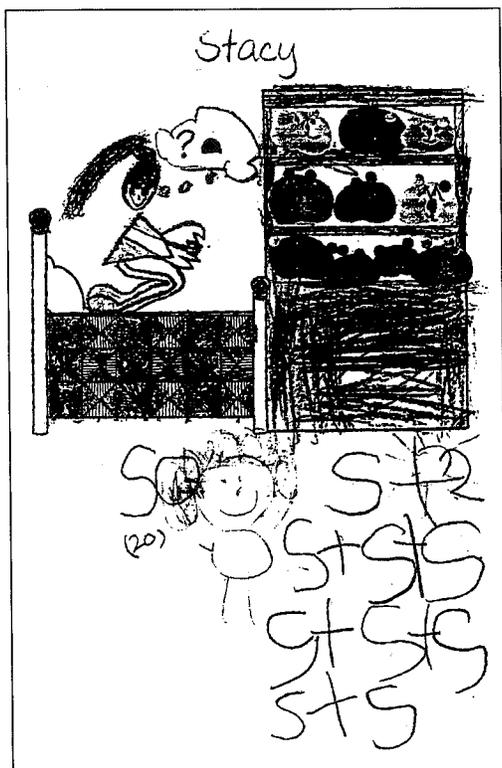
In March, Stacy responds to our picture problem, (*Four happy kids gazing at their lucky meals, how many eyes waiting for a peek?*) by carefully drawing each of the four faces and writing an eight. When asked about the eight, she counts the eyes by ones and gleefully announces, "See, eight!" She seems a

little indignant that we have to ask. Her grasp of number names and quantity has become much more secure.



In mid-May, Stacy has developed a strong friendship with Kristjiana and has become quite fascinated with her use of numbers. She accurately counts the ears on ten bears and records twenty as her answer. She also draws a girl with a big smile. When asked how she figured out the twenty, she starts

writing twos and then looks again to Kristjiana who shows her how to make some pluses in between. When she returns to show us her work, we can't escape her feeling of triumph—she knows she is forging new territory. It will take many more experiences in first and second grade to help Stacy solidify these fragile foundations, but she has demonstrated an ability to solve challenging problems all year. The work she's produced over the past nine months shows unmistakable growth in math and communication skills.

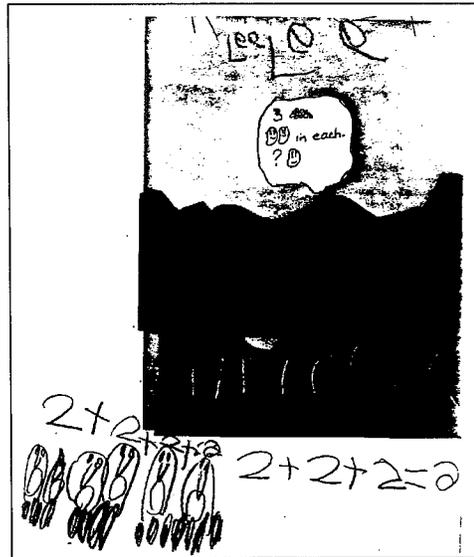


As we look through her collected work, Kristjiana's growth is equally apparent, though different than Stacy's. As early as January, it is clear that she feels great pleasure using numbers to show her thinking (see following page). In her response to the penguin problem Lee has

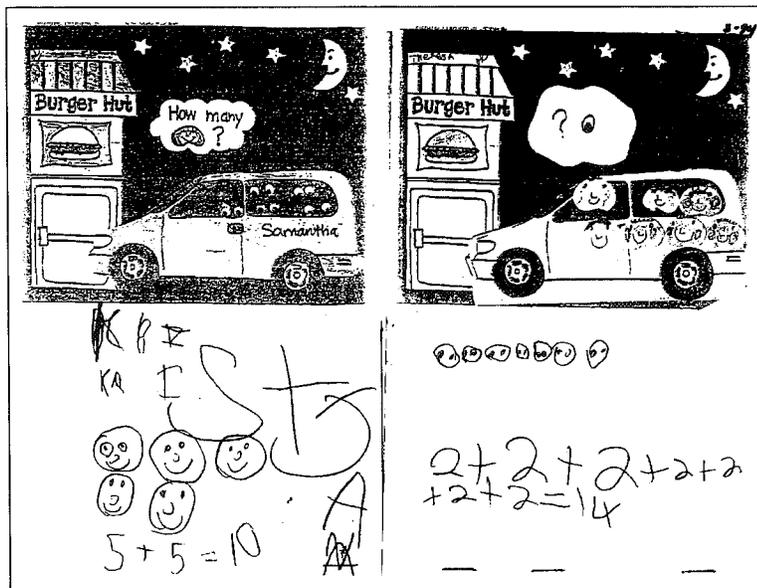
posed (3 nests, 2 babies in each nest...how many altogether?), she writes $2 + 2 + 2 + 6$ and then draws the nests and babies. When that is finished, she rewrites the numbers sentence once again but this time she finishes it with

INTRODUCTION

an equals sign. We wonder if we'll be able to challenge her in the upcoming months since she already seems quite secure in solving these problems.



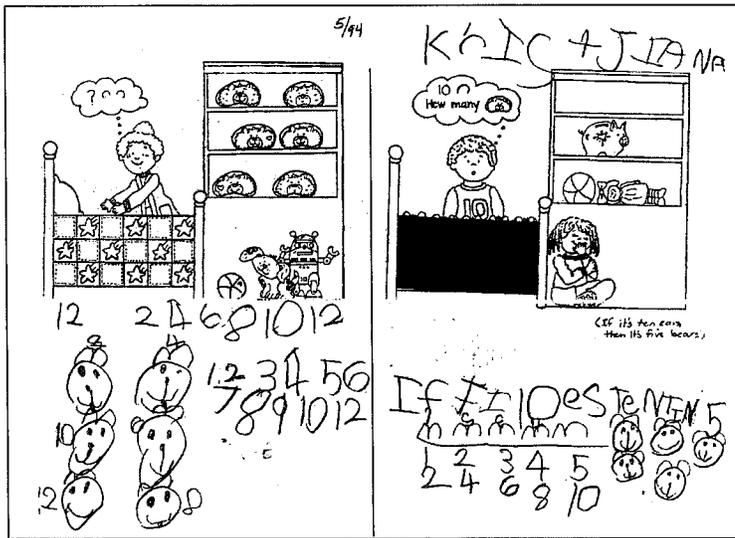
When faced with Samantha's problem (*10 eyes, how many kids?*) in March, she draws five complete faces, each with two eyes. She then writes $5 + 5 = 10$, demonstrating her understanding of how doubling the five will produce the solution because each kid has two eyes. To solve Theresa's problem (*7 kids, how many eyes?*), she quickly draws circles, each with two eyes, to represent the faces and proceeds to write a number sentence to describe her drawing.



Because her ability to represent multiplication as repeated addition seems so solid, we are surprised to see her take a new twist in May. This time, the

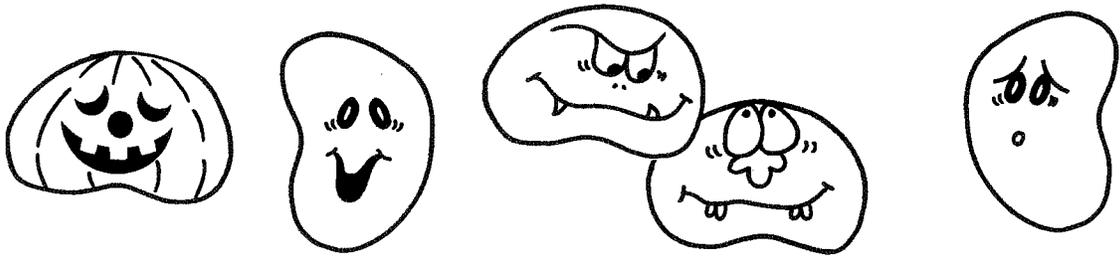
question "6 bears, how many ears?" elicits skip counting, along with a drawing to show that each bear has two ears and a listing of the numerals from one to twelve. There is also a tentative, "6 6" written at the bottom, as if to suggest that there are six ears on one set of three bears and six on the other. Although Kristjiana understands the problem inside and out, she is clearly reaching for new ways to think about it.

This is also demonstrated in her response to the second problem, "Ten ears, how many bears?". First she writes, "If it's 10 ears, then it's five bears". Then she draws five pairs of ears, five bear faces, and finally, in a very organized way, writes 1 2 3 4 5, and under that, 2 4 6 8 10, again showing that she can use her doubling knowledge to divide—two ears for each bear. Successful communication with her classmates has become very important to Kristjiana, but her understanding of the processes of multiplication and division also appears to be growing as she finds new ways to represent her thinking.

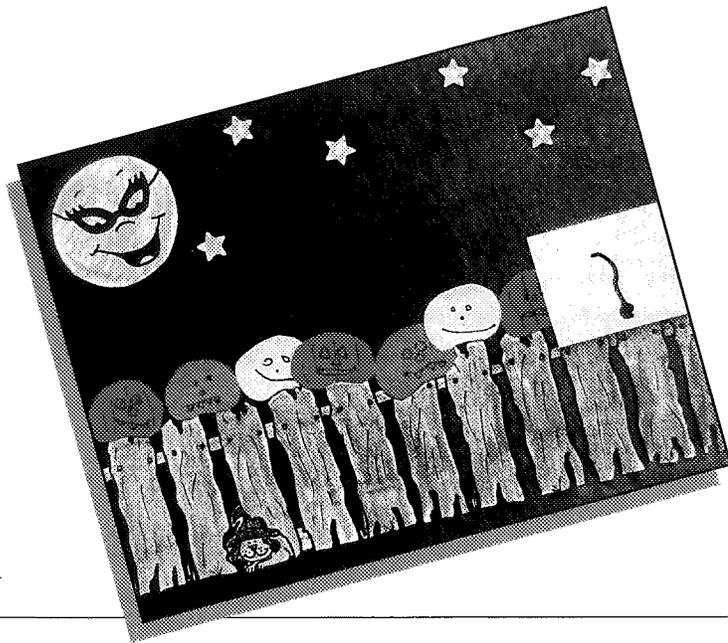


While we can't give you precise recipes for assessment in your own classrooms, we can tell you that we've learned a great deal about our children by listening and watching carefully as they solve problems throughout the year and by saving and analyzing their written work. When we combine this information with observations we make of students' responses in our overall math program, we wind up with fairly comprehensive portraits of children's mathematical thinking. This information can then be used to plan and modify future instruction, to explain children's strengths and needs to parents, and to promote mathematical pride among students. If you decide to invite your children to solve and pose problems with story boxes, we know you too will discover many new and exciting things about your kindergartners.

NOTES



The Spooky House



Theme 1

The Spooky House

Although there are many themes that capture the spirit of fall, none spark young imaginations quite as brightly as does Halloween. In *The Spooky House*, pumpkins, goblins, and ghosts hide behind doors; parade down haunted paths; wink at trick-or-treaters; and provide all kinds of opportunities for children to count, read and write numerals, copy and extend patterns, add, subtract, partition, group and compare quantities in the context of whimsical and interesting problems.

Four friendly ghosts were gathered by the door of the spooky house. Three green goblins were walking down the path. Two orange pumpkins were sitting beside the path. Which group had the fewest?

A trick-or-treater thought she saw four ghosts beside the house, but when she looked again, she saw only two. How many had hidden behind the door when she wasn't watching?

Then she saw eight bright eyes winking at her from the window of the spooky house. How many pumpkins were in the window?

After introducing the theme and showing the children our lima bean Hal-

loween characters, we ask them to construct their own miniature spooky houses and yards from eight-ounce milk cartons, paper, and poster board. They use these three-dimensional "storyboards" and bean characters to enact and solve a variety of story problems, and then move on to recording their strategies and solutions on individual chalkboards. Finally, they create their own pattern problems to share and solve with classmates. The entire process takes about seven days and is just the first step in a year-long series of encounters with story problems.

Note: If The Spooky House is a theme you don't choose to implement, please see Cats, Theme 2, and begin your story problem work there.

HOW IT WORKED FOR US

In the fall of our second year of field-testing story boxes, we reflected on the young mathematicians we had sent onto first grade from the year before. Had we learned enough? How would things work with a brand new group? Did we have a clear idea of what to expect in the early months of kindergarten?

We knew drama could serve as an important link in helping children develop mathematical understandings, but we'd also tried it often enough to know that each child would stay absorbed only until he or she got a turn to be in the production after which interest would quickly diminish, even though many students were still eagerly awaiting a turn. We also disliked the role of director that we so often found ourselves playing in these productions. There *had* to be a better way. We began by making paper story bibs in bean shapes to go with our story box characters. All the old problems reappeared—good behavior was proportionate to individual investment in the production. Kindergartners were better at doing than observing.

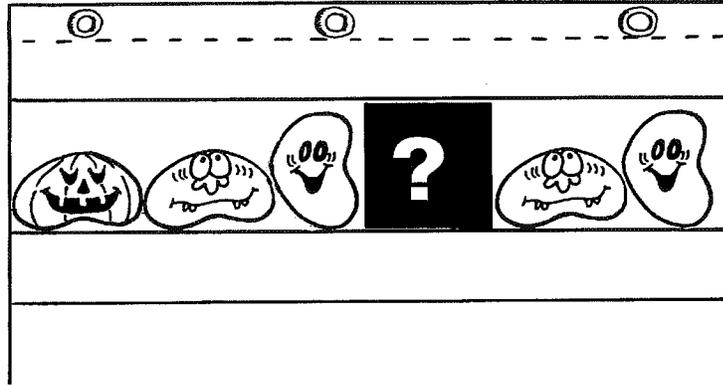
We decided to reduce the scope of our dramatic productions so that children could be active the whole time. We had each student construct his or her own "set"—a three-dimensional spooky house made of a small milk carton, construction paper, railroad board, and stickers. Pumpkin, goblin, and ghost beans were the actors and actresses and the students were the directors and production managers. The children were immensely happy with their spooky houses and we were eager to pose math story problems for them to reenact with their scenery and characters, but we had forgotten one critical component. Our students needed time to play. Their Halloween characters just had to go in and out of their houses and up and down the path. Teacher-posed problems would have to wait awhile. It was charming to nestle in and observe the antics of the pumpkins, goblins, and ghosts as the children each played out their own dramatic productions. Though some had no idea of any audience, others worked in semi-cooperative fashion, entertaining a classmate or two. Nearly all were cheerfully occupied for many

minutes. We had hoped for communication and it happened, *their way*.

The next day, we passed out the beans and spooky houses and most children responded eagerly to the problems we posed. While some simply counted and moved beans in and out of their little houses, others listened hard to the pertinent information and used their bean characters to try to work things out. A few were able to demonstrate their thinking at the pocket chart, using large paper cutouts of the pumpkins, ghosts, and goblins. Both that day and the next, we were surprised at the high level of involvement.

When we introduced some of the problems in picture form, the children were intrigued. Watching their responses, we wondered if they could find ways to show their thinking on paper. Could they use drawings or numbers rather than beans to solve these problems? Would their attempts to invent notation increase their involvement in problem solving, or just get in the way? We decided to try. Though many weren't quite sure how to begin, they watched and listened as classmates eased into the task. Their growing enthusiasm was amazing and they were eager to see each other's work. Was this a developmentally appropriate pursuit for children so young? No child appeared to be unhappy and every student made some attempt. What could we learn from their work? The drawings seemed to be telling us a lot about these very young problem solvers. Many had tried to include numbers, albeit backwards and even floating. We tucked their work into individual portfolios for future reference, along with the drawing and writing samples we were collecting. We hoped these early attempts to symbolize mathematical thinking would be useful in charting growth.

We were, however, brought up short when we (remembering the spring successes of the previous year's group) asked them to pose problems to their classmates. We ended up having to intervene so heavily that the work no longer felt like it belonged to the children. Fall kindergartners were tellers, not questioners—*Five on the fence and a scary one in the house and one more saying boo, and this guy is my best*. For the most part, they just weren't ready to pose computational problems. But they liked the idea of having classmates see their work. We wanted them to pose problems of some sort, but what could they do without intensive teacher assistance? We set our quandary aside for a few days and went back to Pattern Boxes. As we watched their joy in the work and noticed that a few were beginning to show classmates what they had done and even add onto one another's patterns, we realized that many would be able to pose pattern problems. Back to the drawing board—how should we begin? Partially hidden patterns of ghosts, goblins, and pumpkins posted in the pocket chart turned the trick. Students happily responded to the problems we posed and loved having a "secret door" cover different parts of the patterns they had suggested.



Can you figure out what's behind the door?

Could they make their own secret door pattern problems? We set up a center of art materials as another pattern station. The eager beavers who went there the first couple of days produced some magnificent pieces complete with secret doors (though not all the patterns worked). We had the artists hold their work up for class problem solving. The children delighted in figuring out what was behind each door and made helpful suggestions to repair the pieces that weren't repeating patterns. The enthusiasm for this activity proved to be contagious, and soon we had a large collection of hidden Halloween characters.

Day 1: Making the Storyboards

Each child will need...

- a washed half-pint milk carton (the kind you find in school cafeterias) with the front side cut out
- light brown construction paper cut to fit the sides and back of the milk carton
- dark brown construction paper cut to create a roof over the top of the carton
- dark brown pieces of construction paper to create 2 doors to cover the open front of the carton
- dark brown pieces for shutters, and yellow or white for windows
- 5" x 8" piece of green poster board for grass
- 1½" x 8" strip of black construction paper for a path
- 2 Halloween stickers
- glue and scissors to share

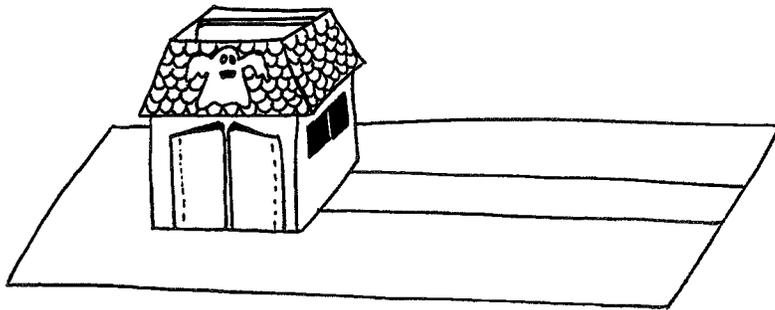
You will need...

- supplies indicated above to make your own spooky house
- your lima bean pumpkin, goblin, and ghost counters, p. 144-146

Show your students the pumpkin, goblin, and ghost beans, and explain the idea of telling math stories about Halloween characters. You may even want to read a few of your favorite Halloween tales to spark their imaginations and get some language flowing. Give them a chance to handle the Halloween beans and watch the magic begin. Explain that you'll be working on solving math story problems with these bean characters and some spooky houses which they'll each make.

Next, show youngsters your milk carton, poster board, and cut construction paper. Demonstrate how the paper you've precut will be glued onto the sides and back of the carton and used for roof, door, and shutters. Tell them that they can each choose two Halloween stickers to make their houses look even more spooky. Finally, show them how to glue a finished house and black paper path onto the green poster board, and send them off to work on their own spooky house storyboards.

Note: If having the children make three-dimensional storyboards seems like more than you want to take on right now, turn to Storyboards, page 148.



Days 2 & 3: Solving Spoken Story Problems

Each child will need...

- his or her Spooky House storyboard (either the child-created three-dimensional board described above or the optional storyboard from the Blacklines)
- 6 goblin, 6 pumpkin, and 6 ghost lima bean counters, p. 144-146

You will need...

- a pocket chart
- pocket chart spooky house (see Blacklines)
- pocket chart characters: 6 goblins, 6 pumpkins, 6 ghosts (see Blacklines)

On Days 2 and 3, spend fifteen to twenty minutes posing some of the story

problems featured below. Ask children to solve each of the problems with their Halloween lima bean counters and storyboards, and call on them to explain their thinking as best they can. A paper house cutout and paper Halloween characters that can be moved in and out of a pocket chart may help some children stay focused. Invite students to come to the chart to demonstrate their thinking, but don't be surprised if some youngsters are unable to verbalize their reasoning, or simply reply, "I just knew it," when you ask them to explain their responses.

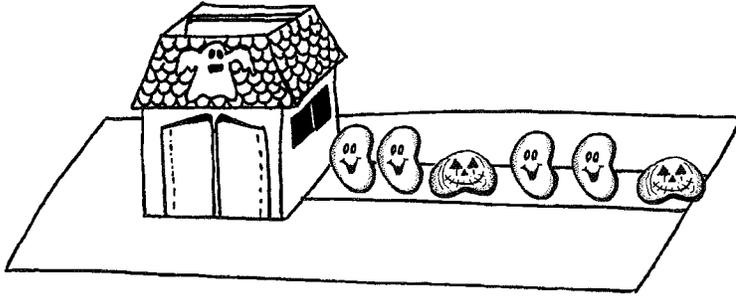
Respond to students' ideas in a way that encourages risk taking and divergent thinking. We find that if we can refrain from pouncing on the correct answer right away, children are more likely to continue working, and also more likely to find their own mistakes. Kindergartners rarely realize they have solved a problem in the same way as other children, so you'll see some duplication of explanations but it's quite okay—allowed to speak up in a risk-free environment, students eventually generate many different ways to solve challenging problems. As children give their explanations, we occasionally try to clarify their methods in hopes that others may benefit.

Counting and Comparing

- There were three green goblins walking down the path. Four pumpkins joined them. Were there more goblins or more pumpkins on the path?
- Four friendly ghosts were gathered by the door of the spooky house. Three green goblins were walking down the path. Two orange pumpkins were sitting beside the path. Which group had the fewest?

Patterning on the Path

- All of the Halloween characters were resting behind the doors of the spooky house. (Ask children to place all of their Halloween beans inside the spooky houses on their storyboards.) It had been a lot of work making Halloween so much fun for the trick-or-treaters. Finally, one of them had an idea. They'd have a pattern parade. Out came a green goblin who hopped all the way to the end of the path. Behind him a nice orange pumpkin rolled into place. They were practically touching each other. They called to a ghost to come out and join their parade. The next to come was a green goblin, then a pumpkin, and another white ghost. Can you keep the pattern growing?
- The Halloween characters enjoyed their parade so much, they wanted to line up a different way. They needed some help. Can you figure out some different patterns on your boards for their parade?



How Many Altogether?

● Four white ghosts hovered above the house and then settled down near the front door to rest. Three green goblins decided to join them. They were tired, too. How many were resting in all?

Children: Lots! A bunch! There are four ghosts and three goblins. One, two, three, four, one two, three! There are seven if you put them together—see? One, two, three, four, five, six, seven! No, it's eight! Five? Nine!

Teacher: You have many different ideas. Would anyone be willing to share their thinking on the pocket chart?

(Timmy comes up and sets four paper ghosts in one pocket and three paper goblins in the pocket directly below.)

Timmy: I think it's seven. There are four here and three here, and I just count them. One, two, three, four, five, six, seven.

Stefani: (Coming up to the pocket chart) There are four here and three here. See? One, two, three, four, one, two, three.

Nandini: It's seven. Three and three are six. Then it's just one more, so seven.

Mandy: (Using her fingers to illustrate her point) I know it's seven 'cause I just go *four*, five, six, seven.

In the fall, the concept of joining two groups is easy for some of our children and quite difficult for others. Many will continue to see two separate groups without being able to attend to the whole for some time to come. Although there's no way to force the issue developmentally, we find that children's skills and understandings blossom with time and opportunity, so we move forward rather than stopping to make sure that everyone "gets it".

- Three jolly pumpkins and three green goblins gathered on the path near the spooky house. How many Halloween characters were on the path in all?
- Three orange pumpkins, one green goblin, and two white ghosts walked into the spooky house. How many were inside altogether?

How Many Are Left?

- Four ghosts slithered through the doors of the haunted house to look around inside. After a little while, three of them decided to come on out and walk down the path. How many were still inside?
 - There were three green goblins, two white ghosts, and one orange pumpkin inside the spooky house. The goblins and ghosts were getting too hot from the flame of the pumpkin's candle so they asked him to go out to the path. How many Halloween characters were still inside?
-

Missing Addend / Missing Subtrahend

- The trick-or-treater thought he saw four ghosts on the path, but when he looked again, he could only see two on the path. Maybe some had gone inside. Can you figure out how many were in the spooky house?
 - The young child noticed three jolly pumpkins sitting by the front door. She turned away for a minute to look at her bag of candy. When she looked again, only two were still by the door. She wondered how many had gone inside. Can you show what happened?
 - Six orange pumpkins were flickering along the path. A gust of wind blew out the candles in some of them and they were taken inside to be lit again. There were only three remaining on the path. How many had been taken inside?
-

Grouping and Partitioning

- The trick-or-treaters had heard there were three happy pumpkins inside the spooky house, each with two glowing eyes. They couldn't wait to peek inside. How many eyes would they see?
- The trick-or-treaters saw four eyes staring at them from the path by the spooky house. It was some ghosts. How many ghosts were on the path?

Day 4: Solving Picture Story Problems

Each child will need...

- his or her spooky house storyboard
- 6 goblin, 6 pumpkin, and 6 ghost lima bean counters

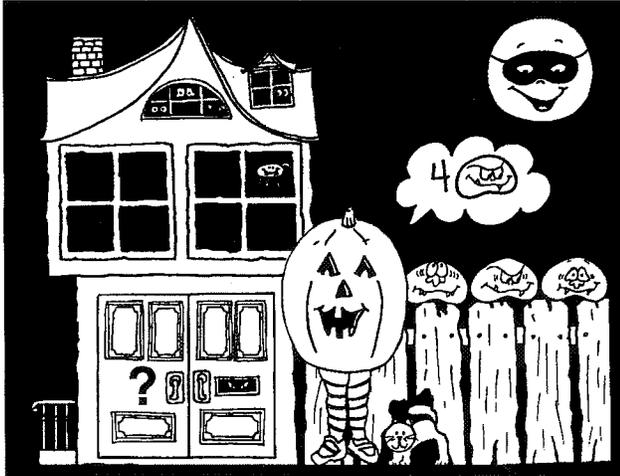
You will need...

- a pocket chart
- pocket chart spooky house (see Blacklines)

- pocket chart characters: 6 goblins, 6 pumpkins, 6 ghosts (see Blacklines)
- Spooky House picture problems 1-6, p. 149-150

THE SPOOKY HOUSE PICTURE PROBLEMS

Picture Problem 1



The little girl was all dressed up for Halloween. When she first walked up to the spooky house, she thought she saw four green goblins sitting on the fence. When she turned around to look again, there were only three. How many of those goblins had disappeared into the house?

Picture Problem 2



Perhaps he was imagining things. The trick-or-treater could see some ghosts on the roof. He was trying to count how many. Then he saw some goblins peering from the windows. How many could he see? Finally he noticed some flickering pumpkins near the doorway. How many pumpkins did he see? Can anyone figure out how many Halloween characters he saw altogether?

THE SPOOKY HOUSE PICTURE PROBLEMS (CONT.)

Picture
Problem 3



As the trick-or-treater stood beside the fence, he could see five goblins. Some seemed to be hooked onto a gate that was swinging back and forth. Oh, oh! Something seemed to be pulling the gate open. Three goblins were disappearing. How many would the child still be able to see?

Picture
Problem 4



Four jolly jack-o'-lanterns had been set in front of that spooky-looking house. Five green goblins were smirking on the fence. How many more goblins than pumpkins did the funny witch see?

Picture
Problem 5



Trick-or-treating was so much fun. Lots of people had decorated their houses for the children. The trick-or-treater saw that the house she was approaching had two flickering pumpkins on the fence, three white ghosts in the windows, and two green goblins by the door. How many Halloween characters did she see altogether?

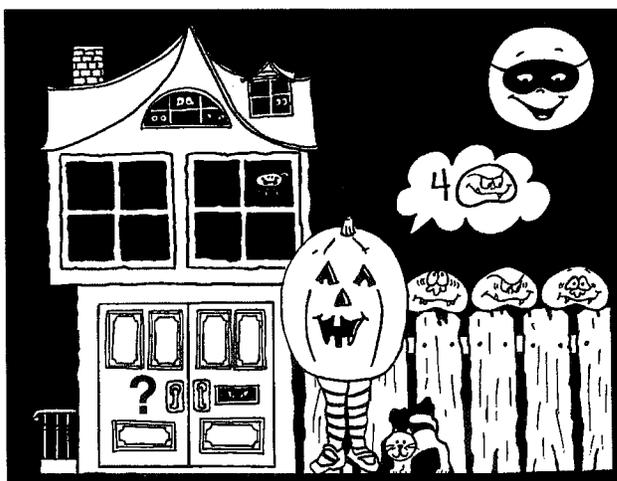
Picture
Problem 6



His mom had told him there were three wonderful pumpkins hidden behind the windows and doors of the spooky-looking house. How many pumpkin eyes will he see?

Now that children have worked to solve story problems for two days, show them the spooky house picture problems you've prepared. While these picture problems are quite similar to those you're already posed, they deliver the information visually, and may be easier for some children to understand. We continue to distribute beans and storyboards, but we also notice that because of the added visual support, a few children begin to solve some of these problems mentally, usually with the aid of their fingers. Many other youngsters continue to use their counters and storyboards quite cheerfully, though some need to see the teacher or another classmate work with paper counters in the pocket chart.

Teacher: I have some Halloween picture problems for you to solve today. Here's the first one. What do you notice?



Children: There's a big orange guy. He looks like a pumpkin. That's his Halloween suit. I'm going to be a pirate. I'm going to be a Ninja guy.

Teacher: What else do you notice?

Children: That bubble over his head says, "Four goblins", but there are only three on the fence. Maybe there's some behind the door. Maybe there's some hiding behind the windows.

Teacher: You're right. There are some hiding behind the door. Can you figure out how many?

Ian: What do you mean?

Teacher: Well, there used to be four goblins sitting on the fence, but now there are only three. How many do you think slipped behind the door to hide when the trick-or-treater wasn't looking?

(Children consider this for a moment. Many place three goblins outside their houses and slip four more into the spooky houses on their storyboards.)

Others simply place four outside their houses, and a few don't know what to do.)

Teacher: Would anyone be willing to share their idea?

Beth: I just put four in my house.

Teacher: Why did you do that?

Beth: Because the guy is saying, "Four." It has to be four.

Teacher: Okay, any other ideas?

Gary: It has to be one behind the door. If there are three on the fence, then one went inside to hide. One, two, three, four—see?

Teacher: Okay, any other ideas? Donny?

(Donny doesn't speak, but she has three fingers up and one folded down.)

Teacher: Donny, can you show us what you're thinking on the pocket chart?

(Donny comes up to the chart. She places four goblins in one of the pockets. Then she removes one and holds it behind the door of the paper spooky house. Mandy waves her hand in the air.)

Teacher: Mandy?

Mandy: See? It is one hiding behind the door—three and one—it's four.

Although not an exact transcript, the dialogue above is quite similar to discussions that took place in our own classrooms when we posed missing addend/subtrahend problems early in the year. When we took a minute or two to pose similar problems with numbers under six, a few more children seemed to comprehend. Others played quite happily with their beans until we held up the next picture problem and kept going. Tempted as we were to dwell on the problem until everyone seemed to understand, we moved along. We knew that many more students would grasp this type of problem with repeated opportunities, and in the meantime it wasn't hurting them to count their beans into groups of three and four and listen to the explanations of others. These were the moments when we reminded ourselves that real problems sometimes remain unsolved or half-solved for many months.

Continue with several other picture problems, inviting children to share their ideas and solutions. You'll probably lose the attention of some children from time to time, but we believe it's appropriate to teach at a challenging level and trust that the joy and understanding many students bring to tasks like this will be contagious over time.

Day 5: Writing Solutions to Picture Problems

Each child will need...

- an individual chalkboard, chalk, and eraser

You will need...

- Spooky House picture problems 1-6
- a pocket chart
- pocket chart spooky house
- pocket chart characters: 6 goblins, 6 pumpkins, 6 ghosts

Now that your children have worked through some of your picture problems with their storyboards and counters and offered explanations, you can encourage them to record some of their strategies and solutions on chalkboards. Choose a picture problem that you haven't already shown, or one that was particularly interesting to the students yesterday. Ask children to use drawings and/or numbers to solve the problem. Even if someone calls out the answer, let them know that you're quite interested in seeing each person's thinking, not just hearing the answer. Hopefully, some will begin working right away and will serve as an inspiration to children who really aren't sure how to begin. If the class seems unable to begin, you may need to model some possibilities. Be prepared, also, for much looking around and copying, or "waiting to see" on the part of many children.

Teacher: Here's one of the picture problems we did yesterday.



Nandini: I remember that one—it has eyes!

Teacher: That's true. The bubble over the trick-or-treater's head says,

"There are three pumpkins. How many eyes do they have?"

Damon: That's easy—two!

Stacy: I think it's six—two, two, two.

Teacher: I already hear some ideas. I'd like you to use your chalk and chalkboards to show how you are thinking about this problem.

(A few children begin drawing, but most sit in somewhat perplexed silence.)

Teacher: Let's put this problem up on the pocket chart. How many pumpkins does the trick-or-treater see?

Children: Three.

Teacher: (Places three construction paper pumpkins in the pocket chart.) Here are three pumpkins. How many eyes do they have altogether?

Damon: (Waving his fingers in the air.) Three!

Teacher: What makes you think it's three, Damon?

Damon: (Comes up and points to the pumpkins in the pocket chart.) One, two, three!

Teacher: There are three pumpkins, Damon. How many eyes do they have?

(Damon looks slightly perplexed.)

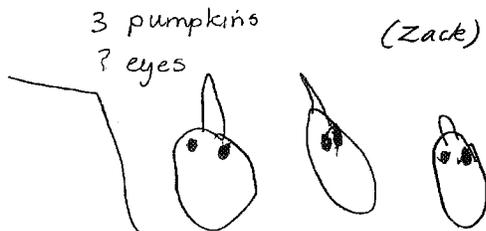
Grayson: Six! (Jumps up to point to the pumpkin eyes.) One, two, three, four, five, six!

Teacher: Grayson counted the eyes to figure it out. How could he show what he did on his paper?

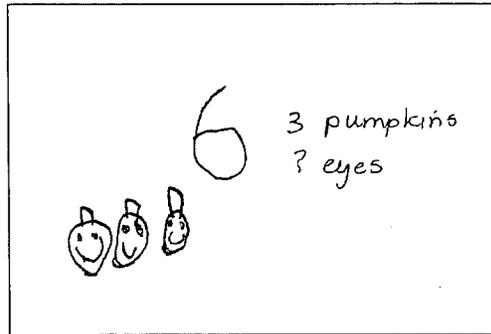
Children: He could draw the pumpkins and show the eyes. He could draw the eyes. He could write six.

In the end, many of our kindergartners show their strategies by drawing the three pumpkins, counting their eyes, and recording their results with numbers.

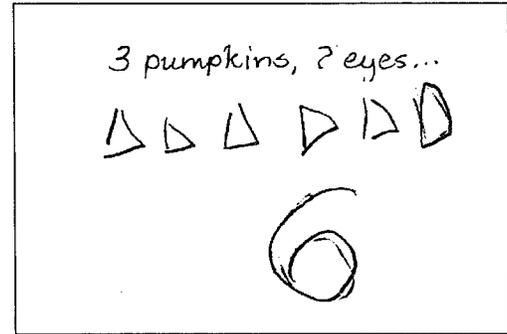
Zack carefully draws pumpkins with two eyes each and writes a seven beside his work. Without discussing the paper with him, it's hard to know what he is thinking. It's possible that he has miscounted or isn't sure which numeral represents the number six. Or perhaps he has simply heard another child say seven. It's also possible that seven is the only number he can write with con-



fidence right now. His work on this problem gives us reason to pay closer attention to Zack. It's clear that we have lots to learn about him.



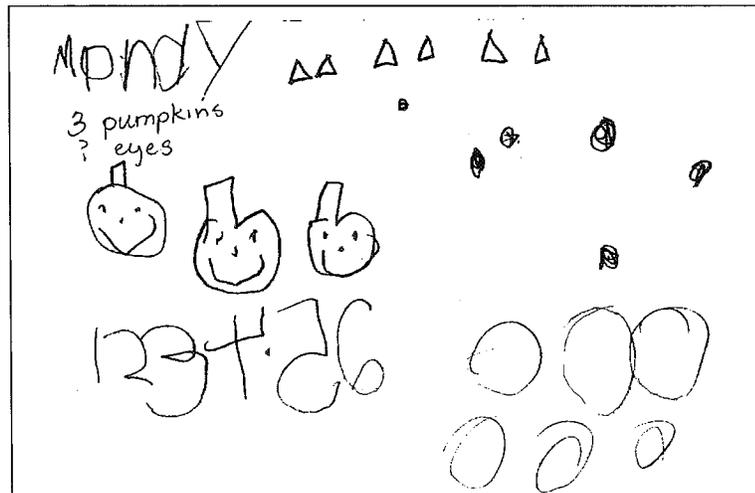
Joey



Sarah

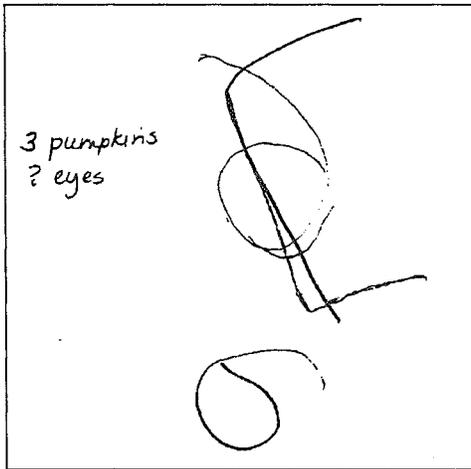
Like Zack, Joey carefully draws three pumpkins, each with two eyes, and records a six. This tells us that Joey is comfortable using pictures as a problem-solving tool, and that he is able to accurately determine the number of eyes as well as write the correct numeral. We aren't able to tell whether he has counted by ones or used some other system, such as counting by twos, to determine the total number of eyes, however.

Sarah takes a more conceptual approach to the problem by drawing triangles to represent the eyes. We note that a five is erased and replaced with a carefully formed six. Has she counted the triangles incorrectly or left one out at first? By some means, she has managed to correct her own mistake in the end.



Mandy

Mandy's work shows several different approaches. We aren't sure which she tried first, but we feel confident that she is eager to show she understands the problem quite well.



Cindy

Though it looks as if Cindy might not be able to solve the problem, we aren't certain. It's possible she knows how many eyes but, in trying to represent her thinking with numbers, has run into some difficulties with numeral writing. We notice a backwards six, a backwards seven, an upside down seven, and finally a correctly formed six. We look forward to learning more about Cindy and realize that this would be a good time to practice some numeral writing with our class.

Day 6: Creating Secret Door Pattern Problems

Each child will need...

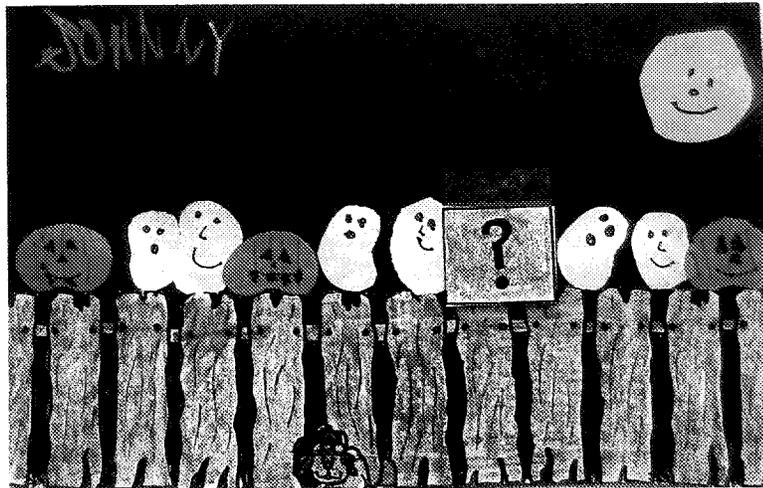
- pumpkin, ghost, and goblin beans to share
- a copy of the Pattern Fence (see Blacklines)
- a 2" x 3" piece of black construction paper for the secret door
- construction paper lima beans in green, orange, and white
- glue, scissors, extra-fine-tip Sanford Sharpie pens, and scotch tape to share

You will need...

- Spooky House picture problems 7, 8, and 9, with the secret doors taped on (see Blacklines)
- a pocket chart
- pocket chart characters: 6 goblins, 6 pumpkins, 6 ghosts (see Blacklines)
- a 6" x 6" piece of black construction paper to use as a secret door on the pocket chart
- a few pumpkin, ghost, and goblin lima bean counters
- a copy of the Pattern Fence (see Blacklines)
- a 2" x 3" piece of black construction paper for the secret door
- construction paper lima beans in green, orange, and white
- glue, scissors, extra-fine-tip Sanford Sharpie pen, scotch tape

One thing we've discovered about kindergarten is that children can pose simple story problems early in the year, as long as we provide clear models

and limit their choices. The selection here is limited indeed. In fact, the only option is picture problems in which each child glues a pattern of construction paper Halloween characters along the top of a fence and tapes a "secret door" over some of them. The problem in each case is to figure out what's behind the door by analyzing the parts of the pattern that are still visible. Children create and choose their own patterns and decide where to place their secret doors.



Begin the lesson by showing a few of your paper ghosts, goblins, and pumpkins in the pocket chart. Ask the children to figure out some way to pattern these creatures.

Yasir: You can go pumpkin, goblin, pumpkin, goblin.

(The teacher displays Yasir's idea in the pocket chart.)

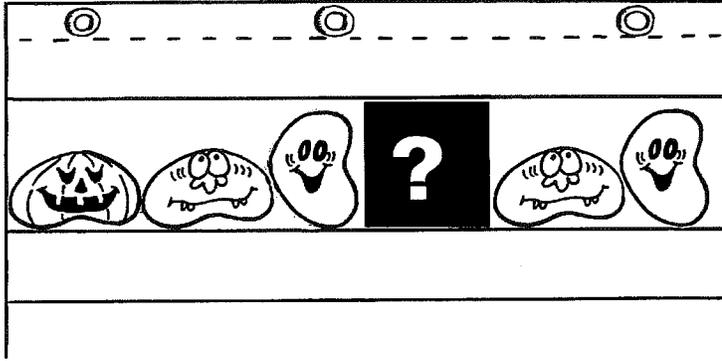
Teacher: Great! Does anyone have a different idea?

Natasha: There's ghost, pumpkin, ghost, pumpkin.

Teacher: Okay, any different ideas?

Donny: We can do pumpkin, goblin, ghost, pumpkin, goblin, ghost.

After building a few of the children's suggestions in the pocket chart, cover a portion of the last pattern suggested with a piece of black construction paper. Can the children figure out which character is hidden under the door by studying the rest of the pattern? Place the door in different spots including the very beginning of the pattern.



Next, show the students Spooky House Picture Problems 7, 8, and 9 and challenge them to figure out what's behind the secret door in each example. Finally, show them the materials they can use to create their own Secret Door Patterns, and demonstrate making one of your own. Before you send them off to work, remind children to set up their patterns with the bean characters first.

After they get friends to check whether their patterns really "work", they should get matching paper lima bean shapes and pens to draw pumpkin, goblin, and ghost faces. Remind them that the pens will be ruined by coming in contact with glue and must be used carefully. Once all the faces are drawn on their paper bean Halloween characters, students can glue them down along the tops of their blackline fences and finally, tape on secret doors.

Day 7 & beyond: Solving Student Story Problems

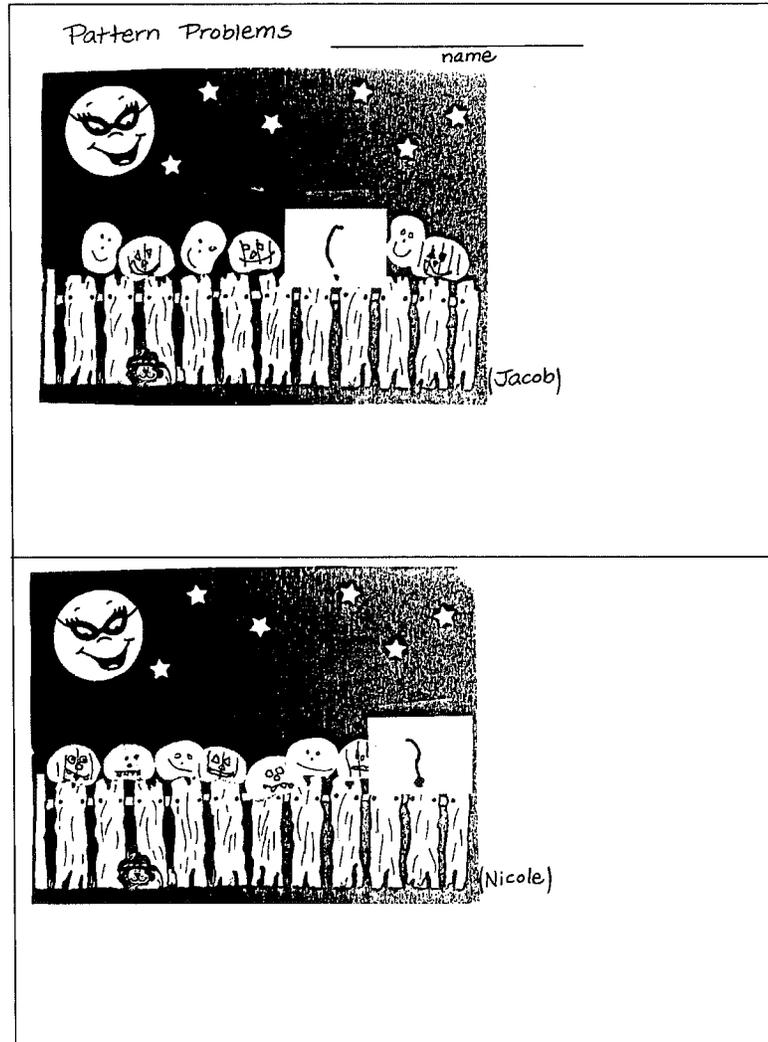
Each child will need...

- a problem-solving sheet (see instructions below for preparation)
- a clipboard or individual chalkboard to provide a hard writing surface
- a pencil
- a green crayon and an orange crayon

You will need...

- children's completed secret door pattern problems

Before you present students' pattern problems to the class, go through the collection and select one of the simpler and one of the more complex patterns for children to solve by writing/drawing. Make a problem-solving sheet by reducing the two problems. Position them on a piece of 8½" x 11" paper in such a way that students will have room to show their responses. Then run enough copies of the sheet for your entire class.



These sheets take some time to prepare, but if you plan to keep student responses in portfolios, you'll find that you need some way of identifying the problems children were solving to make any sense of their work six months down the road.

To begin the lesson, share all the children's problems, taking time to admire each and every one. Then present the first problem to be solved, asking that children show their thinking on their problem-solving sheets.

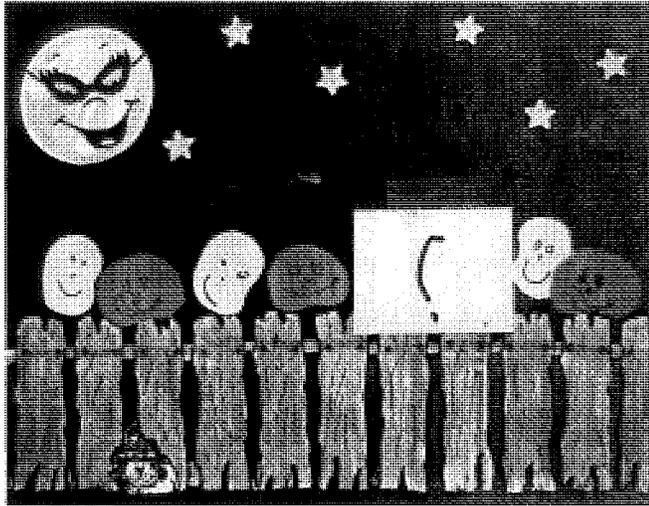
Teacher: Now that we've admired everyone's fine work, we're going to solve two of these very challenging pattern problems.

Tiffany: Is it mine?

Stefani: When can we do mine?

Teacher: We'll get to everyone's problems, but not all at once. The first one we'll try is Jacob's. It's the one that has Jacob's name beside it, and it's at the top of your problem-solving sheet. You can see that he stuck a door

near the end of his pattern. What shall we do to figure out what's behind his secret flap?



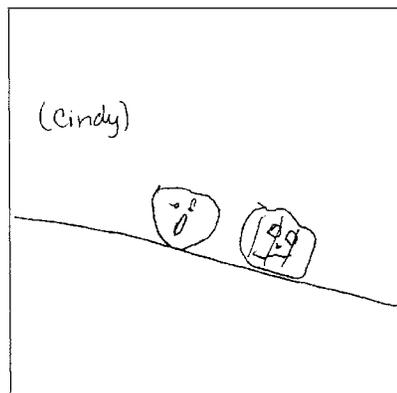
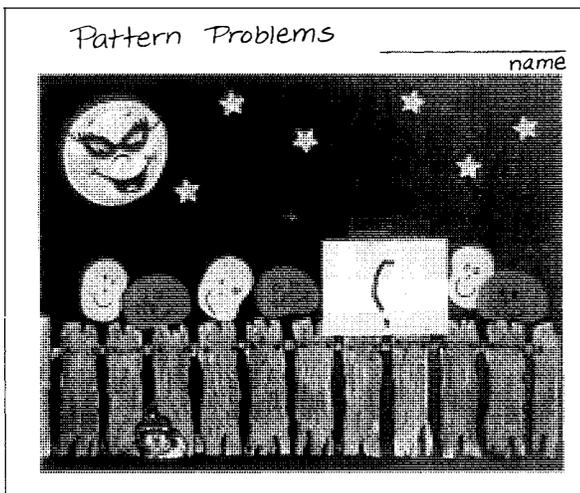
Jory: Say the pattern—it's ghost, pumpkin, ghost, pumpkin; then you can't see what comes next.

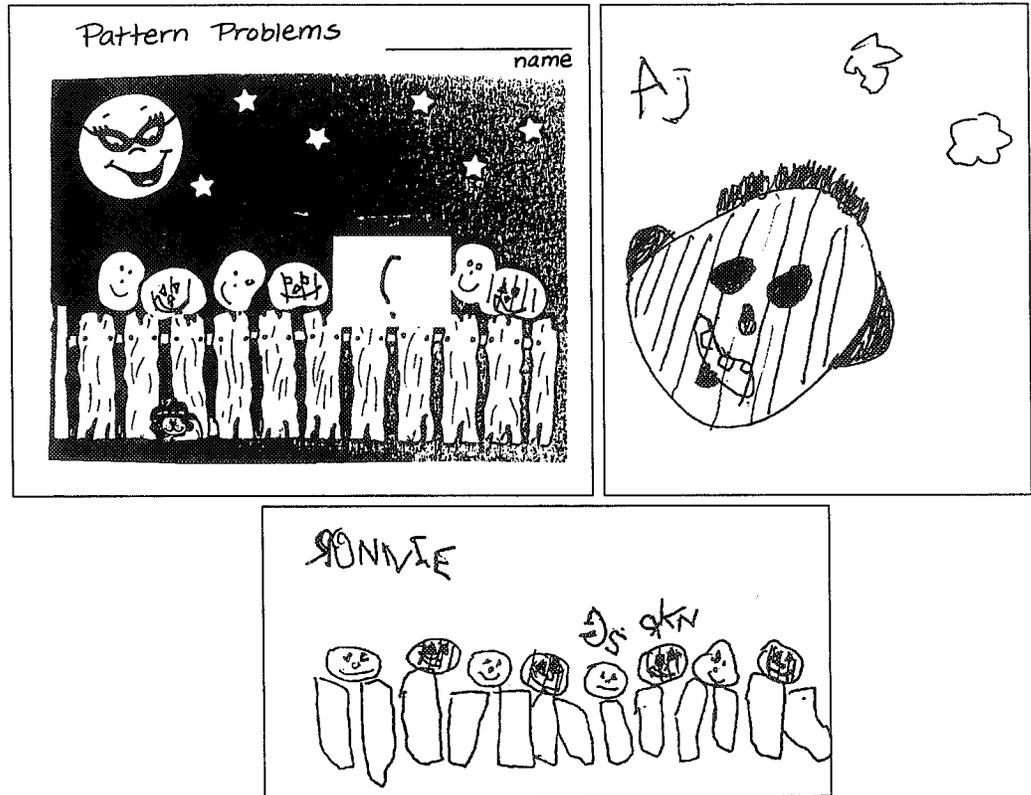
Jeffrey: But then it's ghost, pumpkin, on the other side.

Teacher: Can you use your pencils and crayons to show what you think is behind the flap on Jacob's problem?

(Note: the following work was done before we arrived at the idea of having the children do their work right on a copy of the picture problem. See later chapters for examples of children's problem solving on the same page as the copied picture problem.)

Notice that Cindy responds to this problem by simply drawing what she imagines to be under the secret door—a ghost and then a pumpkin. Ronnie draws out the entire pattern, and AJ gets so involved in drawing a pumpkin

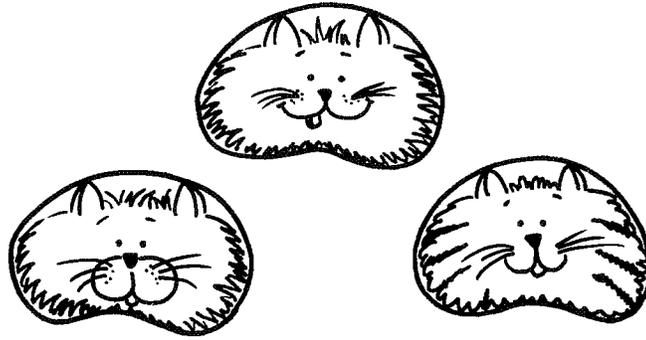




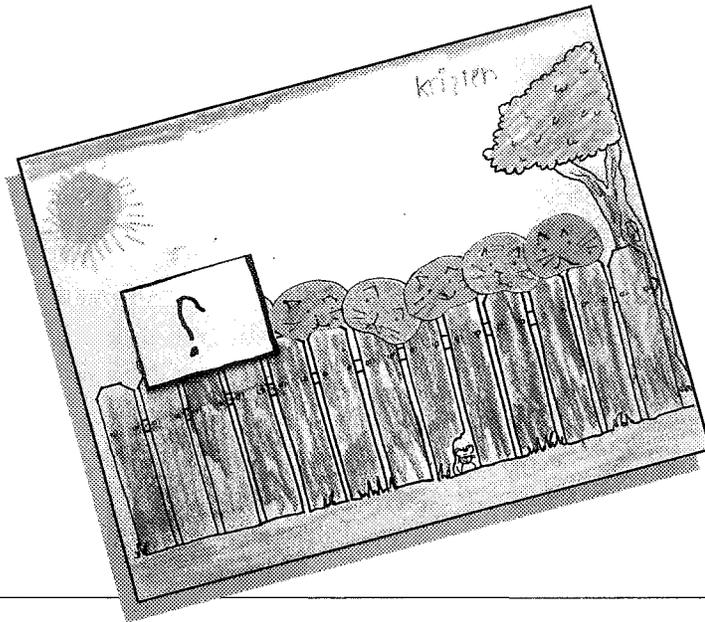
that the problem goes by the wayside. We would have to talk with him to determine whether or not he can figure out what is behind the door.

At the conclusion of this session, collect and date the children's written work and store it in their portfolios. Share the remaining pattern problems over the next several weeks by working two or three a day at an oral level with your group. Once every problem has been shared, consider the following options:

- Post them all on a bulletin board in the classroom or out in the hall along with a sign to explain the problem-solving challenge.
- Bind the problems into small books to be stored in your class library and enjoyed by the children all year long.
- Save each child's problem in his or her portfolio. It can be informative to have a longitudinal sample of the problems children have posed, as well the problems they've solved.
- Send the problems home, along with children's Spooky House storyboards.



The Cat Cottage



Theme 2

The Cat Cottage

Once upon a time, there was a kindly old couple who loved cats. As cats arrived at the cottage of the little old man and the little old woman, they were fed, admired, petted, and allowed to wander in and out at their leisure:

Eight cats were lying in the grass near the cottage waiting for their dinners. The little old man and the little old woman took three of them inside to serve them first. How many cats were still waiting on the grass?

Of the five remaining, one was yellow and four were gray. How many more were gray than yellow?

A young girl came by and saw five cats sitting by the door of the cottage, but when she turned away to see where her brother had gone, some disappeared. If two still remained, how many had gone inside to check on their dinners?

This theme, based loosely on *Millions and Million of Cats*, by Wanda Gag (1928), gives children opportunities to count, read and write numerals, copy and extend visual patterns, partition, group, and compare quantities in the context of whimsical and interesting problems. After introducing the subject and showing the children our lima bean cats, we ask them to construct their own miniature cottages and yards from small milk cartons, paper, and poster

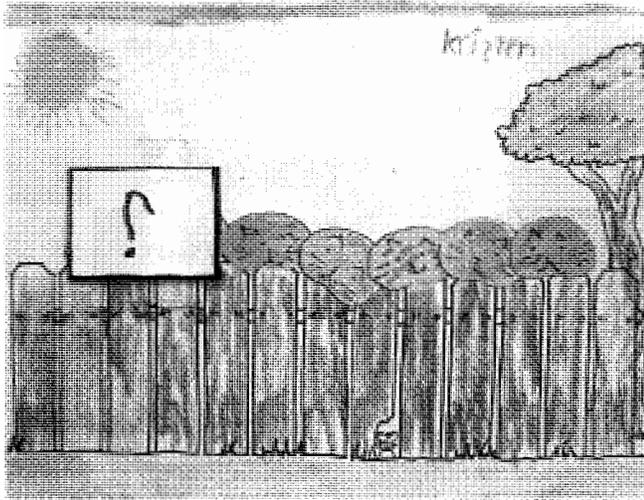
board. They use these storyboards and cat counters to enact and solve a variety of story problems, and then move on to recording their strategies and solutions. Finally, they create their own pattern problems to share with classmates. The entire process takes about seven days, and is just another step in a year-long series of encounters with story problems.

HOW IT WORKED FOR US

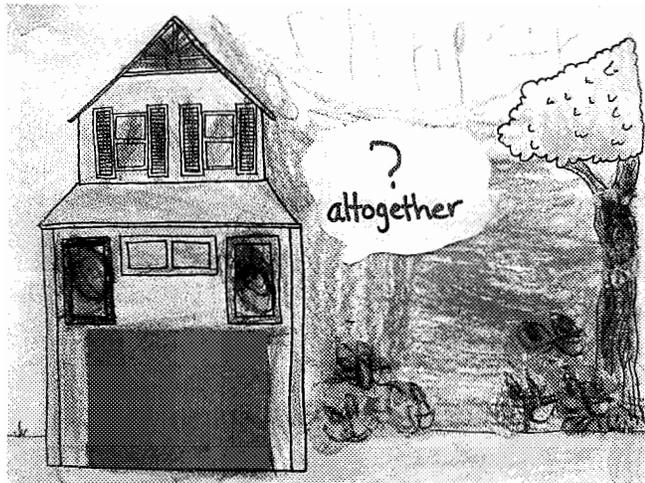
The day we read *Cookie's Week* to our classes, we decided our choice of a cat theme was a good one. This hilarious big book elicited all kinds of tales from the children, and we knew they'd enjoy story problems about cats. As we prepared the new materials, we wondered if the Spooky House lessons from October would carry over and make things a little easier this time. As before, we planned to offer cat counters made of lima beans, and our students definitely wanted to make another set of houses—friendly cottages this time instead of haunted mansions. We asked two parents to cut the door openings on the milk cartons and the children happily created cottages glued onto grassy boards. Some wanted to make trees and bushes and gleefully glued them *flat* on their boards. Only Kyle set out to create three-dimensional landscaping. Everyone seemed duly impressed with his incredible efforts but no one changed his or her flat bushes or trees.

The children loved the bean cats and began play-acting as soon as they had a handful. We waited and watched until it seemed appropriate to pose our first problems. A few children recalled the work we'd done in October and related it to the problems at hand as they shared their solutions and strategies. Others responded as though this was the first time around. Compared to first graders who seemed able to relate more readily to prior experiences, we realized this might be a trend for months to come. The picture problems were well-received and student efforts at verbal solutions drew heavily on counting strategies. Written solutions included drawings and numbers.

Posing problems—were they any more ready than they had been in October to pose computational problems? There was no doubt that many wanted to make new secret door pattern problems. We used the pocket chart to brainstorm possible patterns and showed them the fence board along with precut gray and yellow bean shapes for cats. We also reviewed the computational picture problems we'd worked with earlier. We practiced drawing cat faces on chalkboards and sent them out to create their own problems. Most children quickly set out to make another secret door pattern problem and this time, nearly every pattern worked. The secret doors were joyfully taped into place—they did it themselves.



A few children chose the cat cottage storyboards and after carefully coloring them, began examining our picture problem display. Each of these students made a picture problem as much like one of ours as they could manage—perhaps their own twists would come later in the year. We helped them add talking bubbles.



They were quite pleased with themselves, and their classmates showed their appreciation as the problems were posed. (Only Kyle noted that they were just like the teacher's problems, but he didn't hesitate to work them.) We collected children's written work for both the computational and pattern problems they'd solved and added it to their portfolios. Finally, we sent the children's three-dimensional cat cottages home, along with a page of problems for students to share with their families. We also sent sets of bean cats on loan. We asked for feedback from families and more than half of them let us know how delighted they were with their children's efforts. Nearly all of the bean cats were returned and one of the parent volunteers said she'd be happy to make replacements.

Day 1: Making the Storyboard

Each child will need...

- a washed half-pint milk carton (the school lunch kind) with the front side cut out
- white construction paper cut to fit the outer walls of the (milk carton) cottage
- dark brown construction paper cut to create a roof over the top of the carton
- colored construction paper pieces from which children can create two doors to cover the open front and cut shutters for the "windows" (Cut paper that will fit your student milk cartons.)
- a 5" x 8" piece of green poster board for grass
- a 1½" x 8" strip of brown construction paper for a path
- glue and scissors to share

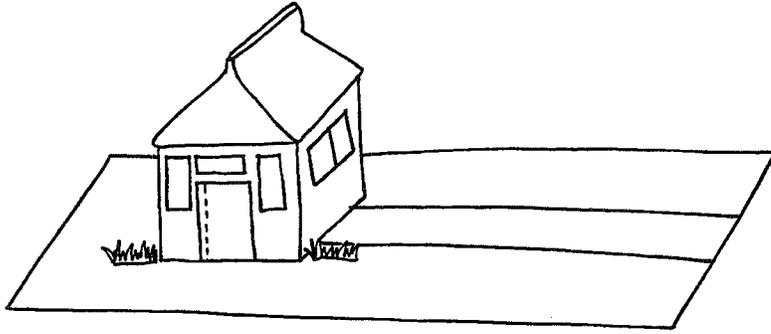
You will need...

- a washed half-pint milk carton and cut construction paper for walls, doors, shutters, and roof
- a 5" x 8" piece of green poster board
- a 1½" x 8" strip of brown construction paper for a path
- glue and scissors
- your lima bean cat counters, p. 146

Show your students the yellow and gray cat beans, and explain the idea of telling math stories about cats. You may even want to read *Millions and Millions of Cats*, although your story problems won't be so violent, and certainly won't involve as many cats! Give children a chance to handle a few of the beans and watch the enchantment begin. After listening to the stories your students will have to tell about their own cats, explain that you'll be working on solving math story problems with the bean cats and tiny cottages. The people who live in cottages are so nice that whenever any lost or lonely cats stop by, they take care of them.

Next, show youngsters your milk carton, poster board, and cut construction paper. Demonstrate how the paper you've precut will be glued on the sides and back of the milk carton and used for roof, door, and shutters. Finally, show them how to glue the finished cottage and brown paper path onto the green poster board, and send them off to work on their own cat cottage storyboards.

Note: If having the children make three-dimensional storyboards seems like more than you want to take on right now, turn to Storyboards, page 148.



Days 2 & 3: Solving Spoken Story Problems

Each child will need...

- his or her Cat Cottage storyboard (either the milk carton board described above or the optional storyboard from the Blacklines)
- 6 yellow lima bean cat counters and 6 gray lima bean cat counters, p. 146

You will need...

- a pocket chart
- pocket chart Cat Cottage (see Blacklines)
- 6 yellow and 6 gray pocket chart cats (see Blacklines)

On Days 2 and 3, spend fifteen to twenty minutes telling some of the story problems featured below. Ask children to solve each of the problems with their cat counters and storyboards, and call on them to explain their thinking as best they can. Respond to explanations in a way that doesn't cut off discussion. When a solution is in error, ask if others obtained the same results.

A paper cottage cutout and paper cats that can be moved in and out of a pocket chart may help some children stay focused. Invite students to come to the chart to demonstrate their thinking when it seems applicable, but don't be surprised if some youngsters are unable to verbalize their thinking, or simply reply, "I just knew it," when you ask them to explain their responses.

Counting

- The little old man looked out the window and noticed some cats on the grass. He tried to play a trick on the little old lady. He told her there were some pretty cats out there. He said there were more than three but less than five. She was trying to figure out how many cats he could see. How many do you think he could see?

Teacher: Some of you have put out three cats; some of you have four, and some of you have five.

Tyler: Not me. I've got three over here and five over here.

Tommy: I didn't do it. I don't know what you mean.

Teacher: Let me read the problem to you again, and then we'll see if we can find out why people put out the number of cats they did.

(The teacher rereads the problem.)

Tyler: See. It's three and five.

Anna: I don't think that's right. I don't think it's three and I don't think it's five, but I don't know what to put out.

Mandy: It has to be four. Can you read it again?

Teacher: Sure. Then perhaps you can show us how you're thinking about this problem.

Mandy: I'll do it on the pocket chart. He said it was more than three, so I put out four like this. But then I thought maybe it was five or six so I put out six. But then he said it wasn't as much as five so it just had to be four.

Donny: I said it's four because I just thought about it.

Children: Me too. That's how I did it. One, two, three, four.

Terrilyn: I can't do it.

Not all of our children fully understand every problem. In posing challenging problems to our students we've had to come to terms with this fact. On the other hand, almost every child is getting something each time, whether it be counting practice, or a growing sense of number or operation. Because we've seen students' skills and understandings develop with time and opportunity, we move forward rather than stopping to make sure that everyone "gets it".

Comparing

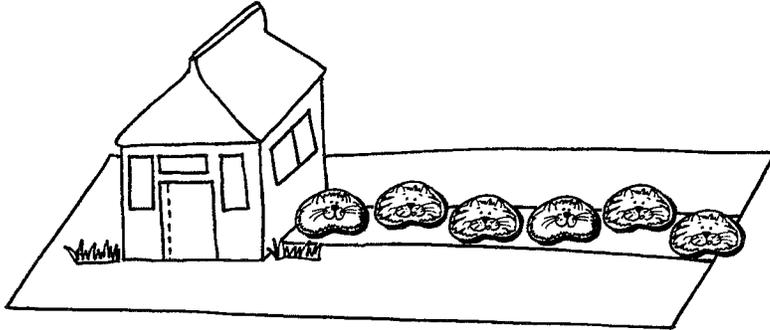
● There were three yellow cats walking on the grass by the cottage where the little old man and the little old woman who loved cats lived. Four gray cats joined them. Were there more yellow cats or more gray cats on the grass? How many more?

Patterning on the Path

● All of the cats had gone inside to eat. (Ask children to place all of their bean cats inside their storyboard cottages.) One of them had an idea. They'd

have a pattern parade. Out came a gray cat who sauntered to the end of the path. Behind him was a pretty yellow cat. They called to another yellow cat who ambled out to join their parade. The next to come was a gray cat, then two yellow cats. Who should come next? And after that?

● The cats enjoyed their parade so much, they wanted to try a different arrangement. They needed some help. Can you figure out a different pattern on your board for their parade?



How Many Altogether?

- Four yellow cats were lying on the grass beside the cottage. Three gray cats decided to join them. They were tired too. How many were resting on the grass altogether?
- Five yellow cats and three gray cats are sitting by the door of the cottage. How many cats are there altogether?
- Four yellow cats were resting on the grass. Five gray cats were resting in front of the door. How many cats in all?

How Many Are Left?

- Six yellow cats crept through the door of the cottage to look around inside. After a while, three of them decided to come out and go for a walk. How many cats were still inside?
- Eight cats were lying on the grass near the house waiting for their dinners. The little old man and the little old woman took five of them inside to feed them first. How many cats were still waiting on the grass?
- Five cats were inside the house. Some children stood at the end of the path and called, "Kitty, kitty, kitty." Two of the cats came out of the house to see what was happening. How many were still inside?

Missing Addend / Subtrahend

- The little old man thought he had seen four cats on the grass but when he looked again, he could only see two lying there. Maybe some had gone inside for a bite to eat. Can you figure out how many were inside the house?
- The young child noticed five pretty cats sitting by the front door. She turned away for a minute to see where her brother had gone. When she looked again, only three cats were still by the door. She wondered how many had gone inside. Can you figure out how many were inside?

Grouping and Partitioning

- The children had heard there were three pretty cats inside the house, each with two beautiful big eyes. They couldn't wait to peek inside. How many eyes would they see?
- The little old lady saw four eyes staring at her from the grass by her lovely little house. How many cats were there?

Day 4: Solving Picture Story Problems

Each child will need...

- his or her Cat Cottage storyboard
- 6 yellow and 6 gray lima bean cat counters

You will need...

- a pocket chart
- pocket chart Cat Cottage (see Blacklines)
- 6 yellow and 6 gray pocket chart cats (see Blacklines)
- Cat Cottage picture problems 1-6, p. 149-150

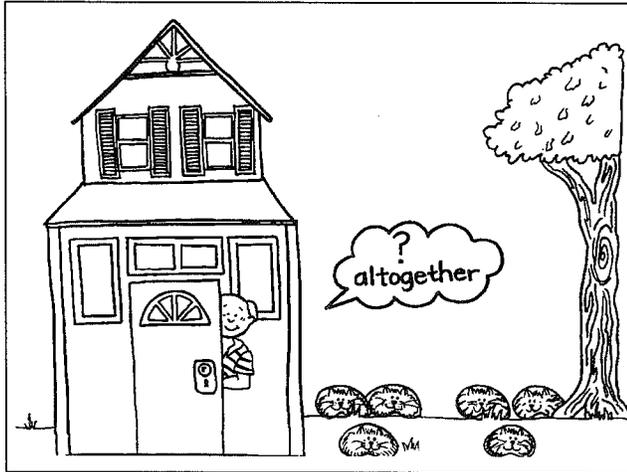
THE CAT COTTAGE PICTURE PROBLEMS

Picture Problem 1



It seems that more cats have come to visit the friendly people who live in the little cottage. Look! The lady has a bubble over her head. What do you think she's trying to figure out? Can you help her count how many yellow cats are out there? How many gray cats have come to visit? How many *more* gray cats than yellow cats does she see?

Picture Problem 2



The kind old man peeked out the door to see if any cats had come to visit. He saw three yellow cats on the grass and three gray cats by his house. How many cats did he see altogether?

THE CAT COTTAGE PICTURE PROBLEMS (CONT.)

Picture
Problem 3



Early one morning, the kind old lady looked out the window and noticed that six cats were waiting by her house. If she had looked more carefully, she might have realized that three were so close to her door they would get pushed away when she opened the door. How many will she still be able to see?

Picture
Problem 4



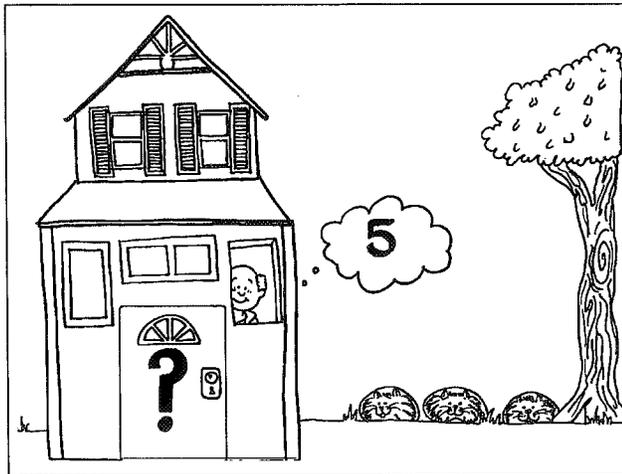
The little old man was playing a trick on the little old lady. He wanted her to guess how many cats he had let into the house. He told her it was less than five. *Pause and let children discuss what the possibilities could be.* The he told her there were two of each color. Finally he told her it was more than three cats altogether. How many do you think are behind the door?

Picture
Problem 5



The moon was shining brightly. The kind old lady peeked out the door and saw three cats near the cottage. How many eyes were glowing in the light of the moon?

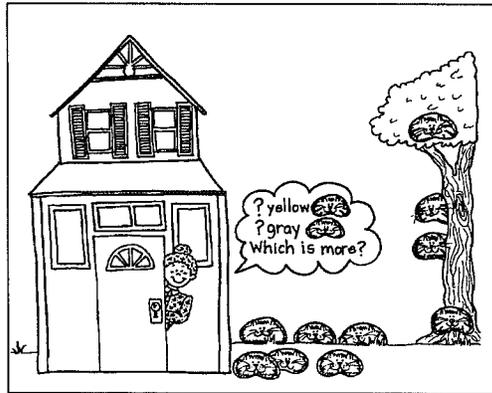
Picture
Problem 6



The kind old man slept a little later than his wife. When he asked her how many cats had come to visit, she told him there were five. When he looked out the window, he could only see three. Perhaps the little old lady had let some of them inside the house. How many cats do you think are inside?

Now that children have worked to solve oral story problems for two days, show them the picture problems you've prepared. While the models involve problems similar to those you've already posed, they deliver the information visually, and may be easier for some children to grasp.

Teacher: I have some special problems for you to solve today. Here's the first one. What do you notice?



Children: The lady is peeking out the door. It's like our cottage. There are lots of cats. I see one, two, three, four of the yellow cats. There are more gray cats. That's sure a lot of cats. What's that cloud for?

Teacher: It's a way of showing what she's thinking. These question marks mean she's trying to figure something out. She is wondering how many yellow cats there are.

Children: It's four, John already counted them. Does she want to know how many gray cats too? One, two, three, four, five, six. It's six.

Teacher: Good job! There's one more thing she wants to know. Which group has more?

Children: I don't know what you mean. It's four. It's six. One, two, three, four, five, six, seven, eight, nine, ten.

Teacher: You are doing a wonderful job of counting. I heard you say there are four yellow cats and six gray cats. Are there more yellow cats or more gray cats?

Children: There are more gray ones. One, two, three, four, five, six. There are only four yellow ones.

Teacher: Please set out four yellow cats on the grass by your cottage. Now set out six gray cats. I want you to see if you can figure out how many more gray cats than yellow cats you have.

Annie: I did it. I have six.

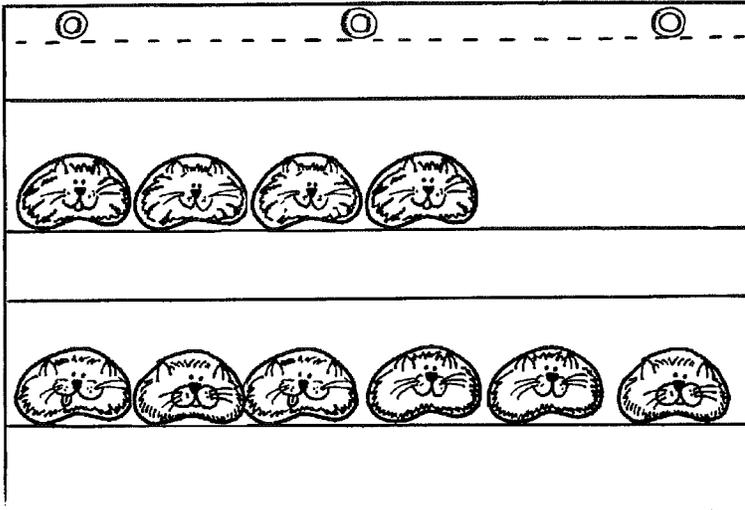
Mariya: I put out four.

Chris: What are we supposed to do?

Timmy: It's two more. See.

Teacher: Timmy, could you come to the pocket chart and use the paper cats to show us what you did?

Timmy: Well, there were four yellow cats, so I put four here. Then I put the gray cats here like this. See. Two more.



Teacher: Timmy, if you'll show us one more time, the children might like to try doing the same thing with their bean cats.

(Some of the children follow Timmy's lead and make two lines of beans on their storyboards, while others look on.)

Teacher: Did anyone solve it a different way?

Nandini: I did. I put up six fingers and then I took away four. There were two left.

Lee: I don't get it.

Nandini: Look. One, two, three, four, five, six. Now fold down four.

Not all children will be able to follow the kind of reasoning demonstrated by Timmy and Nandini above, but don't despair. You'll be providing many more opportunities throughout the year for students who aren't yet able to compare quantities. Some of those children may be able to see that six is more than four. Others may benefit from counting their bean cats into groups. Celebrate whatever level of success each child is able to reach.

Continue as above with several other picture problems, inviting children to share their ideas and solutions. Some will use mental strategies, often in combination with their fingers, while others will use their beans and storyboards. You'll probably lose the attention of some children from time to time but we believe it's appropriate to teach at a challenging level and trust that the joy and understanding some students bring to tasks like this will be contagious over time.

Day 5: Writing Solutions to Picture Problems

Each child will need...

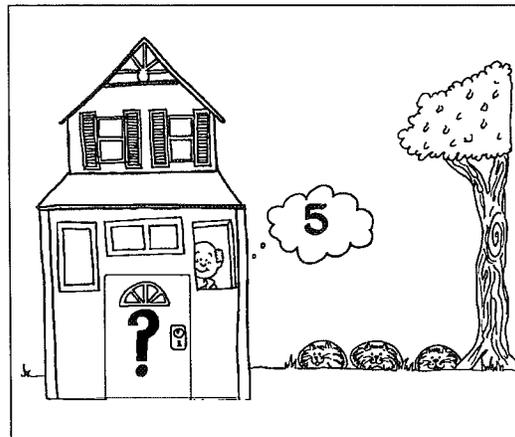
- an individual chalkboard, piece of chalk, and eraser

You will need...

- Cat Cottage picture problems 1-6
- a pocket chart
- pocket chart cat cottage (see Blacklines)
- 6 yellow and 6 gray pocket chart cats (see Blacklines)

Now that your children have worked through some of the picture problems with their storyboards and counters and offered oral explanations, you can encourage them to record their strategies and solutions. Choose a picture problem that you haven't already shown, or one that was particularly interesting to the students yesterday. Ask children to use drawings and/or numbers on their chalkboards to solve the problem. Even if someone calls out the answer, let them know that you're quite interested in seeing each person's thinking, not just hearing the answer. Hopefully, some will begin working right away and they will serve as an inspiration to children who really aren't sure how to begin. If children seem unable to begin, you may need to model some possibilities. Be aware that some children will spend lots of time looking around to see what others are doing, copying from their friends, or simply waiting to see what's going to happen.

Teacher: Here's one of the picture problems we did yesterday.



Jason: I remember that one—it's five!

Gary: It's two!

Stacy: I know! It's five—five are in that house!

Stefani: Eight! It's eight!

Teacher: You certainly do remember this problem. Today, though, I'm going to ask you to use your pencils and paper to show how you figured it out.

Nicole: What do you mean?

Teacher: Let's get out the paper cats to show the problem. I'm going to set three cats in the pocket. How many are there supposed to be in the whole picture, though?

Children: Three! Five! No, nine! Three!

Terrilyn: I think it's five. It says five up there.

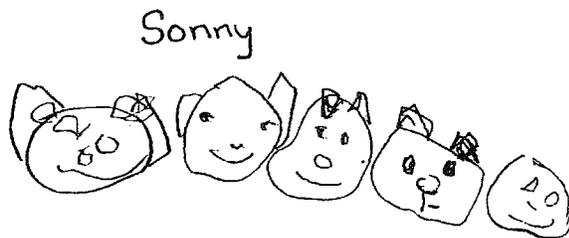
Mario: This is the one where some are hiding.

Teacher: That's true. We can only see three, but the bubble says there are supposed to be five. Can you show how many you think are hiding behind the door on your chalkboards?

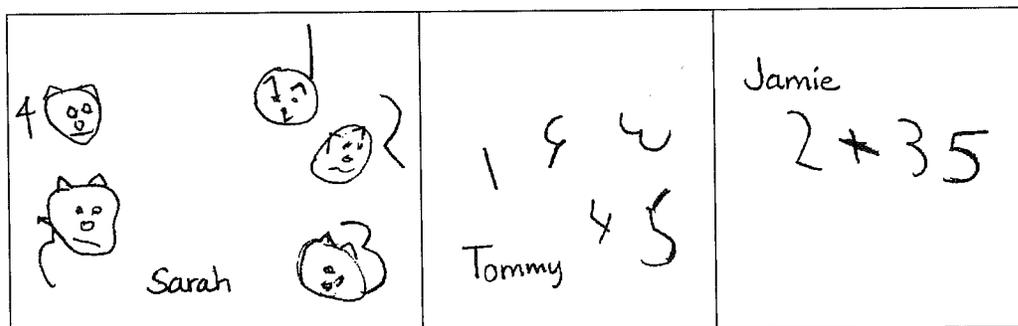


Problems that involve missing addends ($3 + ? = 5$) are quite challenging for many kindergartners, especially this early in the year. Nevertheless, these situations are more interesting to many children than the more typical addition and subtraction stories we often pose, and they will work to make sense of them. Some children respond by simply showing the initial addend (three) and the total (five).

Others, like Sonny, show the total—five cats in a row. Can we be sure he understands that two combines with three to make five? Not unless we ask him, and even then he might not be able to express his thinking in words. We are happy that he's able to show five cats accurately, however.



Still other kindergartners appear to be able to use drawings and/or numbers to make sense of the problem. Like Sonny, Sarah draws five cats, but the first three are positioned to the right—outside the house, and the last two are to the left where the door would be if Sarah had shown the house (see following page). Tommy writes numerals to show the first three cats—1, 2, 3—and shows the last two in their own row. His separation of the two sets indicates some understanding of the idea that two join with three to make five. Jamie's number sentence indicates similar understanding.



Work your way through one or two picture problems, encouraging children to record their thinking as best they can. This is not easy the first few times around, but we've been surprised at how many kindergartners are willing and able to show their strategies and solutions in some way. In our own classrooms, children draw pictures, write numbers, and sometimes combine methods to show their ideas.

Day 6: Creating Secret Door Pattern Problems

Each child will need...

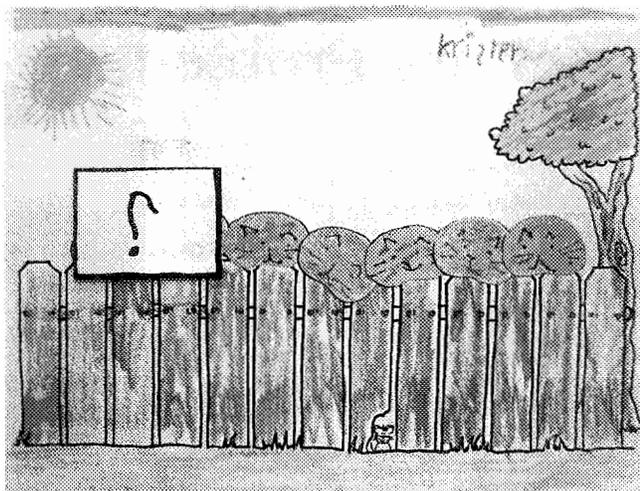
- yellow and gray cat beans to share
- a copy of the Pattern Fence (see Blacklines)
- a 2" x 3" piece of black construction paper for the secret door
- construction paper lima beans in yellow and gray, p. 154
- glue, scissors, extra-fine-tip Sanford Sharpie pens, and scotch tape to share

You will need...

- Cat Cottage picture problems 7-8 with secret doors attached, p. 150
- a pocket chart
- 6 yellow and 6 gray pocket chart cats
- 6" x 6" piece of black construction paper to use as a secret door on the pocket chart
- yellow and gray lima bean cat counters, 6-8 of each
- Pattern Fence, 1 copy (see Blacklines)
- a 2" x 3" piece of black construction paper for the secret door
- construction paper lima beans in yellow and gray, p. 154
- glue, scissors, extra-fine-tip Sanford Sharpie pen, scotch tape

One of the things we discovered in our own kindergarten classes is that children can pose simple story problems early in the year, as long as we provide

clear models and limit their choices. As in Theme 1, the selection here is limited to problems in which each child glues a pattern of yellow and gray construction paper bean-cats along the top of a fence and tapes a "secret door" over one or more of them. The problem in each case is to figure out what's behind the door by analyzing the parts of the pattern that are still visible. Children create and choose their own patterns and decide where to place their secret doors.



Begin the lesson by showing a few of your paper cats in the pocket chart. Ask your children to figure out some way to pattern these cats.

Jacob: You can go yellow cat, gray cat, yellow cat, gray cat.

(The teacher displays Jacob's idea in the pocket chart.)

Teacher: Great! Does anyone have a different idea?

Sam: There's gray cat, yellow cat, gray cat, yellow cat.

Teacher: Okay, any different ideas?

Stacy: We can do yellow, yellow, gray, yellow, yellow, gray.

After building a few of the children's suggestions in the pocket chart, cover a portion of the last pattern suggested with a piece of black construction paper. Can the children figure out which character is hidden under the door by studying the rest of the pattern? Place the door in different spots including the very beginning of the pattern.

Next, show the students Cat Cottage Picture Problems 7 and 8 and challenge them to figure out what's behind the secret door in each example. Finally, show them the materials they can use to create their own Secret Door Linear Patterns, and demonstrate making one of your own. Before you send them off to work, remind children to set up their patterns with the bean

characters first. After they get friends to check whether their patterns really "work", they should get matching paper lima bean shapes and pens to draw cat faces. Remind them that the pens will be ruined by coming in contact with glue and must be used carefully. Once all the faces are drawn on their paper bean-cats, students can glue them down along the tops of their blackline fences and finally, tape on secret doors.

Day 7 & beyond: Solving Student Story Problems

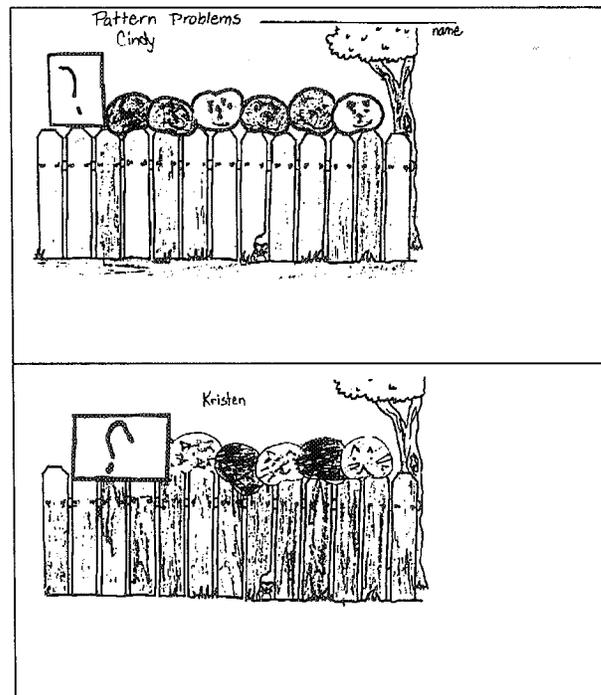
Each child will need...

- a problem-solving sheet (see instructions below for preparation)
- a clipboard or an individual chalkboard to provide a hard writing surface
- pencil and yellow crayon

You will need...

- children's completed secret door pattern problems

Before you present students' pattern problems to the class, go through the collection and select two of the most interesting or challenging examples for children to solve in writing. Make a problem-solving sheet by reducing the two problems. Position them on a piece of 8½" x 11" paper in such a way that students will have room to show their responses. Then run enough copies of the sheet for your entire class.



These sheets take some time to prepare, but if you plan to keep student responses in portfolios, you'll find that you need some way of identifying the problems children were solving to make any sense of their work six months down the road.

To begin the lesson, share all the children's fence pattern problems, taking time to admire each and every one. Then present the first problem to be solved, asking that children show their thinking on their problem-solving sheets.

Teacher: Now that we've admired everyone's fine work, we're going to solve two of these very challenging pattern problems.

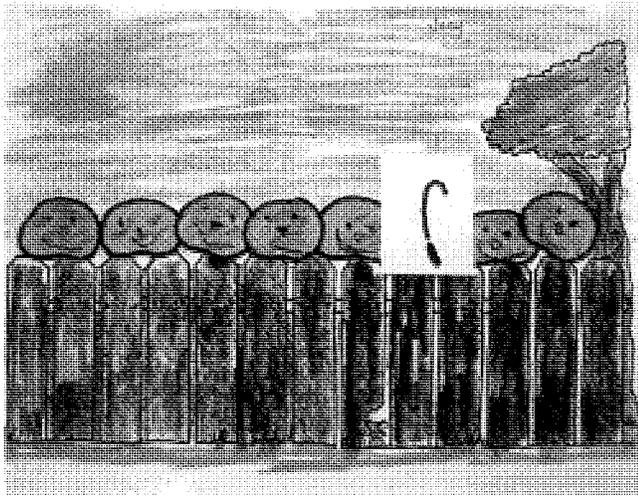
Matthew: Do mine!

Nicole: Do mine next.

Stacy: Me too—do mine!

Lee: Aren't you going to do mine?

Teacher: We'll get to everyone's problems, but not all at once. The first one we'll try is Joey's. It's the one that has Joey's name beside it, and it's at the top of your problem-solving sheet. You can see that he stuck a door near the end of his pattern. What shall we do to figure out what's behind his secret flap?



Jacob: Say the pattern—it's yellow, yellow, gray, gray, yellow—and then you can't see what comes next.

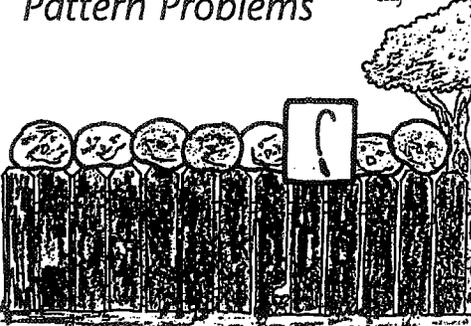
Jeffrey: But then it's gray, gray on the other side.

Teacher: Can you use your pencils and crayons to show what you think is behind the flap on Joey's problem?

Timmy: How can we show the gray cats? We don't have any gray crayons.

Brenton: Just use the pencil for that, 'cause it's gray.

Pattern Problems ^{Joey}

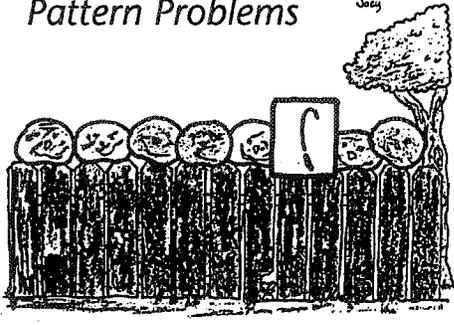


Mark
name



(yellow)

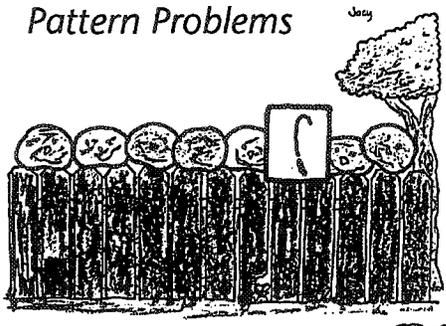
Pattern Problems ^{Joey}



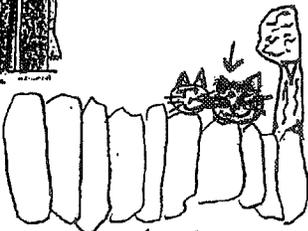
Tommy
name



Pattern Problems ^{Joey}



Sarah
name



(yellow, yellow)

Mark responds to Joey's problem by showing the one cat under the flap—a yellow. Tommy gets involved in drawing a picture of two cats in a tree. Sarah, who needed to draw out the entire pattern the previous month, is able to take a short cut this month, and simply draws the cat that precedes the flap and the cat she thinks is under the flap—two yellows in a row.

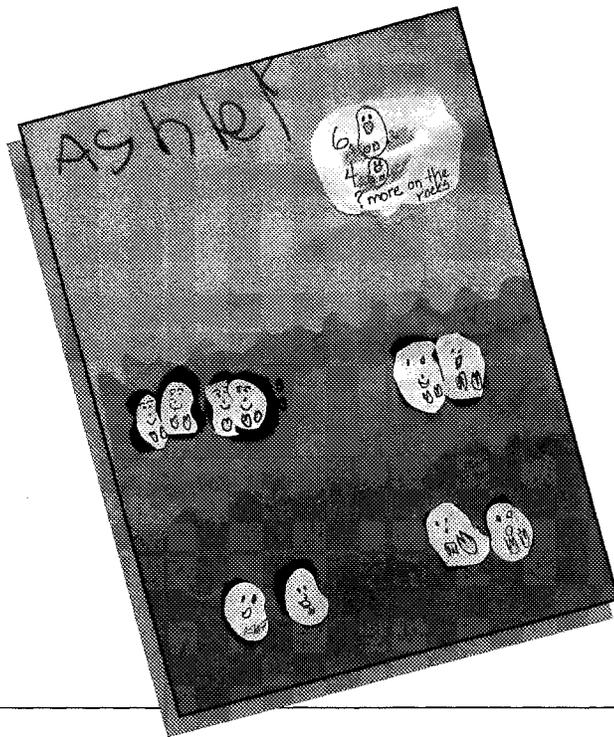
At the conclusion of this session, collect and date the children's written work and store it in their portfolios. Share the remaining pattern problems over the next several weeks by working two or three a day at an oral level with your group. Once every problem has been shared, consider the following options:

- Post them all on a bulletin board in the classroom or out in the hall along with a sign to explain the problem-solving challenge.
- Bind the problems into small books to be stored in your class library and enjoyed by the children all year long.
- Save each child's problem in their portfolio. It can be informative to have a longitudinal sample of the problems children have posed, as well the problems they've solved.
- Send the problems home along with children's Cat Cottage storyboards.

NOTES



Penguins



Theme 3

Penguins

Although many kindergartners will identify sharks, dinosaurs, or tigers as their "best" animals, penguins are also a perennial favorite. Their dramatic coloration, amusing waddle, and streamlined swimming make penguins a big draw at any zoo, and their nesting and child-rearing practices are fascinating to study. This theme will give children opportunities to count, read and write numerals, add, subtract, partition, group and compare quantities in the context of factual information about penguins.

There were three penguin nests safely hidden from view of predators. There were two baby penguins in each nest. How many babies were in the three nests altogether?

There were four penguins on the rocks and five in the water. Were there more penguins on the rocks or in the water? How many more?

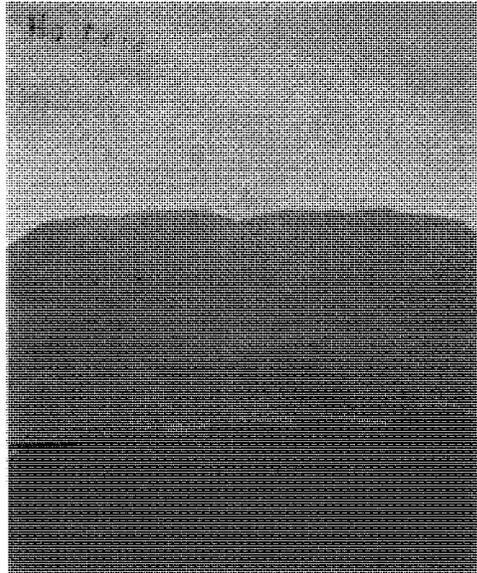
The naturalist looked through her binoculars and thought she saw five penguins on the rocks. Suddenly there was a splash and when she looked again, she could see that only three remained on the rocks. How many had paddled into the water?

After doing a bit of research about penguins with our students and showing them our lima bean adult and baby penguins, we ask them to create their own two-dimensional rookeries with construction paper. They use these

storyboards and penguin counters to enact and solve a variety of story problems, and then move on to recording their strategies and solutions on individual chalkboards. Finally they create their own story problems to share and solve with classmates. The entire theme takes about seven days and is still another step in the year-long series of encounters with story problems.

HOW IT WORKED FOR US

Weeks of other math activities passed before we returned to the story box problems and the new theme of penguins. Would our students recall the work we'd done in October and November? Would problem posing be easier for them this time around? A video team would be filming Donna's children at work for two days. Would the footage confirm the good things we believed were happening for these young learners?



After the children studied penguins for several days, we had them make three-dimensional rookeries from egg carton sections. Though these constructions were charming, the children wanted their lima beans to stand up on the "rocks" like real penguins, but of course they kept falling over. (How come they were perfectly happy with flat landscape features in November?) We finally decided the three-dimensional rookeries would have to go, and provided materials for our students to make their own two-dimensional construction paper boards complete with water flaps. As the unit progressed,

many children wanted to add rock flaps to their storyboards as well.

They were quite happy to solve a variety of teacher-posed problems with their adult and baby penguins, and loved going to the pocket chart to explain their thinking. At first, we heard a fair number of incorrect responses as children eagerly called out numbers while manipulating their bean penguins, but after awhile they began to help each other. By the time volunteers came to the pocket chart to explain their work, many changes had already been made by children who might have misunderstood the problem or miscounted the first time around. Most were able to pay attention at least for awhile to the explanations offered by peers.

The picture problems were a big success and the children responded happily with chalkboard drawings and numbers to several of the problems. In fact, they began to ask if they could make their own problems. Hallelujah!

This was what we had hoped for. Now, could they do it without heavy teacher intervention? We reviewed our picture problem display with each group and sent them out with storyboards, pens, and cut black and white paper bean shapes to create their own problems.

As they set out to work, many began conversing about the kinds of problems they would make. Some needed additional guidance to get started but the collective energy was high. We helped add the question bubbles to children's creations and "fixed" a few problems that didn't quite work. In the end, though, nearly everyone was quite elated about his or her finished problem and could hardly wait to have it shared with the class. Just as we had experienced in our first year of field-testing, these kindergartners were indeed becoming problem posers as well as problem solvers.

Day 1*: Making the Storyboards

Each child will need...

- a 9" x 12" piece of light blue construction paper for the background
- a 4" x 9" piece of brown or gray construction paper for rocks
- 3" x 9" blue or turquoise construction paper for water, 2 pieces
- scissors
- glue and scotch tape to share

You will need...

- chart paper and marking pens
- books, study prints, videotapes, movies, or other materials to familiarize yourself and your students with penguins
- a 9" x 12" piece of light blue construction paper for the rookery background
- 4" x 9" piece of brown or gray construction paper for rocks, 2 pieces
- 3" x 9" blue or turquoise construction paper for water, 2 pieces
- glue, scotch tape, and scissors
- adult and baby lima bean penguins, p. 146

* *If you want to spend more time researching penguins with your class, allow another day or two.*

You might begin this unit by explaining that you've made some lima bean penguins for children to use in telling their next story problems, but in order to tell good stories it will be important to collect some information about penguins. Ask children to tell what they already know about penguins and list their ideas on chart paper. After that, spend enough time collecting information with your students that they have a reasonably clear understanding

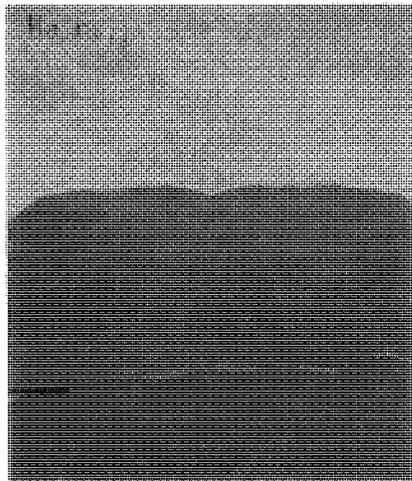
of how penguins live in the wild. We've included a bit of information about penguins below, but we recommend that you find books, films, videotapes, study prints, or other materials that will help bring penguins to life for your students. Two of the books we've used in our own classrooms are:

Lepthien, Emilie Utteg. 1983. *Penguins*. Chicago, Ill.: Children's Press.

Johnson, Sylvia. 1981. *Penguins*. Minneapolis, Minn.: Lerner Publications.

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Background Information on Penguins

By attaching numbered bands to penguins' flippers, scientists have learned that the same birds return to a rookery year after year. The male birds go back first. They walk over cold ice and snow on their short stubby legs to get there. Once they arrive, they gather pebbles for their nests to keep the eggs off the wet ground and to keep them from rolling away. A few days later, the female penguins return, call for their mates, and join in the hard work of bringing pebbles for the nest. Finally, the female lays one egg, and then a second. (Penguins can lay from one to three eggs, but most species lay two.) By then, the female is very hungry and she goes to the sea to feed while the father penguin keeps the eggs warm. By the time the mother penguin returns, the father hasn't eaten for a very long time. The mother penguin takes over egg-watching duties while the father heads out to sea to eat. When he returns, he helps care for the eggs. After about five weeks, the eggs hatch. There are cold, harsh winds and even blizzards, so the new penguin chicks are lucky to have parents to care for them and keep them warm. They only poke their little heads out to feed from their parents' beaks. The parents take turns going down to the sea for fish. When the babies are about three weeks old, they can leave the nest. They are always hungry so their parents are quite busy catching food. Finally, when they are about seven weeks old, the penguin chicks begin to feed themselves. Several weeks later, they all begin the long swim northward. The rookery is abandoned till the following spring, when it all begins again.



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After your students have collected some information about penguins, show them how to draw waves on the top of one of their turquoise or blue sheets of construction paper to create the look of water. Demonstrate how to hold both blue pieces together to cut matching "waves". One piece will be glued to the light blue background. The second piece will serve as the water flap and be taped with scotch tape to one side of the water area. Ask the chil-

dren how you might use a crayon to add more waves. Follow their suggestions. Talk about ways to shape the brown pieces to serve as the rock portion of their storyboards. Follow their suggestions as you draw simple rock shapes. Again, hold both pieces together and cut them into "rocks". Glue one piece down adjacent to the water and tape the other piece at the side to serve as the rock flap. Tell the children that once the glue has dried completely, you'll draw small black rocks in five different areas to create the look of "rock nests" on the glued down portion of the rocks. They will use these storyboards, along with your penguin counters, to enact and solve many problems. The children's storyboards will eventually serve as backgrounds for their own penguin picture problems.

Days 2 & 3: Solving Spoken Story Problems

Each child will need...

- his or her Penguin storyboard
- 8 lima bean adult penguins and 8 penguin babies, p. 146

You will need...

- a pocket chart
- pocket chart scenery (see Blacklines)
- pocket chart penguins: 8 adults and 8 babies (see Blacklines)

On Days 2 and 3, spend twenty to twenty-five minutes telling some of the story problems featured below. Ask children to solve each of the problems with their storyboards and penguin counters and call on them to explain their thinking as best they can. Many will enjoy demonstrating their ideas at the pocket chart, but don't be surprised if some youngsters are still unable to verbalize their thinking, or even reply, "I just knew it," when you ask them to explain their responses. You'll hear some explanations more than once because kindergartners don't always realize that they have solved a problem the same way as other children, but that's okay. The goal is to encourage students to speak out and also to demonstrate that there are numerous ways to solve challenging problems.

Counting and Comparing

- There were four father penguins keeping the eggs warm on the nests. Three mother penguins were swimming in the sea in search of food. How many more penguins were on the nests than in the sea?

- Two of the nests had two penguin chicks each. Their mothers were keeping them warm. Were there more adults or more chicks in the nests? How many more?

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How Many Altogether?

- Three male penguins had returned to the rookery to gather pebbles for the nests. After much calling, three female penguins found their mates. How many adult penguins were there altogether?
- The eggs are in the nests and the father penguins are keeping them warm while the mothers search the sea for food. Four fathers are on the nests, and four mothers are swimming nearby. How many penguins altogether?
- There are three fathers and three mothers waiting on their nests for the eggs to hatch. How many pairs of penguins are there? How many penguins altogether?
- Two pairs of chicks had hatched. How many baby penguins were there altogether?

Because the language of pairs will be quite difficult for most of your kindergarten children, you may need to take time to talk about things that come in pairs: eyes, shoes, socks, hands, etc. We pose these problems to be sure that we are challenging even the most able students in our classes.

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How Many Are Left?

- Six adult penguins were by their nests caring for the eggs. Four of the adults left to search the sea for food. How many remained by the nests?

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Missing Addend / Subtrahend

- The naturalist was counting the penguins in one area of the rookery. When she first looked, she thought she saw six penguins. By the time she reached for her binoculars, only four remained on the rocks. How many had jumped into the water?
- Seven penguins were searching for food in the water. Some of them had very good luck and went back to the rocks leaving only four in the water. How many went back to the rocks?

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Grouping and Partitioning

- There were four pairs of adult penguins sitting on their nests. How many penguins in all?

- The adult penguins are eagerly awaiting the hatching of their eggs. There are three nests. There are two eggs in each nest. How many chicks will there be when the eggs hatch?
- There were six penguin chicks, two per nest. How many nests were filled?

Children: How many nests? What do you mean? There are six babies! No, two! I don't get it!

Teacher: This one is tricky, all right. There were six babies, and they each shared a nest. Do you remember how many babies penguins usually have?

Children: Two! But there are six babies now!

Lee: I know! It's two nests!

Teacher: Would you be willing to come up to the pocket chart to show us your thinking, Lee?

(Lee comes up to the pocket chart and arranges the penguins in two groups of three.)

Lee: See? One, two, three, four, five, six!

Teacher: So you took six penguins....

Lee: Yep! I put them together.

Timmy: But penguins only have two babies—there can't be three in a nest!

Teacher: How would you set it up, Timmy?

Timmy comes to the pocket chart and rearranges the six into three groups of two. Many of the children understand what he's doing. Some remain puzzled by the problem but the teacher moves on, knowing that each child's understanding will grow with experience.

Day 4: Solving Picture Story Problems

Each child will need...

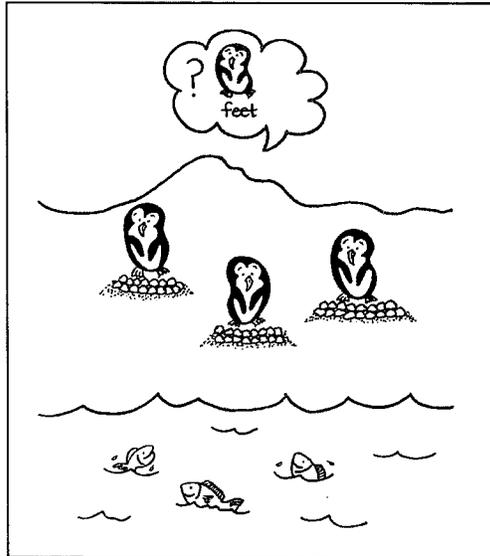
- 8 lima bean adult penguins and 8 penguin chicks
- his or her Penguin storyboard

You will need...

- a pocket chart and scenery
- pocket chart-size penguins: 8 adults and 8 babies
- Penguin picture problems 1-6, p. 149-150

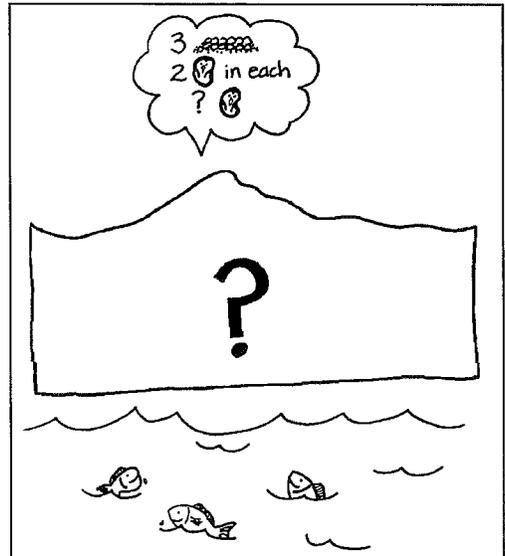
PENGUIN PICTURE PROBLEMS

Picture Problem 1



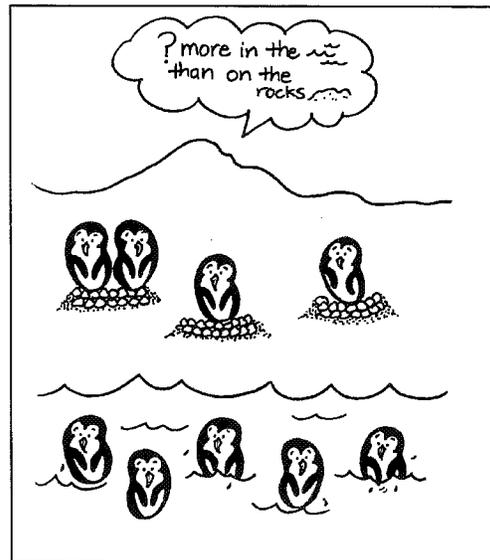
There were three adult penguins sitting on their nests. Their feet seemed to help cover the eggs. How many feet altogether?

Picture Problem 2



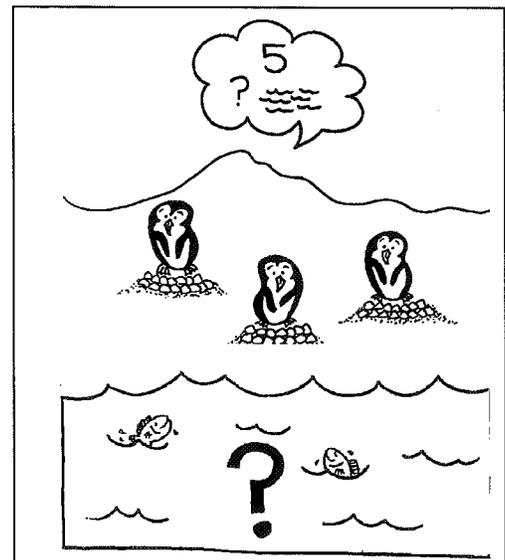
There were three penguin nests safely hidden from view of predators. There were two baby penguins in each nest. How many babies were in the three nests altogether?

Picture Problem 3



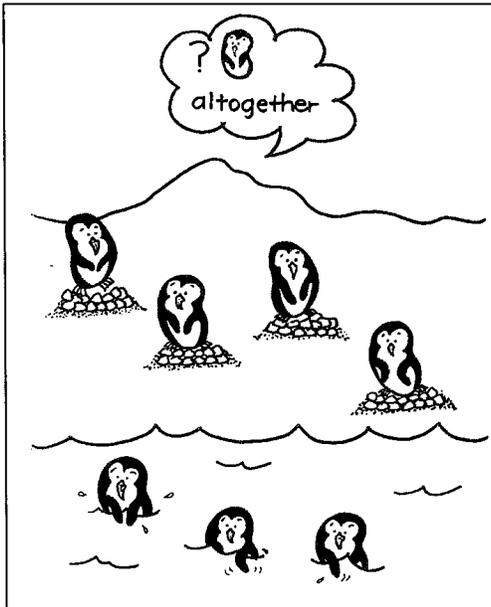
There were four penguins on the rocks and five in the water. Were there more penguins on the rocks or in the water? How many more?

Picture Problem 4



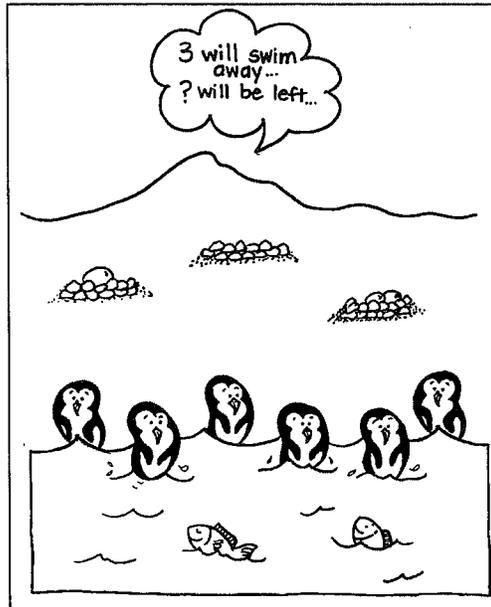
The naturalist looked through her binoculars and thought she saw five penguins on the rocks. Suddenly, there was a splash and when she looked again, she could see that only three remained on the rocks. How many had paddled into the water?

Picture Problem 5



There were four penguins on the rocks and three swimming in the water. How many penguins were there altogether?

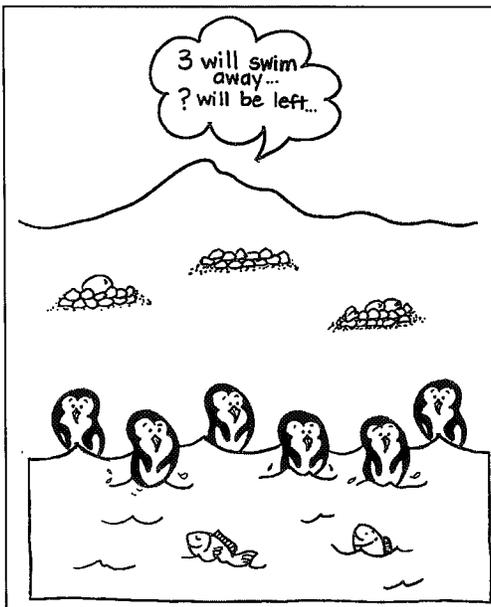
Picture Problem 6



There are six penguins in all, three on the rocks and three in the water. Soon three will swim away in search of food. How many will be left?

Now that your children have worked to solve spoken story problems for two days, show them the picture problems you've prepared. While the pictures involve problems similar to those you've already posed, they deliver the information visually and may be easier for some children to grasp.

Teacher: I have some special problems for you to solve today. Here's the first one. What do you notice?



Children: There are three penguins on the rocks and three in the water. They look like they're swimming. There's one of those clouds. What does it say? Look, the water is loose. It's like a secret door. What's under it?

Teacher: Those are great observations. You're right about the water being like a secret door. You asked about the cloud with the words and numbers. Can anyone read it to tell what we're supposed to figure out?

Children: It says three up there.

Three and a question mark—and some words. But there are six penguins in the picture. What do the words say?

Teacher: They say, "Three will swim away. How many will be left?"

Terrilyn: Can I open that water part and see?

Teacher: That would be okay after everyone has a chance to figure it out on their own. What should we do first?

Children: We have to put six. I'm going to have some babies too. Yeah, and then three of them have to swim away. It's three left. No, it's two. Three in the water, but there are two on the rocks. No, I've got five in both places. I can't do it. What do you mean?

Teacher: Mark, I've been watching you and noticing that you're even helping some of the people beside you. Would you be willing to show your thinking at the pocket chart?

Mark: (Comes up to the pocket chart.) There were six—three on the rocks and three in the water. One, two, three, four, five, six. Then the three in the water are supposed to swim away, so I took them out of the water and there were only three still there. See.

Children: I get it. Me too. That's how I did it. See! Jimmy did it too. He helped me.

Terrilyn: Can I do the secret door?

(Terrilyn swings open the flap as the teacher holds the picture problem for the other children to see.)

Children: Oooh! That's neat. It looks like the penguins swam away. I want to see the back of the door. Do it again. Yeah! When you close the door it looks like they're swimming back.

Once again, not everyone will understand but many will be enchanted by the magic of the door. We don't try to do any more work on this particular problem. Instead, we move along to another picture problem, knowing that our students will have many opportunities to sort things out in the months and years ahead.

Continue as above with the other picture problems, inviting children to share their solutions and frustrations. Some will use mental strategies, often in combination with their fingers, while others will use their beans and storyboards. If some children appear to be inattentive from time to time, trust that experience and opportunity will make a big difference. Remember, enthusiasm is catching!

Day 5: Writing Solutions to Picture Problems

Each child will need...

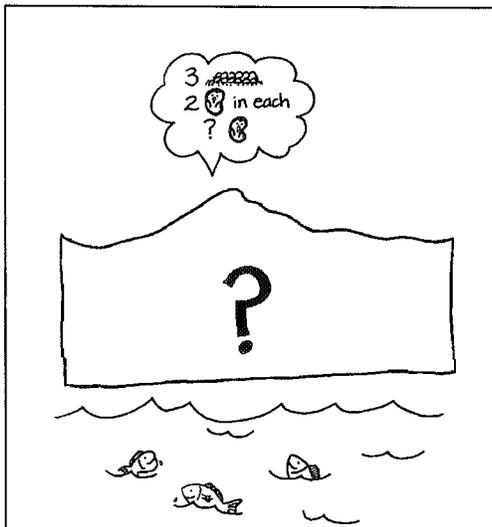
- an individual chalkboard, chalk, and eraser
- access to Penguin storyboards and Penguin counting beans, if desired

You will need...

- Penguin picture problems 1-6
- a pocket chart
- pocket chart scenery and penguins

Now that your children have worked through some or all of the picture problems with their storyboards and counters and offered oral explanations, you can encourage them to record some of their strategies and solutions. Choose a picture problem that you haven't already shown, or one that was particularly interesting to the students yesterday. Ask children to use drawings and/or numbers on their chalkboards to solve the problem. Even if someone calls out the answer, let them know that you're quite interested in seeing each person's thinking, not just hearing an answer. Hopefully, some will begin working right away and serve as an inspiration to children who really don't know how to begin. If some youngsters seem unable to begin, you may need to model some possibilities or ask one of your children to explain how he or she is approaching the task. Be aware that some children will spend lots of time looking around to see what others are doing, copying from their friends, or simply waiting to see what's going to happen.

Teacher: Here's a picture problem we didn't get to yesterday. What do you notice about it?



Children: There are rocks and water, but no penguins. Where are the penguins? Maybe they're hiding behind the rocks. Yeah! The cloud thing says three. There's a two and some penguins in the cloud too. That rock door will open! Can we open it and see?

Teacher: Sure, but before we do, let me give you a little more information. In this picture there are three penguin nests safely hidden.

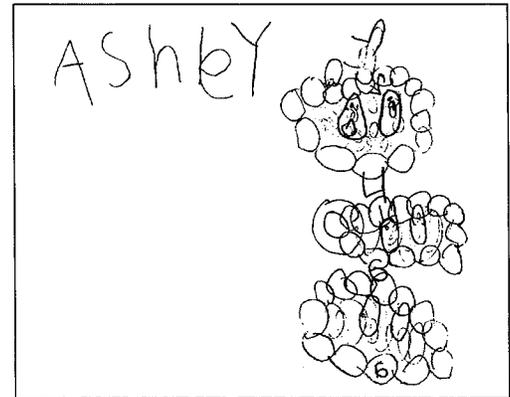
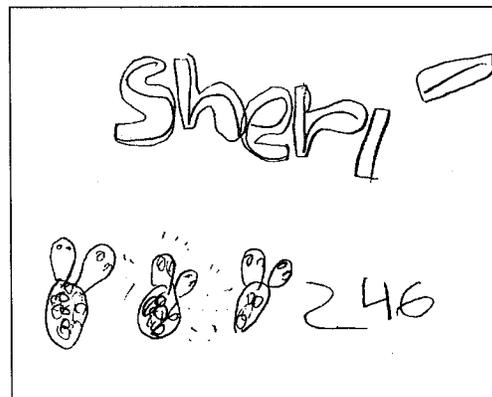
Timmy: That's so the enemies won't get the babies!

Teacher: Right. And there are two baby penguins in each nest. Can you figure out how many babies there are altogether before we peek under the rock flap? See if you can show your thinking on your chalkboard. There are storyboards and penguin beans here if you need them.

Children: Three babies? No, three nests. Two babies in each nest? It's four! No, six! Nine!

Teacher: You have all kinds of ideas. There are three nests, and two babies in each nest. Can you use pictures or numbers on your chalkboards to help you figure out how many babies there are in all?

Some of our students think there are four babies—two in each of two nests. Others think it is nine—three in three nests. After picturing the three nests on their chalkboards, however, many conclude that there are six babies. Some are able to show that they counted the babies by twos, while others number the nests—one, two, three.



Once several children have finished, have them share their solutions. Some like to reproduce their thinking on the pocket chart, while others are willing to have you hold up their chalkboards while they explain their work. Though it isn't easy for kindergartners to explain what they've written, we encourage them to verbalize their thinking. As hard as it is at first, children's abilities to communicate mathematically improve throughout the year.

Day 6: Creating Story Problems

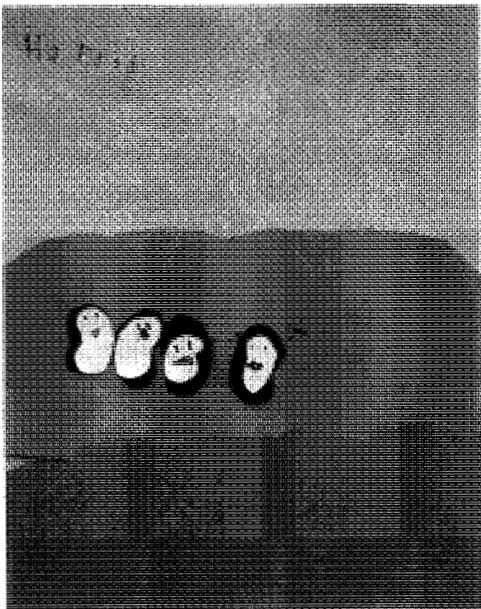
Each child will need...

- his or her own Penguin storyboard
- black and white construction paper bean shapes to create adult and baby penguins, p. 154
- access to extra-fine-tip Sanford Sharpie pens (Set these in an area separate from the glue.)
- glue and scotch tape to share

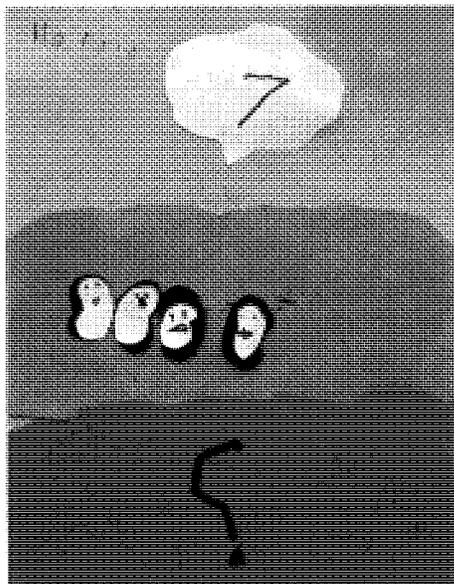
You will need...

- Penguin picture problems 1-6
- precut talking bubbles for children to add to their picture problems
- a Sanford Sharpie pen
- glue

Display all six of your picture problems, take a few minutes to point out the important features of each, and then challenge children to create interesting problems of their own. Be aware that they will use your picture problems as models. Some children, in fact, will make direct copies of your work, while others will vary the quantities, but usually only slightly. For the few who don't know where to begin, you may need to narrow the choice to two or three picture problems and ask them which kind they'd most like to make for their classmates. They will also need help figuring out how to pose the problems they have in mind. Plan to help each child write his or her bubble and add question marks where needed.



Harold, for instance, approaches us with his problem in hand—four penguins on the rock and three under the water flap. It's clear that he has a problem in mind, but he isn't sure how to symbolize it. He says there are seven penguins, but three are hiding under the water. When we ask him what he wants the kids to do, he says he wants them to figure out how many penguins are in the water. We direct him to put a seven on the talking bubble and a question mark on the water flap, explaining that these marks will help the kids



understand what to do and give them some important information. Many kindergartners don't fully grasp this step, but we trust that with more time and opportunity, most will gain a clearer picture of the questioning process.

Day 7 & beyond: Solving Student Picture Problems

Each child will need...

- a problem-solving sheet (see instructions below for preparation)
- pencil and a hard writing surface (such as the backside of an individual chalkboard or a clipboard)
- access to Penguin storyboards and penguin counting beans if desired

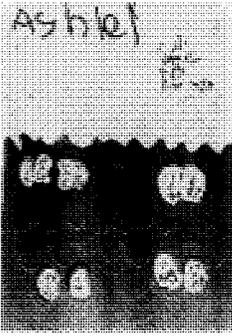
You will need...

- children's completed picture problems

Before you present students' picture problems to the class, go through the collection and select two or three of the most interesting or challenging examples for children to solve in writing. Make problem-solving sheets by reducing each chosen problem on your copy machine and leaving space for student response. Then run enough copies of each for the entire class (see illustration on following page).

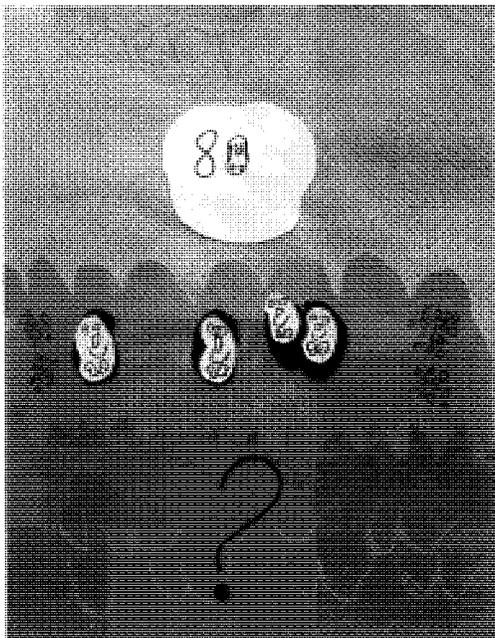
These sets of sheets take some time to prepare, but if you plan to keep student responses in portfolios, you'll find that several months down the road you'll need some way of identifying the problems they were solving. These sheets also prove useful in sharing children's mathematical skills and problem-solving strategies with parents.

Begin the lesson by showing every child's problem and taking time to admire each one. Then present the first problem to be solved, and ask children to record their thinking on their problem-solving sheets.

Picture Problems	name
	

Teacher: Now that we've seen everyone's beautiful work, we're going to solve a few of the problems.

Children: Will it be mine? I hope it's mine! Me too!



Teacher: We'll try to solve everyone's problem eventually, but today we'll only have time for two or three. Here's Sheri's problem. You'll notice there's a miniature version of it on this problem-solving sheet. What do you think she wants us to figure out?

Children: There are some penguins on the rocks. Four of them. But that cloud thing says eight. There aren't eight penguins though. But some are in the water—you can see there's a flap. Can we lift it and see?

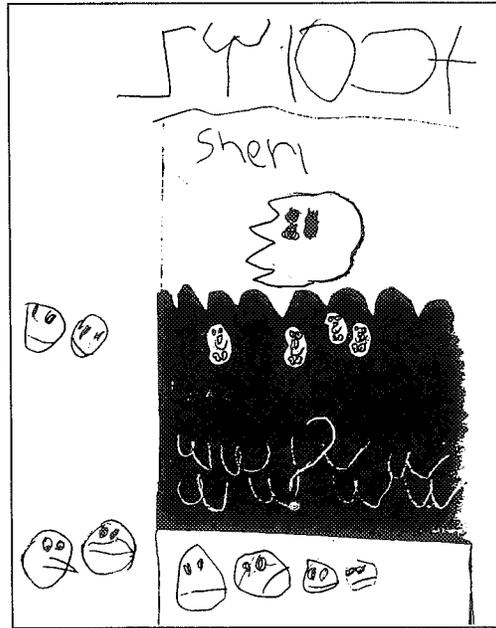
Teacher: Sure, but let's see if we can figure out how many penguins are in

the water before we lift it. Can you use your paper and pencil to make some kind of drawing or write some numbers that might help you solve this problem?

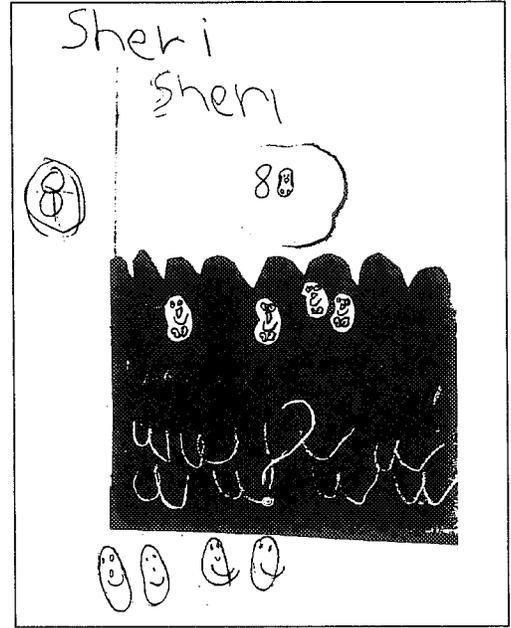
Circulate among the children as they work, offering encouragement. If a few youngsters don't seem to know where to begin, try seating them beside children who are working confidently.

THEME 3: PENGUINS

In our classrooms, most students are able to put something down on paper. Many conclude that there are four penguins in the water, but they use different strategies to solve the problem.



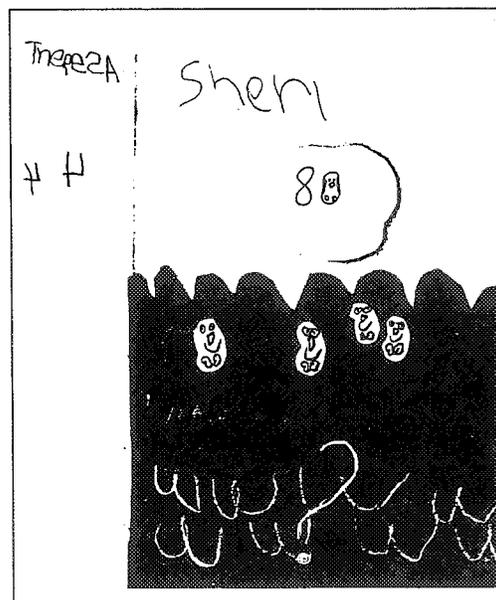
Stacy



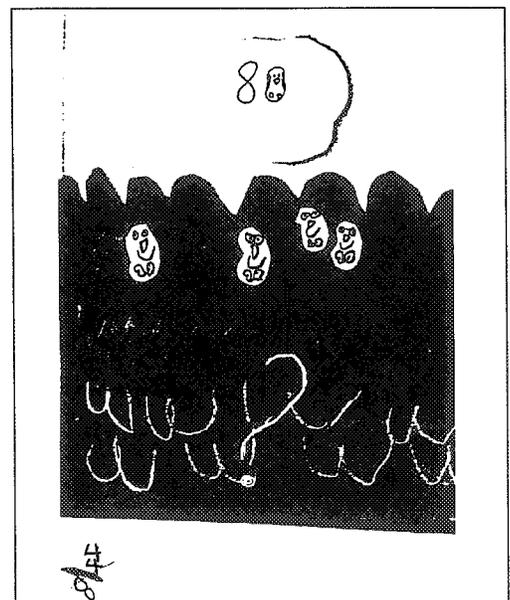
Sheri

Stacy copies the four penguins on the rocks and keeps drawing until she has a total of eight.

Sheri solves her own problem in a similar manner but is apparently able to count on from four rather than drawing the entire collection.



Theresa



Harold

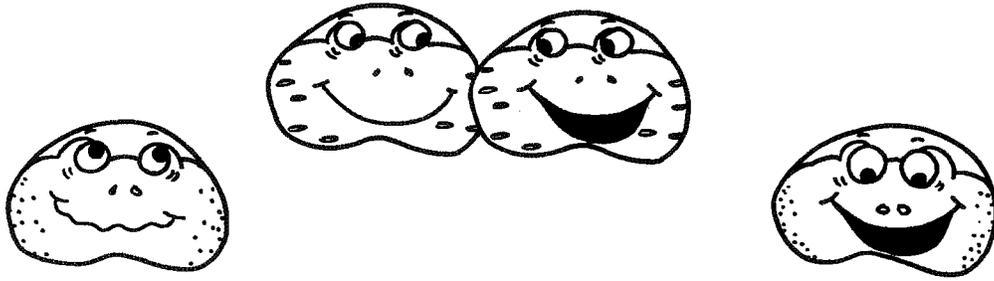
Theresa shows her thinking by writing two fours, and when questioned says she knows that four and four make eight, so there have to be four penguins hiding in the water.

Harold, too, uses numbers rather than drawings to show his thinking.

At the conclusion of this session, collect and date the children's written work and store it in their portfolios. Share the remaining problems over the next several weeks by working two or three a day at an oral level with your group. Once every problem has been shared, consider the following options:

- Post them all on a bulletin board in the classroom, out in the hall or in the school office along with a sign to explain the work.
- Bind the problems into small books to be stored in your class library and enjoyed by the children throughout the remainder of the year.
- Save each child's problem in his or her portfolio. It can be interesting to have a longitudinal sample of the problems children have posed, as well as the problems they've tried to solve.
- Send the problems home.

NOTES



Frogs & Toads



Theme 4

Frogs & Toads

What young child hasn't at some time happily found a frog or a toad in their backyard, by a nearby pond, or on a family camping trip? What adult doesn't envy the awe and delight a young child exhibits as a big toad seizes an insect or hops away? Young or old, who among us doesn't marvel at the distant chorus of frogs or toads on a warm night? As frogs and toads come and go, peer back at the biologist, or stare out of the water with only their eyes showing, many opportunities can be provided for children to count, read and write numerals add, subtract, partition, group, and compare in the context of intriguing problems.

The biologist was trying to count the frogs in the park. When she first looked, she was quite certain she saw seven of the critters sitting on the log. She reached for her binoculars to have a better look. Kersplash! Only four were still sitting on the log. Some must have jumped into the pond. How many had jumped into the water?

Late in the evening, Grandpa offered to take his young grandson on a walk to the pond. In the beam of the flashlight, they could see eight eyes peering at them from the large lily pad. How many frogs were sitting on the lily pad?

Five frogs sat on the old log looking for delicious bugs. How many eyes were searching for food?

Since many kindergartners enjoy books such as *Jump Frog Jump!* by Robert Kalin and the many Frog and Toad books by Arnold Lobel, as well as the accompanying video, frogs and toads are easily incorporated into math story problems.

After immersing children in the language of frogs and toads and perhaps doing a bit a research on their habits, we show students our lima bean frogs and toads and ask them to create their own two-dimensional frog and toad ponds, grassy areas, and logs. They use these storyboards and frog and toad counters to enact and solve a variety of story problems and then move on to recording their strategies and solutions on individual chalkboards. Finally they create their own story problems to share and solve with classmates. The entire theme takes about seven days and is still another step in the year-long series of encounters with story problems.

HOW IT WORKED FOR US

Six or seven weeks had passed since we set the last student-posed penguin problems aside, and we were eagerly looking forward to a new theme. Would students be able to utilize new problem-solving strategies they'd seen their classmates share? Would problem-posing be any easier? Would more youngsters be able to add twists of their own?

To start the new theme, we had our students make their own construction paper storyboards—no three-dimensional structures this time! The ponds and logs were very charming and the children thought the frogs and toads were wonderful. They were more purposeful this time around and we were able to begin a little more quickly. From the first day, some began to talk about the kinds of problems they would make.

Children seemed able to solve many of the teacher-posed problems with growing confidence, and were increasingly focused in their efforts to listen and help one another. One-by-one counting was still the order of the day, but we heard more counting on, counting by twos, and grouping than in previous months. Their written work began to change too. Children who had solved the *3 pumpkins, how many eyes?* problem by drawing three pumpkins and counting the eyes—by using drawings almost as manipulatives—might now be calculating the answer to a similar problem (e.g., *5 frogs, how many eyes?*) by recording the counting numbers in some fashion:

1 2 3 4 5 6 7 8 9 10 or 5 6 7 8 9 10 or 2 4 6 8 10

and then making drawings to validate their conclusions. The numbers themselves seemed to act as problem-solving elements.

Many children were so eager to make their own problems that they scrutinized our picture models quite thoroughly. Some began to talk about how they'd make their problems a little like ours, but a little different too.

As a theme, Frogs and Toads was a winner and the growing portfolio col-

lections of problem-solving papers, student-posed problems, and anecdotal notes gave us some insights that were invaluable in preparing for spring parent conferences.

Day 1: Making the Storyboards

Each child will need...

- a 9" x 12" piece of light blue construction paper for the background
- a 5" x 9" piece of green paper for the grass
- two 4" x 9" pieces of aquamarine blue construction paper for the pond (one to glue onto the green, one to serve as a taped "water flap" for the critters that have hopped into the water)
- two 3" x 6" brown pieces of construction paper for the log (one as a flap)
- assorted scraps of yellow, white, brown, and green if children want to add trees, bushes, clouds, or the sun to their boards
- crayons, scissors, and glue to share

You will need...

- all of the materials listed above
- scotch tape
- your frog and toad lima beans counters, p. 146

Show your students the frog and toad beans and explain that in this new theme you'll be telling math stories involving frogs and toads. Ask them to tell about a time they've encountered a frog. You may even want to make a class chart as they relate some of their encounters. It's a lot of fun to include the children's frog and toad adventures in a few story problems you pose.

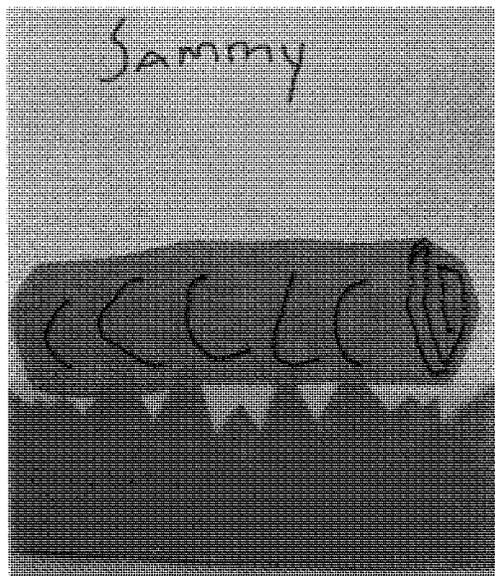
Explain that you'll be working on solving math story problems with these bean characters and a pond storyboard which you'll need each of them to make today. By now, if you've done several of the other themes, they will hardly be able to wait until they get to make their own problems.

Teacher: I want to show you how to make your own storyboards which we'll use for solving frog and toad math problems.

Children: I know what kind of a problem I'm going to make already. I want to trick everybody. Can we make our problems now? I'm going to make mine real hard. I'm gonna do a whole lot of frogs. Me too!

Teacher: I know you love making problems for your classmates. But first, I have some problems I want you to solve so that you'll have some new ideas for your own picture problems.

Show the children how to glue the green piece to the bottom of the light blue paper to serve as the grass around the pond. Ask for ideas of how to



shape the pond and use one of their suggestions to draw, and then cut, two identical ponds—one which will be glued on top of the grass, the other taped on one side to serve as a secret flap. Ask for suggestions about how to draw the shape of a log on one piece of your brown paper and then cut both pieces out at the same time. Show children how they might want to add lines of black crayon to give the log pieces the appearance of old bark. Glue one log to the upper portion of the grass and tape the second over it to serve as a flap.

Days 2 & 3: Solving Spoken Story Problems

Each child will need...

- his or her storyboard
- 7 brown toads and 7 green frogs

You will need...

- a pocket chart
- pocket chart scenery (See Blacklines)
- 7 brown toads and 7 green frogs for pocket chart (see Blacklines)

Spend about twenty to twenty-five minutes each day posing some of the story problems featured below. If you can adapt some of them to include your students' encounters with frogs and toads (remember your class chart), they will be even more enchanting. As your children are solving the problems, invite them to share the various ways they are working. (Using the pocket chart characters will help listeners stay focused.) You may see the child who is doing the explaining quickly turn back to his or her storyboard to reaffirm how it looks in order to demonstrate at the pocket chart. Communicating mathematical thinking is a long-term goal and you'll find that sometimes you need to help clarify a child's efforts a bit. Good pacing is also critical to keeping the lesson alive and well. If a problem has been easy for

nearly everyone, don't take time to have more than one child come up to the pocket chart. If the problem has been challenging to many, try to have more than one solution demonstrated. Be an insightful observer as you circulate and question so you can draw upon several different methods of finding a solution. Try not to focus only on right answers. Solutions that are in error can provide some excellent opportunities for learning.

Counting and Comparing

- There were five green frogs basking on a log near the pond. Two brown toads were swimming in the pond. Were there more frogs or toads? How many more?
- Six brown toads were sitting on the log waiting for some delicious bugs to come close. Three green frogs were lazily floating in the water. Were there more brown toads or more green frogs? How many more?

How Many Altogether?

- There were four green frogs and six brown toads sitting on the log looking for tasty bugs. How many frogs and toads were on the log altogether?
- Three green frogs were diving underneath the water. (Children tuck them under the pond flap.) Two brown toads were sitting on the grass getting ready to dive in. Three more brown toads were looking for a tasty insect to eat as they sat on the log. How many frogs and toads were there altogether?

How Many Are Left?

- Eight frogs and toads were sitting on the log. Suddenly, three jumped into the water. How many are still on the log?
- Seven frogs and toads were swimming around looking for delicious water bugs. Suddenly, one frog disappeared under the water. How many frogs and toads were left?

Missing Addend / Missing Subtrahend

- The young boy was carrying his bucket. He wanted to catch some frogs and toads. He could see seven of them sitting on the log. As he crept closer to them, some leaped into the water. Only two were left on the log. How many had jumped into the water?
- The little girl loved catching frogs and toads. She had a net and crept up on six she could see basking on the log. She swung her net over them, but when she counted the frogs and toads she had caught, there were only two in her net. How many had escaped into the water?

Grouping and Partitioning

- The little girl and her grandma had gone searching for frogs. They could see ten big eyes peering at them from the water. How many frogs were in the water?
- Six frogs were sitting on the old log. Their bulging eyes were probing for some juicy insects. How many eyes were looking for bugs?
- There were four frogs sitting on the log. Suddenly, half of them jumped into the water. How many were left on the log? How many were in the water?

Children: I can't do that one. What do you mean? I put four on the log. What did you say?

Teacher: It sounds like I've tossed out a tricky problem this time. What do you think about when you hear the word half?

Mark: My mom lets me have half of a candy bar if I eat all my dinner.

Sonny: I like my sandwiches cut in half.

Cindy: Sometimes my mommy lets me have half a cup of coffee.

Mandy: When my sister and I share the cookies, we each take half. If we have two cookies on the plate, I take one and she takes one.

Paul: My brother always takes the big half when it's cake. My mom gets mad.

Teacher: You seem to know a lot about cutting things in half or filling a glass or a cup half full or eating only half of a candy bar. Mandy and her sister each get half of the cookies. Paul thinks that cutting things in half doesn't always turn out to be fair when his brother is around. But what does that mean when you're thinking about four frogs on the log and half of them need to jump in the water?

Mandy: I think I know. If just two frogs were there, one would jump in the water. So if four frogs are there, you just put one in the water and one on the log, then one more in the water and one more on the log. That's like sharing the cookies.

Teacher: Would you come up to the pocket chart and show us that, Mandy?

Many children won't find Mandy's solution meaningful with a concept as new as one half. We believe it's okay for children to puzzle about things they don't understand and we come right back with similar problem to see if they can find a way to figure it out.

Teacher: Great job! Let's see if Mandy's method is helpful to some of the rest of you. I'm going to put six frogs here in the pocket by the log. I want half of them to jump in the water. How many will need to jump in?

Ashley: I think I know. Look! This one is going to jump in, this one stays. This one jumps in, this one stays, and this one jumps in and this last guy stays here. See!

Teacher: Ashley seems to think that half of six is three. Do you agree?

Kristjiana: I think it's three too, but I just know that three plus three makes six, so half of six is three.

Teacher: Could you show us how you're thinking with these Unifix cubes?

Kristjiana: Look, I'll snap these together—one, two, three, four, five, six. Now you just cut them right down the middle. See! Three and three!

Tommy: I don't get it. Can we quit doing this stuff now?

Don't we all want to escape once in awhile when things get just too complicated to comprehend? We trust that over time, nearly all the children will begin to get a clear impression about "half" so we don't belabor the issue. Many children will need months, or perhaps years before all of these big ideas become intuitive.

Day 4: Solving Picture Story Problems

Each child will need...

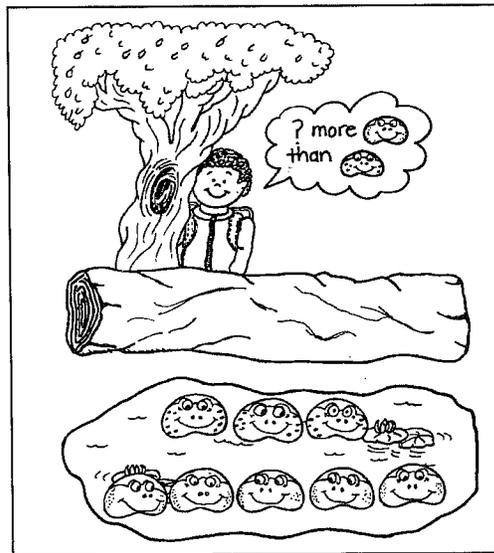
- his or her Frog and Toad storyboard
- 8 frogs and 8 toads

You will need...

- a pocket chart
- pocket chart frogs, toads, and scenery
- Frog and Toad picture problems 1-6, p. 150-151

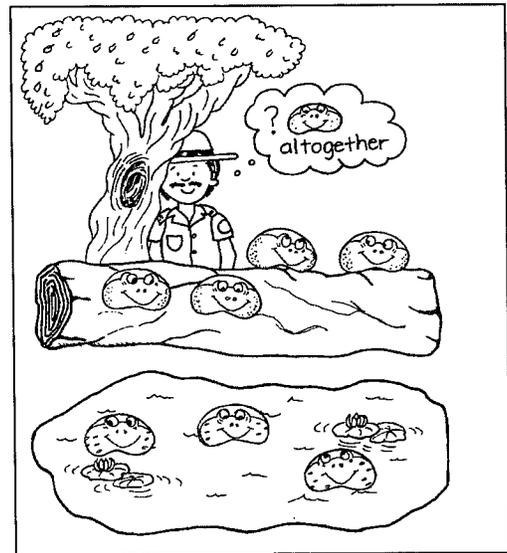
FROGS & TOADS PICTURE PROBLEMS

Picture Problem 1



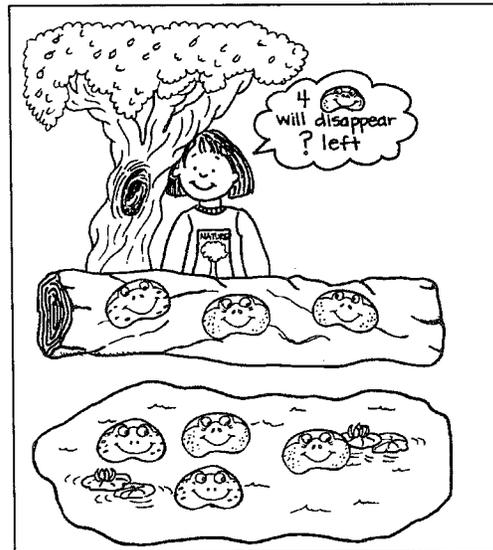
The young boy was hoping to find some frogs and toads. He peeked out from behind a tree and saw three brown toads and five green frogs swimming in the water. How many more green frogs than brown toads?

Picture Problem 2



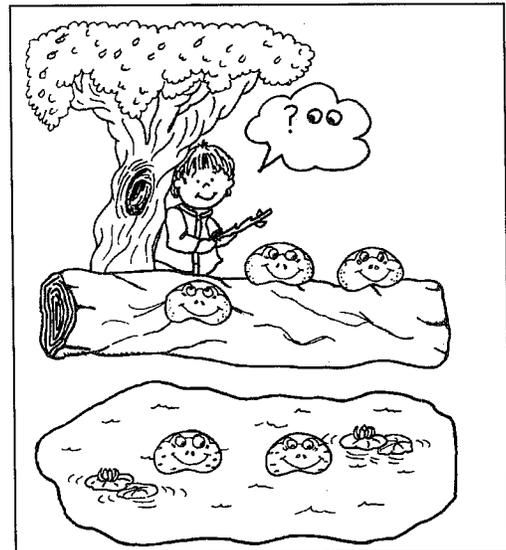
A park ranger was studying the park's frogs and toads. He saw four green frogs on a log and three brown toads in the water. How many frogs and toads did he see in all?

Picture Problem 3



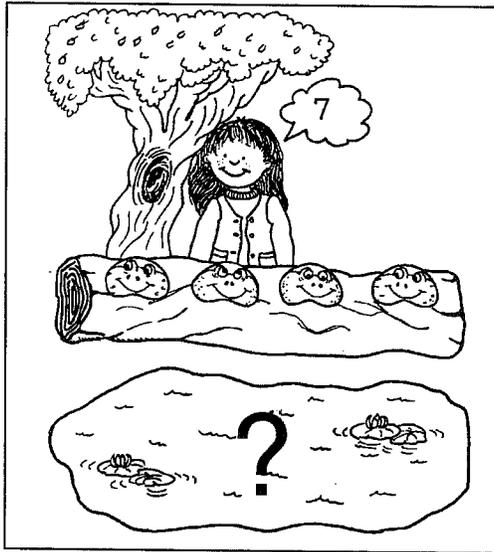
The woman thought she could see seven frogs and toads in all. Suddenly, a big wave hit the water. Perhaps a boat had gone by because four of the frogs and toads just seemed to disappear. How many were left?
Swing water flap away to have them disappear.

Picture Problem 4



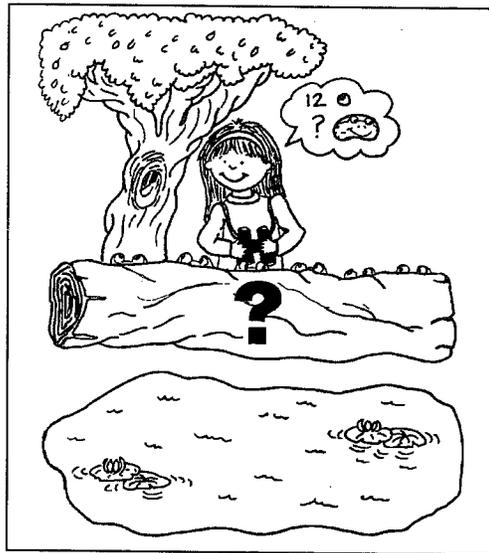
The little boy couldn't believe what big eyes those frogs and toads had. He could see five frogs and toads altogether. How many big eyes did he see?

Picture Problem 5



The biologist thought she had seen seven frogs and toads on the log, but when she looked again, some had apparently jumped into the water. Only three were still on the log. How many are in the water?

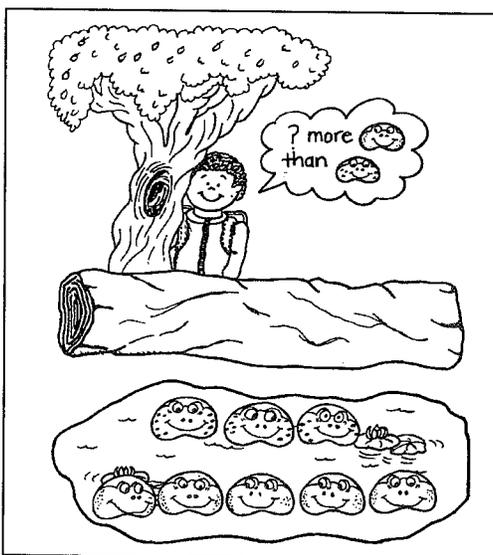
Picture Problem 6



The young girl loved frogs and toads. She noticed that twelve eyes were peering up at her from on top of the log. She grabbed her binoculars to have a closer look. How many frogs did she see?

The picture problems serve as a good means of revisiting problem solving as well as helping the children shape ideas for the kinds of challenges they'll pose for their classmates. We find that showing the problems in picture form encourages a bit more mental processing. Many children will still persevere with their beans and storyboards, however, and a few will be very happy to receive peer support.

Teacher: I have some Frog and Toad picture problems for you to solve today.



Here's the first one—what do you notice?

Sonny: I bet that kid wants to catch some of those frogs.

Cindy: There sure are lots of frogs and toads swimming around.

Children: One, two, three, four, five, six, seven, eight. There are eight of them. What does that white bubble say?

Mandy: I can read it. Just a minute. I think it's—how many more green frogs than brown toads?

Children: Oh, I can do that kind. Me too. I think it's eight. No, that's how many altogether. Here I'll show you. Watch.

Teacher: How about all of you working on this for a minute? How many green frogs do you need to put in your water? How many brown toads?

Theresa: I did it. I've got it. It's two more, see.

Harold: Me too! It's two.

Tommy: I've got five. See, one, two, three, four, five.

In prior themes, comparing problems may have caused plenty of consternation for some children, but over time more and more of them begin to make sense of these questions. Encourage children to share their thinking at the pocket chart.

Continue with three more of the easier picture problems, inviting students to share their ideas about what each picture problem is asking them to figure out as well as the varied ways of solving the different problems. Save two problems that seem more challenging for the next day. You'll notice below that we saved Picture Problems 3 and 6 for writing solutions and we share a class discussion as best we can remember it as we challenged our children to take the next step.

Day 5: Writing Solutions to Picture Problems

Each child will need...

- a chalkboard, chalk, and eraser

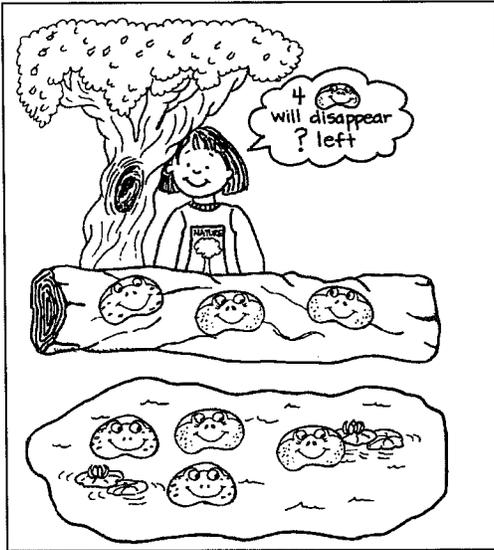
You will need...

- the two picture problems saved from the day before
- pocket chart, scenery, frogs, and toads

Now that your children have worked through some of the picture problems with the storyboards and beans and shared their solutions, urge them to record some of their strategies and solutions on chalkboards. Encourage them to use drawings and/or numbers to solve the problems. Even if someone calls out the answer, let them know that you're eager to see their strategies.

Teacher: Here's one of the picture problems we didn't get to yesterday. What do you think you have to figure out?

Children: How many are in there? No, I think it's how many eyes. But the bubble doesn't have a picture of eyes. I know, maybe some are going



away. What does the bubble say?

Teacher: Can someone read what it says?

Children: It's got a four and a frog. What are those words? That's a long word. I know, it says disappear.

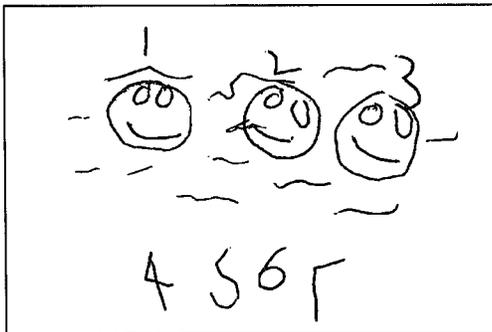
Teacher: You've got it. Four will disappear, perhaps they'll chase after some bugs. How many will be left?

Sonny: I know! Three.

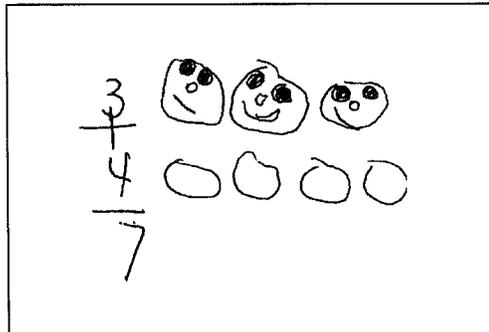
Children: Me too! It's three! Yeah, three.

Teacher: Suppose you were trying to help a friend from another class see how to figure that out. Can you use pictures, numbers, and even words to show how you'd explain it to your friend?

The sketches below are our reproductions of some of the strategies we commonly see on children's chalkboards.



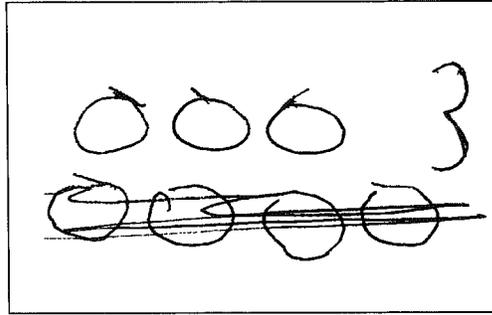
Joey



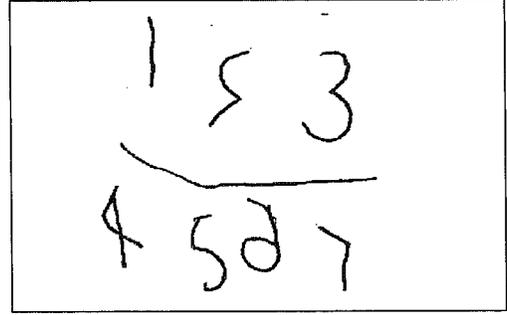
Mark

Joey pictures the remaining three frogs still on the log and, when asked to write some numbers, he goes back and numbers those three. Upon further encouragement to write more numbers, he adds the four, five six, and seven, though it is difficult for him to explain why. We suspect he's beginning to use some form of counting on as a strategy.

Mark first writes the vertical number sentence and when questioned about what that means, he agonizingly adds the drawings beside it. When he is asked why he wrote the three plus four, he says he just knows that three and four make seven. We find that as children begin to write number sentences, they often write the two parts that make up the whole in addition form.



Cindy



Sonny

Cindy draws three circles and then another group of four, which she crosses out. When asked to include some numbers, she writes the three. We can probably conclude that she understands that four of the seven have been somehow swept away leaving only the three.

Sonny has written the numerals one through seven. When asked how many frogs will be left, he quickly points to the numerals one through three. When asked if there is some way to help his friends understand his strategy, he underlines the first three numbers. When asked about the four, five, six, and seven, he says those are the frogs that went away. Sonny demonstrates an ability to recreate the whole as well as see the parts of the problem.

Day 6: Creating Story Problems

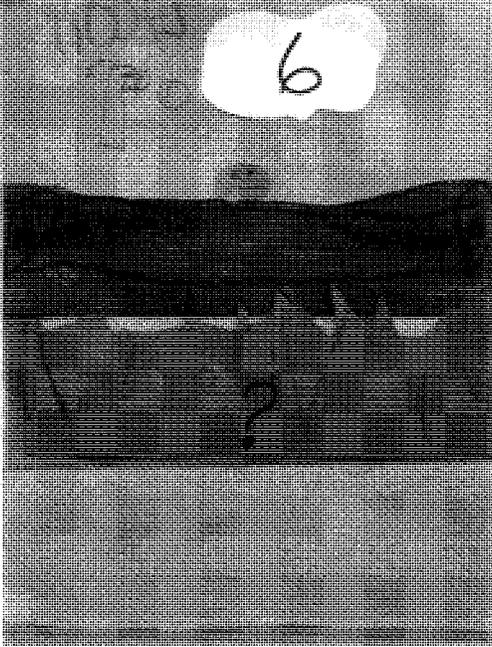
Each child will need...

- green and brown paper bean shapes, p.154
- his or her storyboard
- extra-fine Sanford Sharpies to share (away from the glue area)
- glue to share (Be sure to set this up in a separate area so children finish drawing before they get out the glue.)

You will need...

- all of your picture problems displayed in an easily seen area
- extra-fine Sanford Sharpie pens
- precut white bubbles (one per child)

Take a few minutes to review each of the Picture Problems the children have worked to solve and ask them to be thinking about which kind of problem each of them will pose for the class. As soon as it is evident that most of them know what they want to make, discuss the materials available and how and where to use pens and glue. Hand out their storyboards and ask them to get started. For the few who don't know where to begin, you may need to narrow the choices to two or three picture problems and ask them which



kind they'd most like to make for their classmates to figure out.

Circulate to provide encouragement and help as needed. Once the children have added the frogs to their storyboards, help them with their talking bubbles so the problems they are posing are as clear as possible. Save the finished problems for another day.

Day 7 & beyond: Solving Student Story Problems

Each child will need...

- a problem-solving sheet (see instructions below for preparation)
- a clipboard or individual chalkboard to provide a hard writing surface
- a pencil

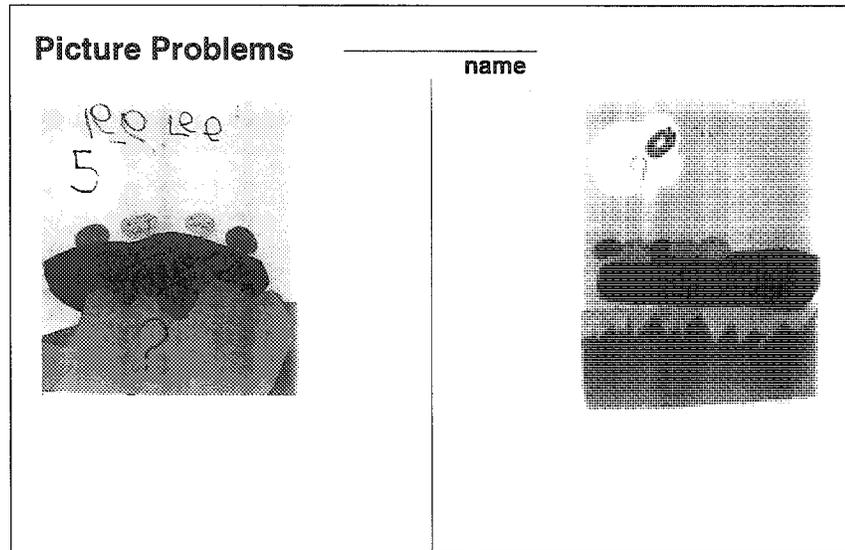
You will need...

- children's completed problems

Before you present students' problems to the class, go through the collection and select one of the simpler and one of the more complex problems for children to solve using drawings, numbers and/or words. Make a problem-solving sheet by running reduced copies of these two problems, cutting them out and gluing them to a full sheet of paper in a way that will leave working space (see following page for example).

These sheets take a little extra time to prepare but if you plan to keep student responses in portfolios, you'll find that you need some way of identifying the problems children were solving to make any sense of their work several months down the road.

To begin the lesson, share all of the children's problems, taking time to admire each and every one. Then present the first problem to be solved, asking that children show their thinking on their problem-solving sheets.

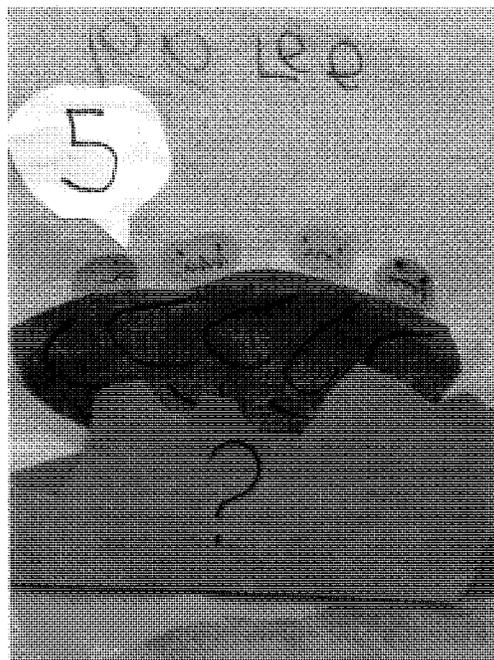


Teacher: Now that we've admired everyone's fine work, we're going to solve two of these very challenging problems.

Theresa: I hope it's mine.

Ashley: No, I want it to be mine.

Teacher: We'll try to solve everyone's problem over the next few days but today we'll only have time for two or perhaps three. Here's Lee's problem. You'll notice there's a miniature version of it on your problem-solving sheet. What do you think Lee wants us to figure out?



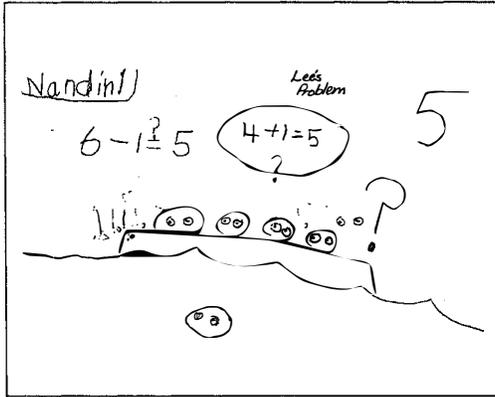
Children: There are some frogs on the log and there's a question mark on the water. Some are hiding. I've got it! One is under that water. Let's peek.

Teacher: Not so fast! We don't want to know *just* the answer. We want to see how you're figuring it out. Can you draw some pictures and write some numbers on your problem-solving sheet by Lee's problem so other children can see your strategies?

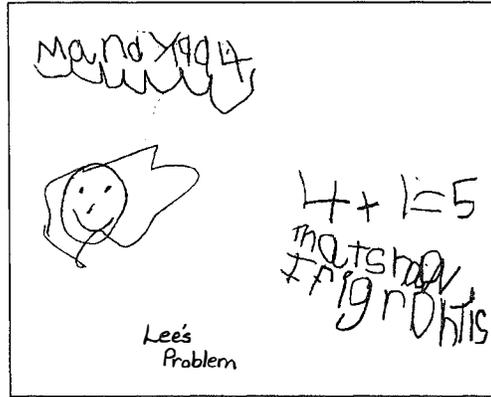
Circulate among the children as they work offering encouragement. If a few youngsters don't seem to know where to begin, try seating

them beside children who are working confidently.

In our classrooms, most of the students are able to put something on paper. Nearly everyone concludes there is one frog in the water but demonstrates a different strategy for solving the problem.



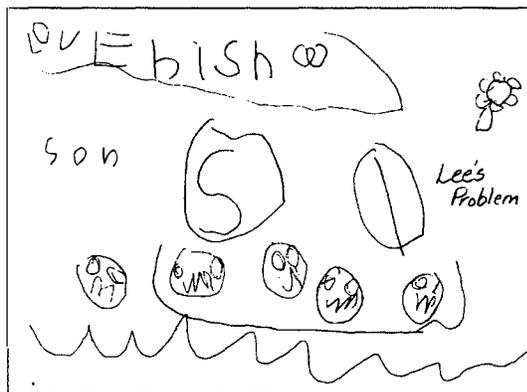
Nandini



Mandy

Nandini begins by writing the five. She then draws the four on the log and the one in the water. When asked if there are any other numbers she can write, she promptly writes the two number sentences above. Nandini is a very sophisticated kindergartner who handles number combinations with ease. We know that it will be important to challenge her with some harder problems in each theme.

Mandy begins with a drawing of the one frog in the water and then writes a number sentence ($4 + 1 = 5$) along with the statement, "That's how I figured this." She'll also need additional challenges in problem solving to keep her enthusiastic about learning mathematics.



Lovenisha

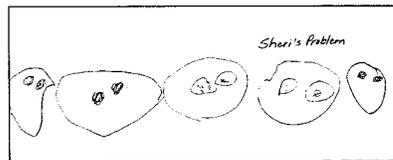
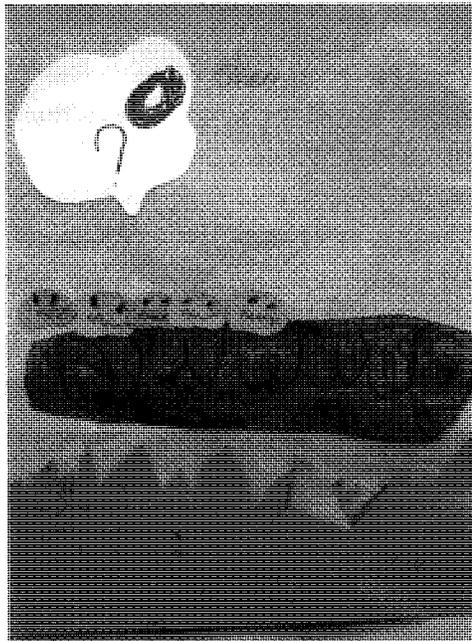
Lovenisha writes a five and a one. When asked to include some pictures (so we might better understand her thinking) she is able to picture the one and the four. We feel confident that she understands this problem and wonder if the numbers pose a bit of confusion for her at this time.



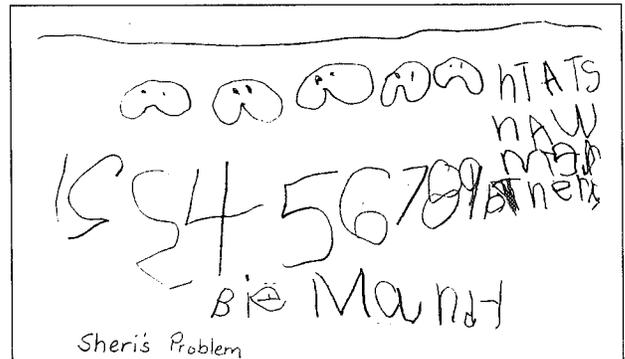
Stacy

Stacy also begins by writing a numeral. She's not very confident yet at writing numbers. Her picture shows the four frogs on the log and one down below, which makes it evident that she does understand that four and one more make five. Stacy will have plenty of opportunities to learn to write numerals, but her lack of proficiency shouldn't blind us to the fact that she understands many mathematical concepts.

Sheri poses a problem about eyes: *There are five frogs on the log. How many eyes?*



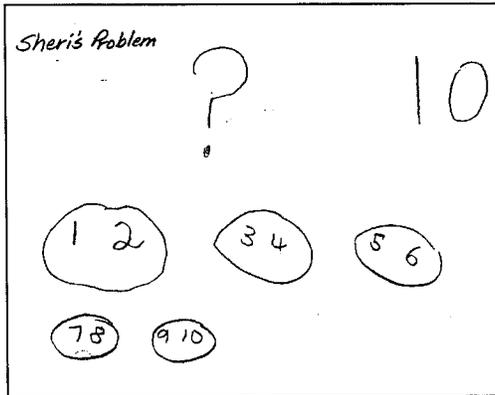
Stacy



Mandy

Stacy tackles Sheri's problem via drawings. Each circle includes two eyes. When asked to explain her work, she carefully points to each eye and counts to ten. She makes it clear she doesn't want to write numbers.

Mandy, on the other hand, draws out the five bean shapes, adds two eyes to each and then writes the numerals 1-10 along with, "That's how many there are."



Nandini

Nandini begins by writing the 10. She then tries writing a number sentence, $7 + 2$, but erases it and replaces it with a large question mark. Underneath that, she draws the bean shapes and adds numerals to each to show how many eyes there are on five frogs. We suspect that she knows the number sentence she tried to write was incorrect, and needed to draw a picture to be certain of the answer.

As you can see from the small sampling of children's work above, the range in most kindergarten classes is great. We believe that within nearly every good problem, there can be some level of success and challenge for every child. In problems like these, some children may "count on" to find the answer to Lee's problem. A few might simply draw five more under the water in response to the numeral five. Some will attempt number sentences in some form while others write a few words about their strategy. All in all, we learn more about children as we examine their written responses and talk with them about their work.

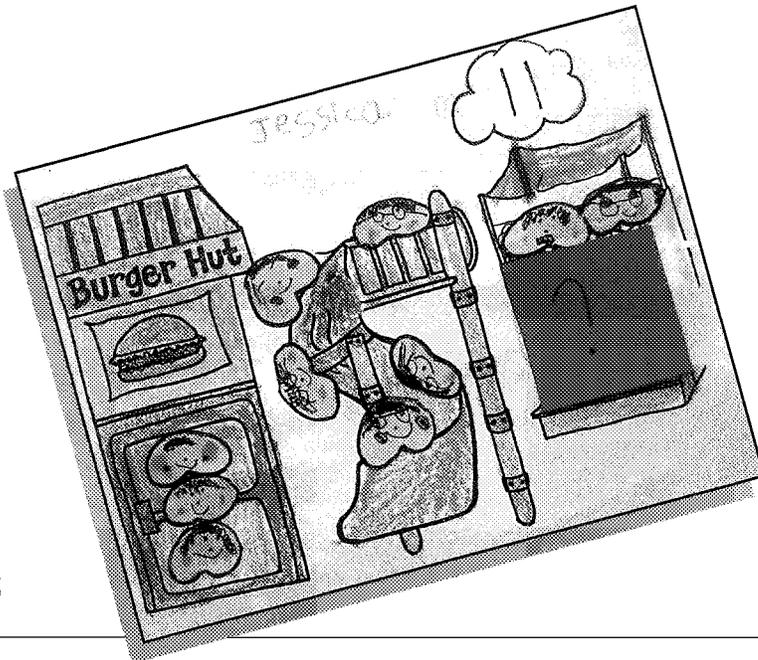
At the conclusion of this session, collect and date the children's written work and store it in their portfolios. Share the remaining problems over the next several weeks by working two or three a day at an oral level with your group. Once every problem has been shared, consider the following options:

- Post them all on a bulletin board in the classroom, out in the hall, or in the school office along with a sign to explain the work.
- Bind the problems into small books to be stored in your class library and enjoyed by the children throughout the remainder of the year.
- Save each child's problem in their portfolio. It can be interesting to have a longitudinal sample of the problems children have posed, as well as the problem they've tried to solve.
- Send the problems home.

NOTES



The Burger Hut



Theme 5

The Burger Hut

Talk to young children about their favorite eating places and invariably, they'll talk about McDonald's, Taco Bell, Burger King, Jack in the Box, or a favorite local fast foods or pizza place. The food won't be nearly so important as the toys that come with the kid meal or the play area the establishment provides. As children run to the slide, climb into the ball cage, or marvel at their lucky meal prizes, mathematical opportunities abound.

The baby sitter took seven children to the Burger Hut. Some of them ran straight to the play area. Two of the children went inside to help carry out the food. How many of the children were in the play area?

Grandpa bought lucky meals for his four grandchildren. They were so happy when they saw the prizes inside, their eyes sparkled with delight. How many sparkling eyes did Grandpa see?

After talking about students' favorite fast food places—their favorite play areas, plus the toys or prizes they get with their meals—we show them our Burger Hut storyboard and bean "kids" and ask them to prepare their own storyboards which will be used to enact and solve a variety of story problems, including counting, comparing, adding, subtracting, figuring out missing addends and subtrahends, grouping, and partitioning. As the theme progresses, children share their problem-solving strategies orally and in writing. Finally, they create their own story problems to share and solve with

classmates. The entire theme takes about seven days and is still another step in a year-long series of encounters with story problems.

HOW IT WORKED FOR US

Because the previous theme had produced some new problem-solving strategies, we were interested to see where Burger Hut would lead. In Frogs and Toads we had seen a move from straight one-by-one counting to an increase in counting by twos, counting on and forms of grouping: *I just knew that three and three were six so three were on the log and three had to be in the water. Each frog has two eyes and so you just count one frog for these eyes and one frog for these eyes.* We had even seen a little growth in solving comparing problems: *This brown one has a green friend, this brown one has a green friend and these two brown ones don't have any friends.*

To begin Burger Hut, we presented the artist-drawn boards and children eagerly colored them while telling a friend or the teacher about their last trip to a favorite burger place and the toys they got in the kid meal or just how fast the slide was. A few were even talking about the kinds of problems they would pose.

Children solved many of our problems with more confidence and their verbal explanations, though sometimes fragmentary, were more diverse than before. We found ourselves clarifying students' strategies in hopes of helping other children see new possibilities. Their written responses also began to show some different kinds of number work. Instead of the frequent counting by ones we had seen earlier, children drew pairs of eyes and labeled them with twos or wrote an answer and then drew pictures to demonstrate how they figured things out. Some tried to write full number sentences, while others put down numbers to match the groups but didn't include any process signs.

On the day we challenged them to pose their own problems, they paid great attention to our picture problem display and some confidently announced that they were going to make their problems harder than ours as, indeed, they did. The pride students felt when it was their problems the class would try to solve was extraordinary.

Day 1: Making the Storyboards

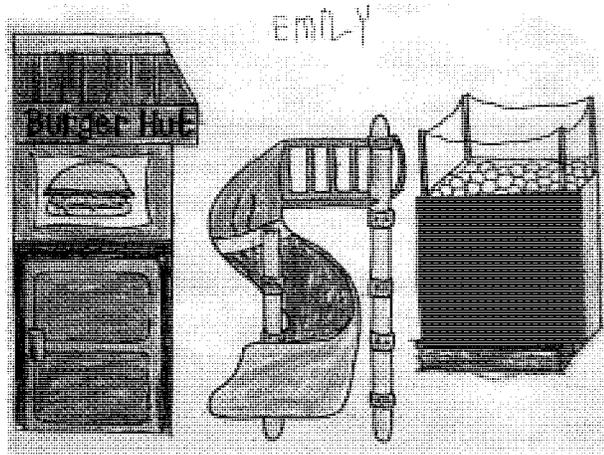
Each child will need...

- a copy of the Burger Hut storyboard with a construction paper door taped over the ball cage so it can open and close (see Blacklines)
- crayons and/or water-based felt tip marking pens

You will need...

- lima bean kids, p. 147
- a colored Burger Hut storyboard with a paper door taped over the ball cage (see Blacklines)

Show students your Burger Hut storyboard and your bean "kids" and give them a chance to handle a few of the beans. Explain that today, each of them will color a copy of the storyboard to use in solving many problems and ultimately, for creating their own picture problem for their classmates to solve. Discuss the art supplies they'll be able to use and send them out to do their finest coloring.



Days 2 & 3: Solving Spoken Story Problems

Each child will need...

- his or her colored storyboard
- 10 lima bean kids

You will need...

- a pocket chart
- pocket chart burger hut and ball cage with taped doors and slide (see Blacklines)
- 10 kids in a variety of skin colors for pocket chart (see Blacklines)

On Days 2 and 3, spend twenty to twenty-five minutes telling some of the story problems featured below. Ask children to solve each of the problems with their bean kids and storyboards. As they solve the more challenging

problems, call on them to come to the pocket chart and explain their thinking as best they can. Try to respond to explanations in a way that will encourage several children to volunteer their strategies for solving the problem. Once an explanation has been given, ask if anyone has a different strategy, or even a different answer. If you're willing to call on all volunteers, you'll find that most of your students' ideas are logical, even if incorrect, and that learning can sometimes be enhanced by examining mistakes.

Kindergartners frequently don't realize they have solved a problem in the same way as another child so you'll often see duplication of explanations but that's okay—the goal is to provide an exploratory environment that encourages students to take mathematical risks, share their thinking, and demonstrate numerous ways to tackle challenging problems.

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Comparing

- There were five kids going down the slide and three kids peeking out from under all the balls. Were there more kids on the slide or in the ball cage? How many more?

Teacher: Check to see if the children next to you have put five kids on the slide and three at the top of the ball cage.

Danny: A.J. didn't have it right on the ball cage, but I helped him fix it.

Children: I helped Marty. I got it right. It's eight kids. One, two, three, four, five—one, two, three.

Teacher: You're already trying to figure out what the problem is. I hear some counting and I think I even heard someone say they think eight kids are in the play area.

Children: That's what I've got. Me too. One, two, three, four, five, six, seven, eight. Three and five! This kid fell off.

Teacher: It sounds as if most of you believe eight children are on the playground, but I'd like you to figure out whether there are more kids on the slide or more in the ball cage.

Children: There are more on the slide! There are just three bouncing in the ball place.

Teacher: How many more children are on the slide than in the ball cage?

Sarah: Five, it's five. See!

Benjamin: One, two, three, four, five. One, two, three.

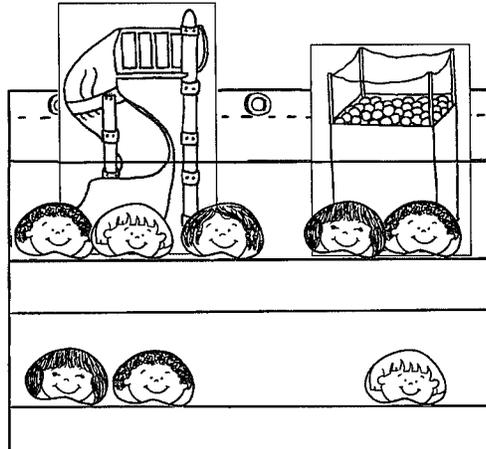
Katelyn: I think it's two.

Children: It's two. No, it's five. Eight? What do you mean?

Teacher: Would someone come up to the pocket chart and show us what you think?

Tracy: I will. I put five by the slide and three by the ball cage.

Teacher: You've set that up very well. Which has more kids?



Tracy: There are more here (on the slide.)

Teacher: How many more?

Tracy: Five?

Jeffrey: That's what I did. It takes more room for the kids on the slide so it's more.

Teacher: It does look that way. Is there any way to figure out *how many more* are on the slide than in the ball cage?

Mandy: Look! I go one, two, three, up here on the slide. Then—one, two three, over here and see there are two more.

Taylor: That's what I'm thinking about. There's not *four, five*, in the ball cage, just on the slide.

Ashley: I could do it. This one has a friend (moving one from the ball cage up to match a child on the slide), this one has a friend, this one has a friend, and these two don't have a friend.

Teacher: Ashley, Taylor, and Mandy think there are two more on the slide, Do you agree?

Children: I do. Me too. I think it's two. I did it like Ashley. Ashley's my friend. I think it's five—one, two, three, four, five. No, that's how many on the slide. That's not how many more. See, it's two more. I got eight. I don't know what you mean.

Not all children are able to see beyond their own tactics to get into someone else's thinking. Others don't express an opinion at all. Many young children need lots of teacher and peer modeling before they're able to talk about their own thinking. Even though the problem above isn't accessible to every student, they are all learning about mathematics at some level. While a few are able to find solutions to the entire question, others may be counting each group accurately, figuring out the sum of the two groups, or contemplating the fact that five is more than three. If you continue to pose challenging problems to children, there will be some degree of success and understanding for every youngster. As time passes, you will see a ripple effect as children utilize one another's strategies in new settings.

How Many Altogether?

- The children had finished eating their lucky meals and headed to the playground. Five climbed into the ball cage and four started up the slide. How many children were in the play area?
 - One child went inside the Burger Hut to order some french fries. Two were playing on the slide and three were in the ball cage. How many children were at the Burger Hut altogether?
-

How Many Are Left?

- Five youngsters went into the Burger Hut to figure out what they wanted to eat. Two came out and climbed into the ball cage. How many are still inside the Burger Hut?
-

Missing Addend / Missing Subtrahend

- Five youngsters were playing in the play area. One of the dads called for his kids to come inside and eat. Only three were left on the play area. How many went inside to eat?
 - Seven of the neighborhood kids went to the Burger Hut for lunch. Four ran to play on the playground and the others went inside to order. How many children went inside?
-

Grouping / Partitioning

- Mom noticed six delighted eyes when her children opened their lucky meals and found their special prizes. How many children did Mom take to lunch?
- The slide was SO slippery that four children had to shut their eyes as they went down together. How many eyes were shut?

Day 4: Solving Picture Problems

Each child will need...

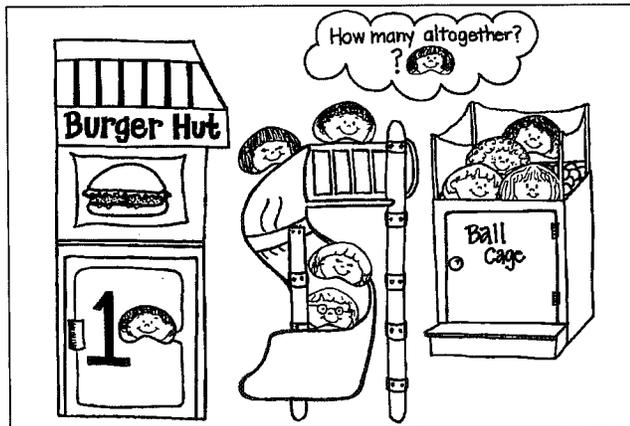
- his or her Burger Hut storyboard
- 10 Burger Hut Kids

You will need...

- Burger Hut picture problems (see Blacklines)
- a pocket chart
- pocket chart kids and scenery

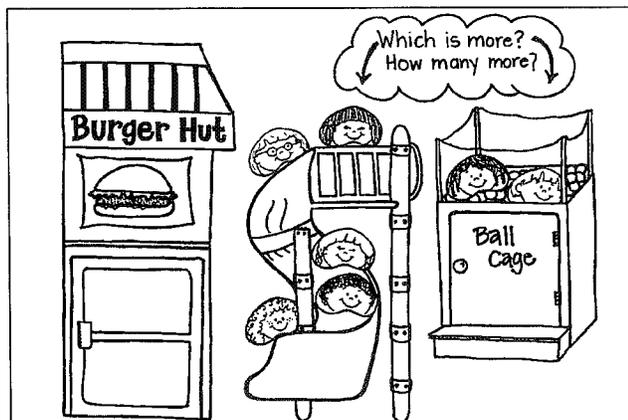
THE BURGER HUT PICTURE PROBLEMS

Picture Problem 1



One thoughtful child is waiting by the Burger Hut doors to help carry out the food. Four grinning kids are playing in the ball cage and four cheerful kids are taking turns on the slide. How many kids are visiting the Burger Hut altogether?

Picture Problem 2



There are five silly kids playing on the slide. Two bouncing kids are playing in the ball cage. Which play area has more children? How many more?

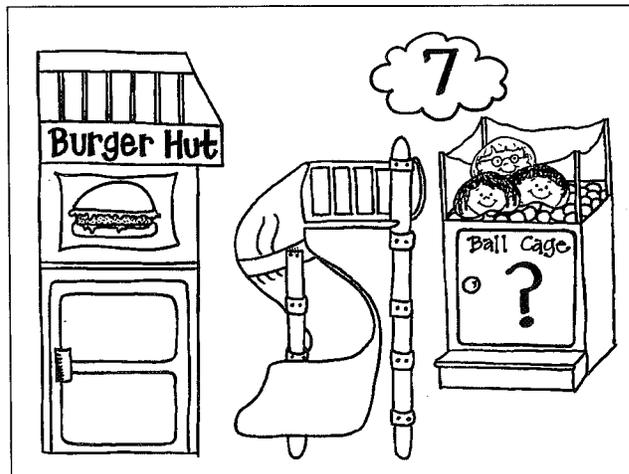
THE BURGER HUT PICTURE PROBLEMS (CONT.)

Picture Problem 3



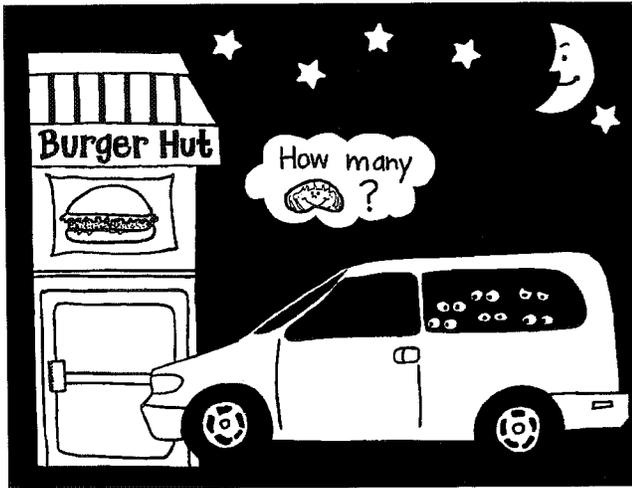
There are six happy kids by the doors of the Burger Hut. Three of them have to go home. How many children will be left?

Picture Problem 4



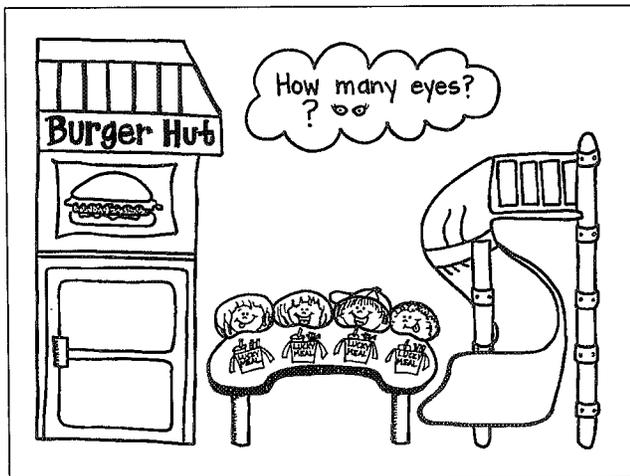
Seven kids are playing in the play area of the Burger Hut. Oh dear, some must be under the balls. How many are hiding?

Picture
Problem 5



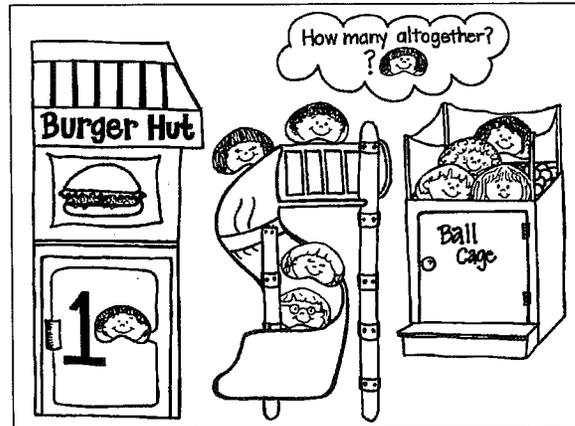
There are twelve beaming eyes looking for their dads who will bring them food from the Burger Hut. How many hungry kids are in the van?

Picture
Problem 6



Four happy kids are gazing at their lucky meals. They can hardly wait to see the prizes inside their boxes. How many eyes are waiting for a peek?

Now that children have worked to solve spoken story problems, show them the picture problems you've prepared. These models involve problems similar to those already posed, but they deliver the information in visual form.



Teacher: I have some Burger Hut picture problems for you to solve today. Here's the first one. What do you notice?

Children: There's some kids on the slide. And some more in the ball cage. There's a kid by the door. And there's a question mark and a kid on that white thing, the bubble, and it has some letters.

Anna: I know what it means. You have to count all of them.

Children: That's easy. There are four in the ball cage and four on the slide. It's one, two, three, four, five, six, seven, eight.

Teacher: Does everyone agree?

Neal: Oh, we forgot the kid by the door. It's nine!

Children: Seven? Nine? Ten? One, two, three, four, five, six, seven, eight, nine. It's nine! I counted. Me too. I know.

Teacher: You're all working hard. Many of you have counted from one to nine. Did someone have a different way of figuring it out?

Anna: I did. I could see four on the slide and then I went five, six, seven, eight, and one more behind the door, and I got nine. (Anna uses her fingers to show her thinking.)

Neal: I already knew there were eight on the play stuff and eight and one more is nine.

Kristjiana: I know five and five are ten, so it's nine.

Teacher: But what made you think of five and five?

Kristjiana: I just know it.

Teacher: But how did you get five and five from this picture problem?

Kristjiana: I saw four and four but then I thought about one more in the door and that was five—five and five make ten.

Teacher: But you said it was nine kids altogether. What did you think about to get to the nine?

Kristjiana: There are only four on the slide so I had to take one away.

Kristjiana is one of those mathematically talented children, several of whom often appear in heterogeneously grouped kindergarten classes. While many children won't be able to conceptualize what she's saying at this time, it's important to acknowledge her methods. As children like Kristjiana share their thinking, we depict their strategies with the pocket chart kids or in some other way, so other students may begin to consider new ideas.

Continue posing a few more picture problems and invite children to share their solutions and even their frustrations. A few may use mental strategies, often in combination with their fingers, while others will use their beans and storyboards. Some may opt to get out Unifix cubes or other math manipulatives. You'll probably lose the attention of some children from time to time, but try to teach at a challenging level and trust that the joy and understanding many students bring to their work will be contagious and draw back those who temporarily drift away.

Day 5: Writing Solutions to Picture Problems

Each child will need...

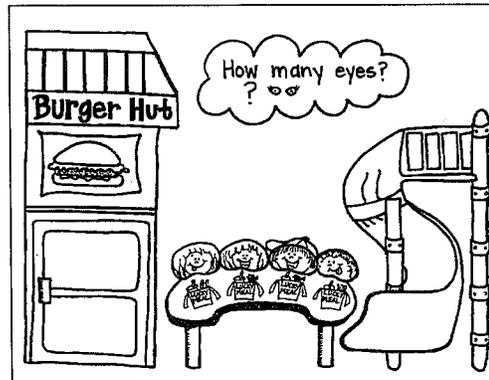
- a chalkboard, chalk and eraser

You will need...

- Burger Hut picture problems

On Day 4, the children worked through some of the picture problems with their storyboards and counters and shared a variety of ways to solve them. Today, you can encourage students to share their strategies and solutions to one or two of the picture problems on their chalkboards. Choose a picture problem that you haven't already shown, or one that was particularly interesting to the students yesterday. Ask children to make drawings and numbers or even words on their chalkboards to show how they're working on the problem. Though several children will quite likely call out the answer, let them know that you're very interested in seeing each person's thinking. As a few children begin drawing or writing numbers, you may need to hold up work samples to help reluctant workers find a way to begin. Some may still need to copy a nearby friend, while a few may just draw or write numbers

without much purpose at first. Don't despair. The joy for this stage of problem solving is always infectious. With each new theme, student confidence increases and over time, every child begins to find strategies that work.



Teacher: What do you notice?

Children: The kids each have a box. They're all smiling. Yeah, four kids. They must be finding the prizes. I got a prize last time. There's a bubble with a question mark. And an eye. Do we have to figure out how many eyes? Easy. I can count them. It's eight. But I only see four kids, there aren't eight kids.

Teacher: I'd like to see how each person is solving this problem. Can you draw some pictures and write some numbers on your chalkboard so we can see how you're figuring it out? Some of you might even want to write some words about your thinking.

Anna: I can! I'm going to draw four kids and then count their eyes.

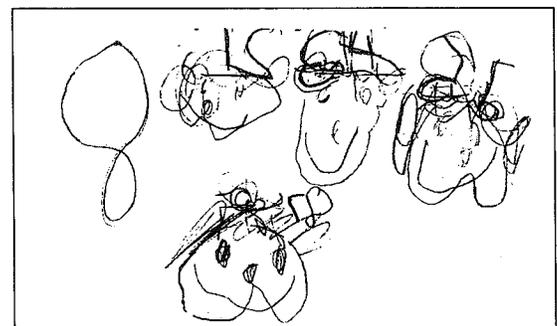
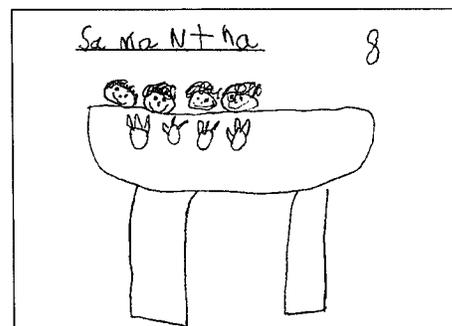
Neal: I'm just going to write an eight.

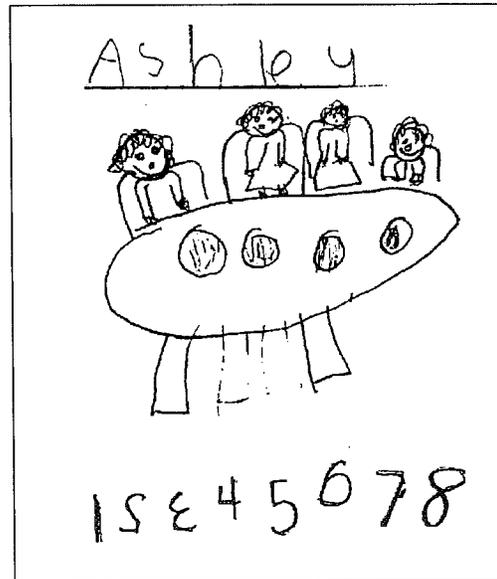
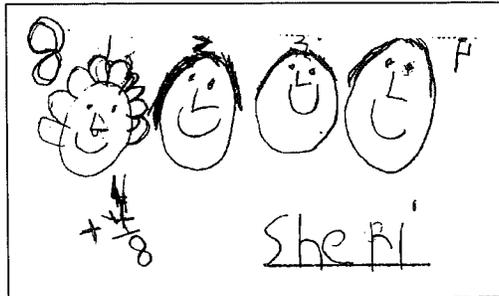
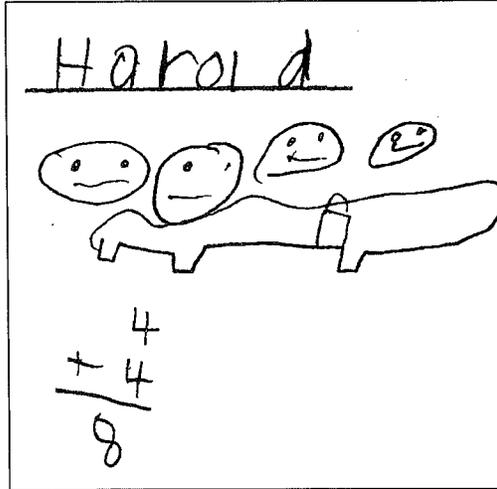
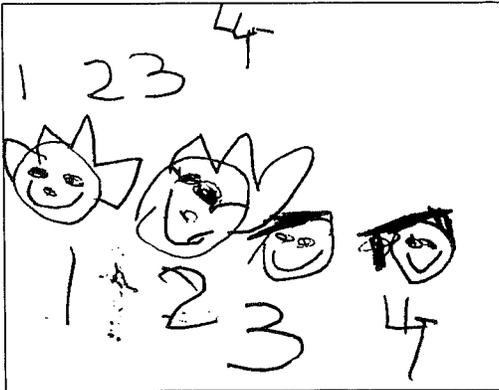
Teacher: We want to see how you figured it out. Can you find a way to show us on your chalkboard?

Neal: I counted the eyes. Maybe I could just write eight eyes.

Kristjiana: I counted by twos. I'm going to show everyone.

Harold: I'm putting two fours.





Once several children have finished, have them share their solutions. Though it isn't easy for kindergartners to explain what they've written, we try to draw out some kind of oral explanation to support their drawings and numbers. This sharing proves quite worthwhile over time.

Day 6: Creating Story Problems

Each child will need...

- his or her own storyboard
- construction paper beans shapes in a variety of skin tones
- crayons and/or water-based felt tip pens if they plan to create a car storyboard
- access to fine tip Sharpie pens (keep separate from the glue)
- glue

You will need...

- the Burger Hut picture problems
- precut talking bubbles for children to add to their picture problems to pose the question
- a Sanford Sharpie pen so children can add question marks, etc., to their bubbles
- a few blank copies of the car storyboard and car flap for children who want to make a problem about eyes and kids at night (see Blacklines)
- scotch tape and glue

Take a few minutes to review each of the Picture Problems the children have worked to solve and ask them to be thinking about which kind of problem each of them would like to pose for the class to solve. Some children may want to make problems involving the car so they will need a car storyboard on which to work. Remind them about glue and pens. It is usually evident who will need guidance and support to get started. Circulate to help wherever needed and encourage children to help one another. As children finish, have them show their problems to you so you can help them figure out whether they are ready for their bubbles. Help each child write on the bubble and add a question mark to a secret door if needed. Finally, have children set their problems in a safe area to dry.

Day 7 & beyond: Solving Student Picture Problems

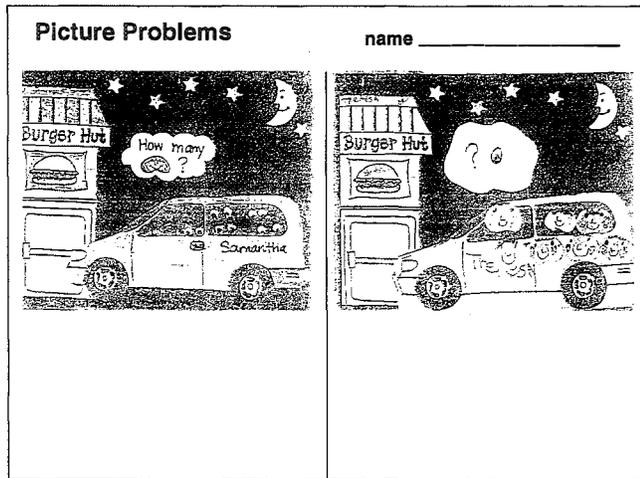
Each child will need...

- a problem-solving sheet (See instructions below for preparation.)
- paper and pencil and a hard writing surface (such as the backside of an individual chalkboard or clipboard)

You will need...

- children's completed picture problems
- the Burger Hut bean kids nearby along with a few extra storyboards in case some children want to use them
- Unifix cubes nearby

Before you present students' picture problems to the class, go through the collection and select two or three of the most interesting or challenging examples for children to solve in writing. Make the problem-solving sheets by reducing each chosen problem on your copy machine and leaving space for student responses. Then run enough copies for your entire class.



These sheets take a bit of time to prepare, but if you plan to keep student responses in portfolios, you'll find that you need some way of identifying the problems they were solving in order to make sense of their work later. These sheets are also helpful in discussing student work and problem solving strategies with parents as you conference.

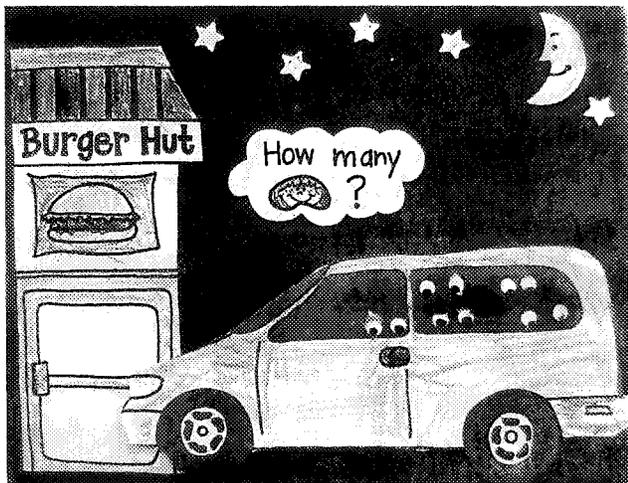
Begin the lesson by sharing every problem and taking time to admire each one. Then present the first problem to be solved, and ask children to show their thinking on their problem-solving sheets. Remind them that you're interested in strategies as well as answers.

Teacher: Now that we've seen everyone's beautiful work, we're going to solve two of your problems.

Jonathan: I hope we do mine.

Lee: Me too.

Jennifer: Are you going to do mine?



Teacher: We'll try to solve everyone's problem eventually, but today we'll probably only have time for two. Here's Samantha's problem. You'll notice there's a miniature version of it on your problem-solving sheet. What do you think she wants us to figure out?

Children: There are some eyes in the car. And there's a kid and a question mark in the bubble. I know. Those are kids in the car. She wants to know how many kids. One, two, three, four, five, six, seven, eight, nine, ten. It's ten kids. No, it's five kids. Maybe it's nine or eight.

Teacher: You're thinking very hard about Samantha's problem. Can you show me how you're figuring it out on your paper? You can write in the blank space right under her problem.

Andy: I don't know what you mean.

Lovenisha: Me either.

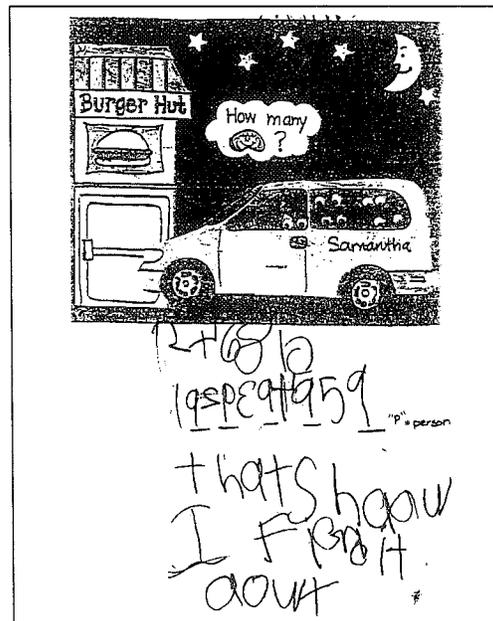
Teacher: Remember how you shared your thinking on chalkboards yesterday? Can you figure out how many children are in the car?

Lee: Can I get some beans?

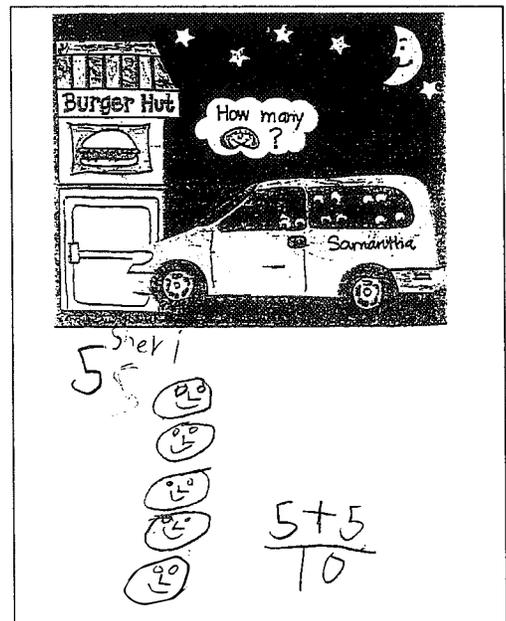
Mandy: I'm going to use Unifix cubes. I'll put two together for each kid.

Teacher: That would be fine. You may use whatever you think would help you figure it out. Just be sure to show how you did it with drawings and numbers or even words when you write it down.

Nearly everyone concludes that there are five kids in the car but several different strategies are used in solving the problem.



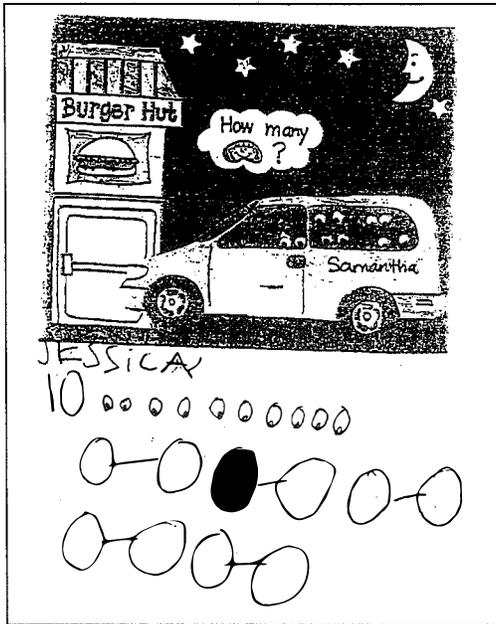
Mandy



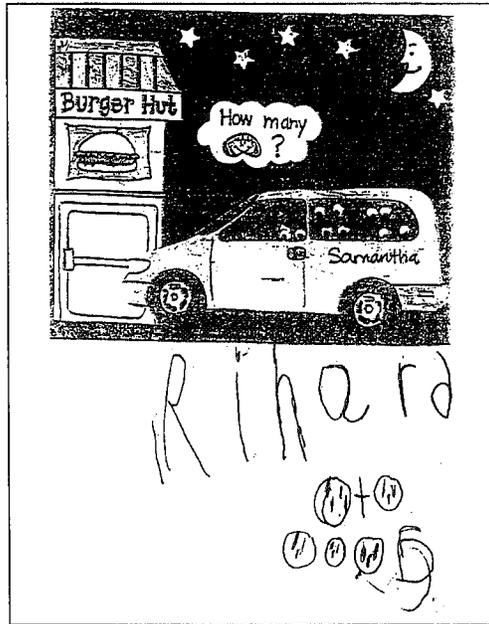
Sheri

Mandy counts by twos and then writes (though without spaces in between) 1P, 2P, 3P, 4P, 5P. Though at first glance the P seems to be a nine, Mandy explains that her two represents one person, the four is for two people, etc. She finishes with the declaration, "That's how I figured it out."

Sheri writes only the answer at first but, when asked to show how she has arrived at that answer, she draws five faces, each with two eyes. To conclude her work, she indicates with a number sentence that five eyes plus five more eyes make ten.



Jessica

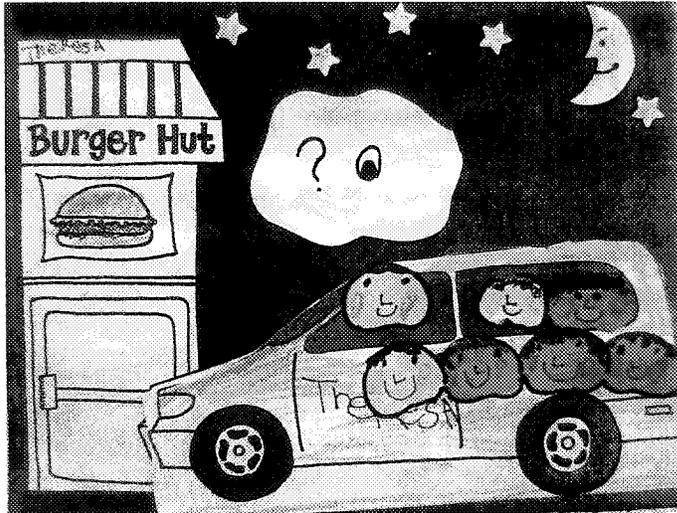


Richard

Jessica begins by writing the numeral 10 for the eyes and carefully drawing each eye. Then she represents the eyes with circles and draws connecting lines to indicate each pair of eyes stands for one child. Jessica's primary language is Korean so her verbal communication is limited at this time, but her written solutions make it very clear that she understands and is able to solve Samantha's problem.

Richard solves the problem by drawing faces. He inserts a plus in the top row and wraps it up with a five to indicate the total number of kids in the car.

Teacher: It's exciting to see how many different ways you have to solve problems. Here's the problem Theresa posed. What do you notice here?

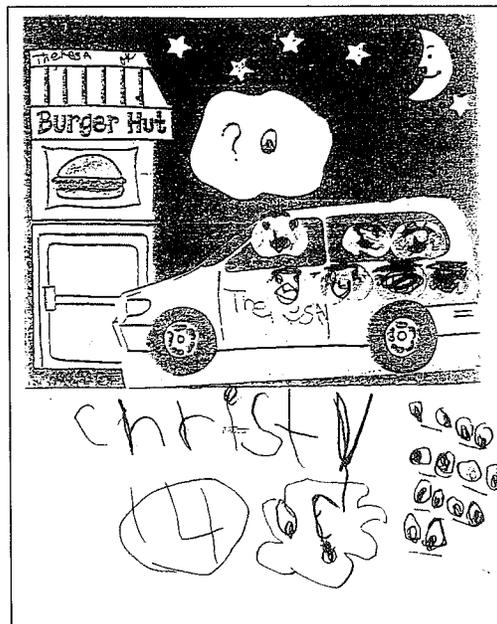


Children: Hers has a car too. It's about eyes—see the eyeball? There are lots of kids in the car. Yeah—one, two, three, four, five, six, seven.

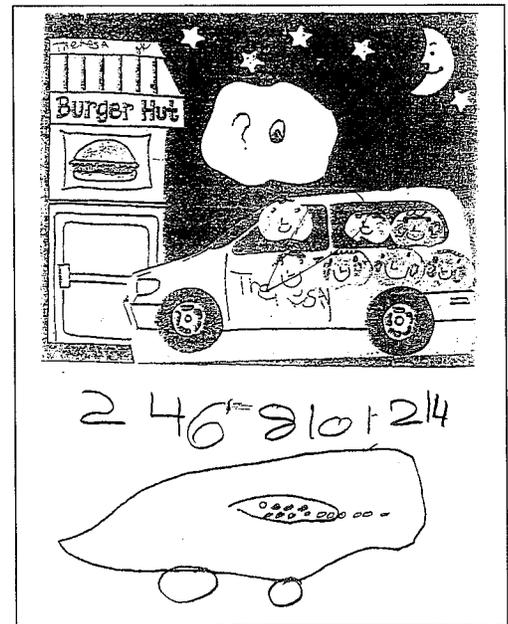
Teacher: Theresa, can you tell the children what it is you'd like them to solve?

Theresa: How many eyes. How many eyes in the car?

Again, many of the children are able to respond to this problem in some form.



Christy

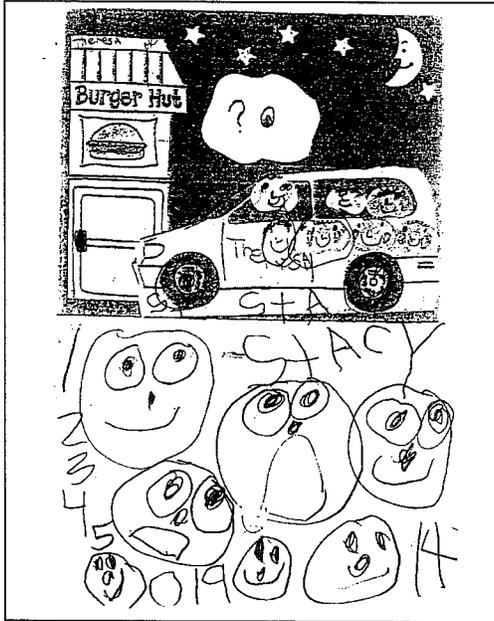


Harold

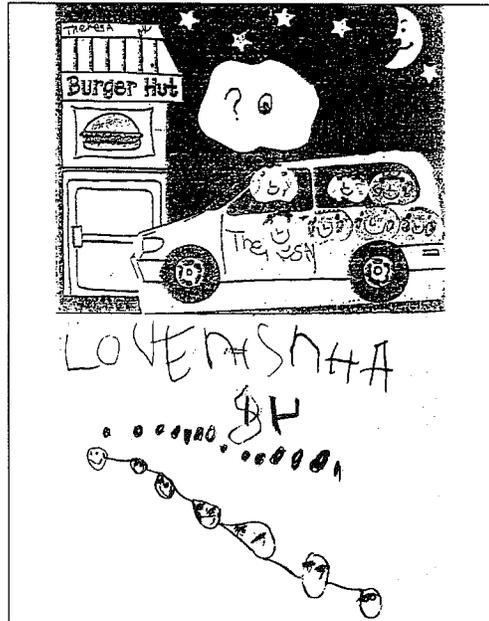
Christy solves the new problem by writing the fourteen she's heard. When questioned about how she has come up with the fourteen, she duplicates the problem bubble. With further encouragement she draws the eyes and adds

the lines underneath to demonstrate how each pair of eyes belongs to one kid and grins all over as she shares her work with a friend.

Harold counts by twos to solve this problem. When questioned about how he knows that counting by twos will work, he doesn't say a word but instead goes back and draws fourteen tiny eyes on a van. He hands over his finished work with a giant smile.



Stacy



Lovenisha

Stacy assuredly draws all the faces complete with eyes. When encouraged to write some numbers to go with her drawings, she begins the task with great determination. Though her understanding of the problem is clearly demonstrated in her drawings and oral counting to fourteen, writing the numerals to 14 without assistance is a bit too difficult.

Lovenisha begins by boldly writing an eight. When asked if she can show how she figured it out, she goes away to draw some eyes, discovers her own error and erases the eight replacing it with a fourteen. She then draws faces with connecting lines to demonstrate that each face has two eyes.

Circulate as children work offering encouragement as needed. If a few youngsters don't seem to know where to begin, try seating them beside classmates who are working with confidence. At the conclusion of this session, collect and date the children's written work and store it in their portfolios. You may want to save four or five diverse approaches to copy and enlarge to display along with the original problems. This will be great P.R. for all the challenging work your students have been doing.

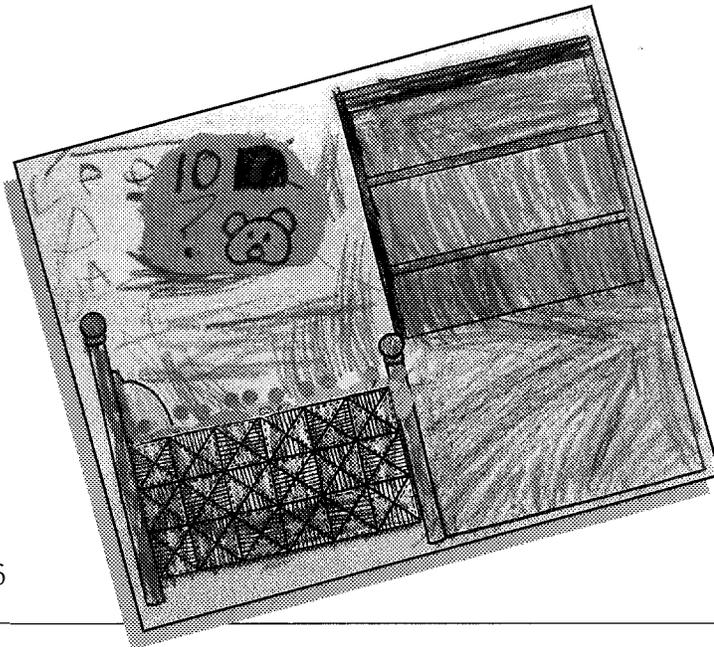
Share the remaining problems over the next couple of days. Encourage children to solve some of the easier ones mentally. Some may want to demonstrate their solutions with the pocket chart kids or with drawings and

numbers on the chalkboard or at the easel. Once every problem has been shared, consider the following options:

- Display all of the problems on a bulletin board in the classroom, out in the hall, or in the school office along with a sign to explain the work.
- Bind the problems into small books to be stored in your class library and enjoyed by the children throughout the remainder of the year.
- Save each child's problem in his or her portfolio. It can be interesting to have a longitudinal sample of the problems children have posed, as well as the problems they've tried to solve.
- Send the problems home.



Rainbow Bears



Theme 6

Rainbow Bears

It is said that it all began with President Theodore Roosevelt, teddy bears, that is. Whatever the case, teddy bears have been loved by children of all ages for scores of years. In many of the kindergarten classes we know of around the country, a Teddy Bears' Picnic has become an annual spring tradition and the math and literature opportunities surrounding this event have been powerfully engaging. It seems natural, therefore, to have teddy bears serve as the final theme for a new round of story problems. We count on the likelihood that there is a teddy bear in nearly every child's life and that relating to teddy bears' antics will be intriguing to most of our students.

There were five yellow bears on the bed and four green bears on the shelf.
How many bears were in the room altogether?

There were four bears on the top shelf and half that many on the second shelf. How many bears were on the second shelf?

Six fuzzy ears were sticking out from under the quilt. How many bears were hiding under the quilt?

This theme provides new challenges for children to count and compare, to figure out how many altogether and how many will be left, to solve for missing addends and subtrahends, and to group and partition. As the theme

progresses, you'll find that many of your children will be more eager to share their problem-solving strategies than they were earlier in the year. Some of them may even begin planning their own story problems as they work on solving yours.

After encouraging children to share their bears from home, we show them our Rainbow Bear beans and have them prepare their own storyboards to use in solving a variety of teddy bear problems. Ultimately, they create their own story problems to share and solve with classmates. The entire theme takes about seven days and is the last step in a year-long series of encounters with story problems.

HOW IT WORKED FOR US

We worked on Rainbow Bears in our own classrooms in mid-May and as we began to examine student work folders in preparation for writing year-end reports, we marveled at what had happened over the year. *Every* student demonstrated some kind of growth. A few had simply become more confident at counting as well as reading and writing numerals. Others had begun to develop creative methods for comparing quantities. The question, "How many more?", which had seemed so unattainable earlier was becoming more understandable. Some children were beginning to "count on" to solve addition and grouping problems. (*"Four on the shelf, five, six, seven, eight, nine altogether when you count those on the bed."* *"Five bears—how many ears? Okay—you go five, then six, seven, eight, nine, ten!"*)

We also saw indications that some children were developing an affinity for "friendly" numbers; beginning to think in "chunks" rather than always counting one by one to solve problems. (*"I just know that three plus three makes six."* *"Well, two and two is four so it just has to be five—I don't know, it just popped into my brain because I know about that".*) We could see that more than half of our children were attempting to write number sentences of one sort or another to accompany their drawings or to support the answers they had noted on their papers as a problem was first posed. Some were using notation they'd learned from brothers or sisters at home or from other children in class. Others invented their own. A few were also attempting to explain their thinking in invented spelling. Taking a serious look at these collections of work gave us the courage to begin modeling a bit more standard mathematical notation in response to the children's spontaneous efforts. Some youngsters comfortably connected with our models while others weren't yet ready for that step. Nevertheless, we were pleased with the growth and engagement all our students showed in their work with the Rainbow Bears theme.

Day 1: Making the Storyboards

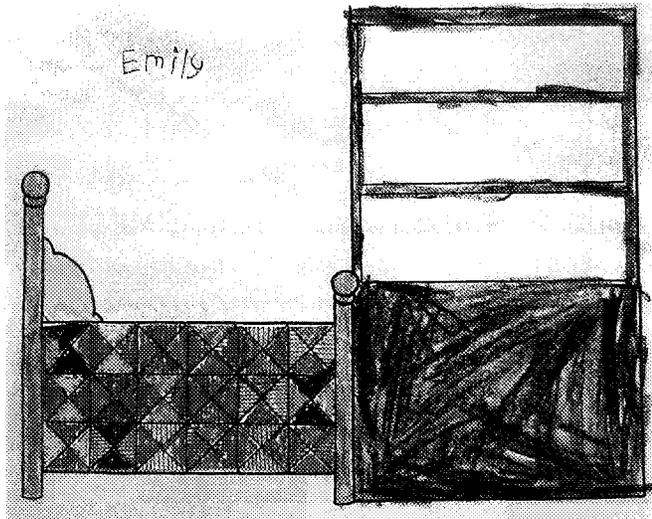
Each child will need...

- a copy of the Rainbow Bears storyboard (see Blacklines)
- a Rainbow Bears quilt flap to color and attach to the bed (see Blacklines)
- crayons and/or water-based felt tip marking pens
- scissors

You will need...

- lima bean rainbow bears, p. 147
- a colored Rainbow Bears storyboard complete with taped quilt flap
- scotch tape

Show your students the Rainbow Bears storyboard and your bean "bears" and give them a chance to handle a few of the beans. Explain that today each of them will color a copy of the storyboard to use in solving many problems and ultimately, to create a picture problem for their classmates to solve. Discuss the art supplies they'll be able to use and send them out to do their finest coloring on the boards as well as on the extra quilt which will become the flap. Once everything is colored, help them tape the quilt flap in place.



Day 2 & 3: Solving Spoken Story Problems

Each child will need...

- his or her colored storyboard
- 12 rainbow bears, 4 of each color

You will need...

- a pocket chart
- your pocket chart, rainbow bears, and scenery (see Blacklines)

On Days 2 and 3, spend twenty to twenty-five minutes telling some of the story problems featured below. Ask children to solve each of the problems with their bean bears and storyboards and call on them to explain their thinking at the pocket chart. Encourage several children to volunteer their strategies for solving each problem. Once an explanation has been given, ask if anyone figured it out a different way. Don't hesitate to call on children who seem to have incorrect solutions—sometimes the logic behind their answers will prove instructive to the rest of the group.

Comparing

- There were five bears on the top shelf and three on the second shelf. Which shelf held more bears? How many more?

How Many Altogether?

- Dad went into the bedroom to wake up his little girl to get ready for kindergarten. He noticed there were four bears on the top of her bed and three more that had fallen off onto the floor. How many bears must have slept with the small child the night before?
- There were three yellow bears on the top shelf, two pink bears on the second shelf and four green bears on the third shelf. How many bears were on the shelves altogether?

How Many Are Left?

- There were seven bears on the quilt which made it too crowded for the little boy to get into bed. He decided he would put four of them back on the shelf. How many would still be on the bed?

Teacher: This is an interesting problem. What will you have to do to solve it?

Sarah: Put four on the shelf.

Nicole: No, put seven on the bed first. Then move four of them to the shelf.

Zach: I put seven on the bed and four on the shelf. One, two, three, four, five, six, seven, eight, nine, ten, eleven!

Teacher: You have all kinds of ideas about how to approach this problem. What if we get some of the teddy bears from the play corner and try acting it out just like in real life?

Carl: I'll get the bears!

(There are occasions when larger props and real life action seem to help young children come to grips with a problem. After gathering the bears and listening to the story again, this group decides that they need to start by placing seven bears on the bed and then moving some of them to the shelf. Then the action returns to their storyboards.)

Teacher: Check to see if everyone beside you has set seven bears on the bed.

Children: How many bears did you say the boy put back?

Teacher: He decided he would put four of them back on the shelf. He needed some room to sleep.

Children: One, two, three, four. Three! I've got four here and three here. Me too. One, two, three. One, two, three, four.

Teacher: Once we decided how to start, that problem seemed pretty easy. Does anyone know how older children use numbers to write a problem like that?

Since some of our students have made attempts to write number sentences in prior problem-solving situations, we decide to take a few moments to examine standard notation. While not all of the children are attentive, many are quite interested. It's always a dilemma to know how much notation to show them and how soon. We try to watch their reactions carefully so as not to impose instruction that might interfere with the methods they've invented to communicate their growing understandings.

Donny: I do. Can I show you on the chalkboard?

$$7 - 4 = 3$$

Teacher: We'd like that. Come and give it a try.

Teacher: What do you think the 7 stands for?

Children: That's how many bears there used to be on the bed.

Teacher: Is that what you mean, Donny?

(She nods.)

Teacher: What does the four mean?

Children: Those got put back on the shelf. That's why she wrote the three. There are three left on the bed. That other thing is "leaves". No, my dad says it's "equals".

Teacher: You're learning so much about the numbers and symbols used in math. There's one more thing that Donny needs in her number sentence. Does anyone know what is missing?

Harold: She didn't put the little line.

Kyle: It has to go here. (Kyle jumps up and points to the space between the seven and the four.)

Teacher: Does anyone know what that little line means?

Richard: My sister says it's take away.

Teacher: Did we take some away?

Children: We put four back. That's it. Seven take away four. Then you have three.

Teacher: You've done that very well. Older students might read that as "seven minus four equals three," but there are many ways to say it. Does anyone know another way to write this number sentence?

Children: Do you mean to put a cross in there? Yeah, an add. No, that would mean he got some more bears. I don't want to do this, it's too hard.

Kyle: I think I know how. My sister showed me.

Teacher: That's a very good try. You have all the parts. Let me write the number sentence again beside yours so you can see how older students might write it.

$$\begin{array}{r} 7 \\ 4 \\ \hline \end{array}$$

$$\begin{array}{r} 7 \\ 4 \\ \hline 3 \end{array} \qquad \begin{array}{r} 7 \\ -4 \\ \hline 3 \end{array}$$

.....

Missing Addend / Missing Subtrahend

- The little boy was certain he had put six bears on his bed but now he could only see two. There were some lumps under his quilt. Some must have gotten under it. How many were hiding under the quilt?

Grouping / Partitioning

● Grandma was helping her grandchild clean his room. She set four bears on the shelf and half that many on the bed. How many bears did Grandma set on the bed?

Children: What do you mean? I don't know what to do.

Teacher: What do you think of when someone says you can have half?

Brian: My dad only lets me have a half a glass of water before I go to bed.

Stephanie: I got to have half the cookies last night. My brother ate the other half.

Teacher: How many cookies were there?

Stephanie: Four. I got two and he got two.

Teacher: How did you know how many you should get?

Stephanie: John gave me two.

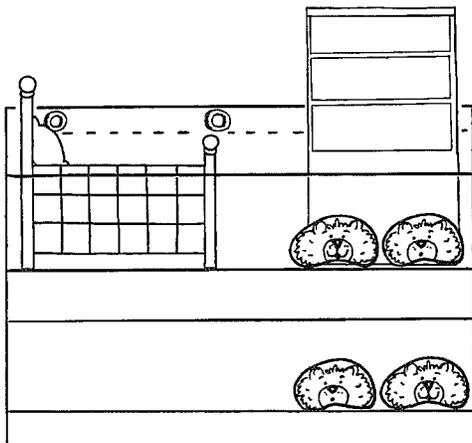
Teacher: Class, let's suppose that Stephanie had to figure it out herself. What could she have done?

Harold: Two plus two is four. She just would take two.

Samantha: I think I know. You take one for Stephanie, one for her brother, one for Stephanie, and then one more for her brother.

Brian: I think it's like cutting a sandwich in half. Can I get some cubes?

(Brian sets out four Unifix cubes in a line and then uses his hand to slice through the middle, demonstrating that two are on each side when it's cut in half.)



Teacher: Let's use some of your ideas to help solve this problem. We'll line up four paper bears in our pocket chart. Grandma put half as many as four on the child's bed.

Theresa: Does that mean she took some of those away?

Teacher: I suppose it could but the little boy had more than four bears to put away so this problem means that half as many *more* were set on the bed. We have to figure out how many half of four would be and then we'll set them on the bed.

Children: It's two. Cut them in half like Brian. See it's two. It's like one for the bed and one for the shelf and one for the bed and one for the shelf. No, that doesn't work. We have to get two more. Yeah! See it's going to be six altogether. Four on the shelf and two on the bed.

A.J.: I don't know what you're talking about.

Once again, we encounter the dilemma of how much we should ask of children so young. We want to continue to challenge our highly talented students but don't want to frustrate other youngsters too much. We have learned that small doses of disequilibrium are appropriate and constructive. Exploring new challenges is often exciting and new tactics do evolve from children's home math experiences as well as from school math.

Grouping / Partitioning (continued)

- There were eight ears peeking out from under the quilt. How many bears were hiding from the little boy?
- There were seven bears on the shelves. How many ears did the bears have altogether?

Day 4: Solving Picture Problems

Each child will need...

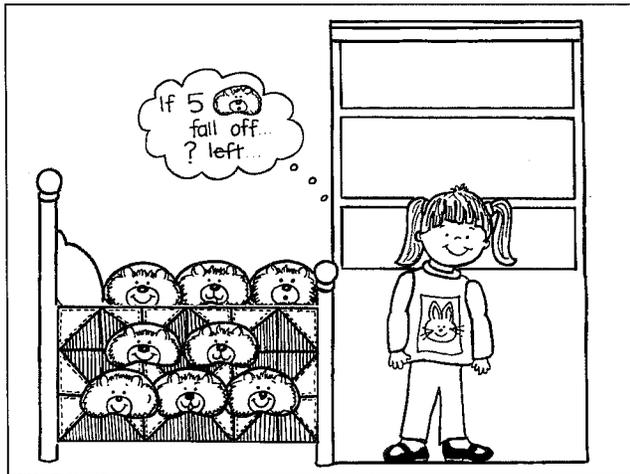
- his or her Rainbow Bears storyboard
- 12 Rainbow Bear beans: 4 of each color

You will need...

- Rainbow Bears picture problems (see Blacklines)
- a pocket chart
- pocket chart rainbow bears and scenery

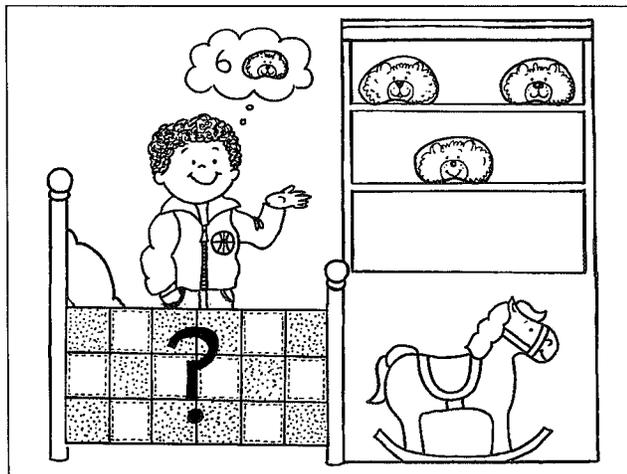
RAINBOW BEARS PICTURE PROBLEMS

Picture
Problem 1



She will have to take the quilt off to change her sheets. Five of those bears will fall off under the quilt. How many will be left?

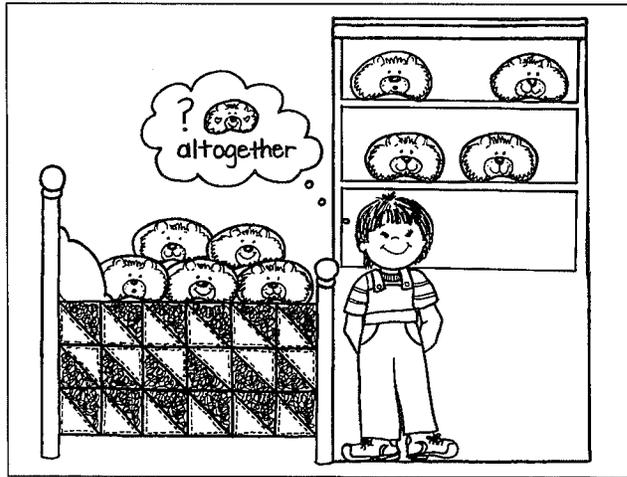
Picture
Problem 2



The teenage boy was sure his little brother had six rainbow bears altogether. He could see three bears on the shelves. Perhaps some of the bears were hiding under the quilt. How many bears will he find under the quilt?

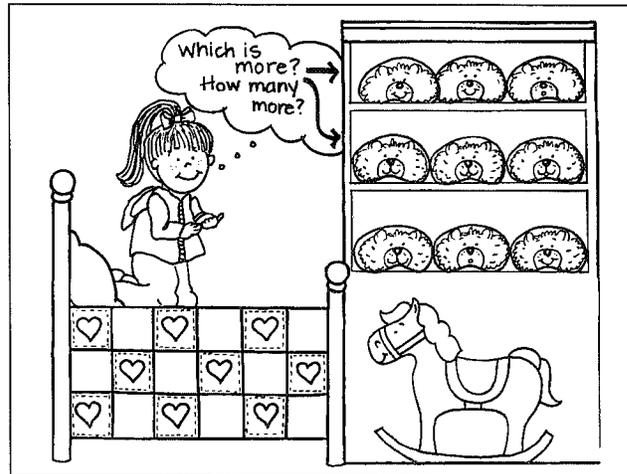
RAINBOW BEARS PICTURE PROBLEMS (CONT.)

Picture
Problem 3



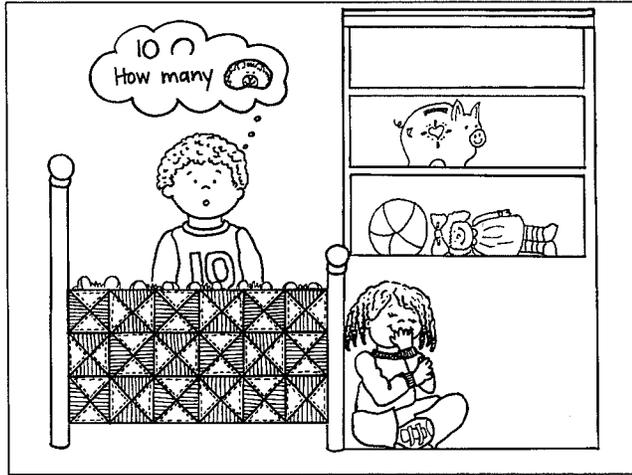
The young boy had four rainbow bears on his shelves and five bears on his bed. How many rainbow bears did he have altogether?

Picture
Problem 4



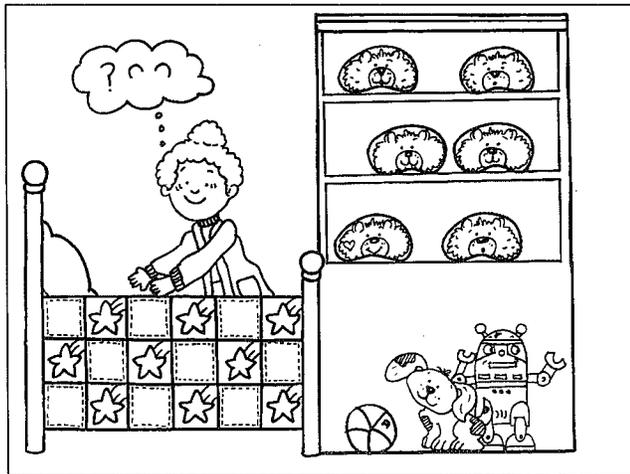
There were three pink bears on the top shelf and six yellow bears on the lower shelves. Did the young girl have more pink bears or more yellow bears? How many more?

Picture
Problem 5



His little sister loved hiding her bears under her quilt. Her big brother could see ten ears sticking out. How many bears are hiding under the quilt?

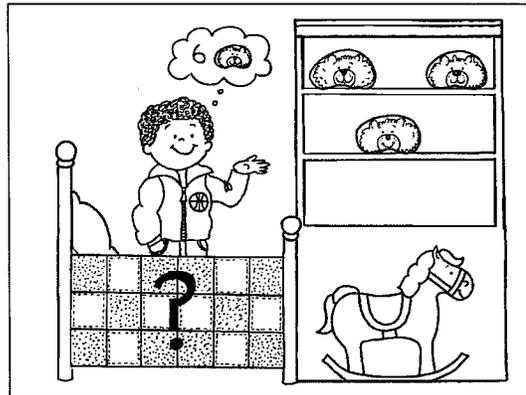
Picture
Problem 6



There were six rainbow bears on the grandmother's shelves. She loved collecting bears for her grandchildren. How many ears are on her shelves?

Now that children have worked to solve spoken story problems, show them the picture problems you've prepared. These models involve problems similar to those already posed but they deliver the information in visual form.

Teacher: I have some Rainbow Bears picture problems for you to solve today. Here's the first one. What do you notice?



Children: I have a horse in my room. The boy has a nice coat. There's a six by the boy with a bear. And there are three bears on the shelf. There's a question mark on that quilt. I know already. Me too. It's six under the quilt. No it's not. It's only three. There are going to be nine.

Teacher: Wait a minute! A lot of thinking seems to be going on and I bet each of you has a good reason for the answer you're thinking. Let's examine some of those solutions. I heard that some of you think there are six under the quilt. What makes you think so?

Jimmy: It says six in the bubble, see. And then if you put them with the three on the shelf, it makes nine.

Teacher: That makes sense the way you're thinking about it. You think the boy wants us to picture six bears in our heads and then add in three more. You were working hard to figure that out.

Kyle: I think it's like before in the other kinds—six bears are supposed to be in the room. Maybe some are under the covers. That's probably why there's a question mark there on the bed.

Teacher: That's another good way to think about it. Maybe I'd better read the story so you can figure out for sure what the problem is about.

The teenage boy was sure his little brother had six rainbow bears altogether. He could see three bears on the shelves. Perhaps some of the bears were hiding under the quilt. How many bears will he find under the quilt?

Kyle: I knew it!

Kristjiana: It's three. Three and three make six.

Teacher: There's a lot of good thinking going on in this room. But, suppose not everybody is convinced there are three under the quilt. How could you be sure?

Children: We could use our bean bears. We could write it down. We could get out the real bears. I can just do it in my brain—one, two, three on the shelf and four, five, six, under the quilt. I used my fingers. See! (Samantha shows three on one hand and three on the other.) I'm going to make that kind of problem. I like it when some hide. Mine will be hard.

Once the picture problem question is determined, encourage children to show their friends how to figure it out. Don't limit students to their bean bears. As you can see by the remarks above, they will share a variety of ways to solve the problem.

Pose a few more picture problems and invite children to share their solutions and strategies. You may lose the attention of a few children from time to time, but trust that the delight and understanding many students bring to their work will be contagious and draw the focus of those who have temporarily drifted away.

Day 5: Writing Solutions to Picture Problems

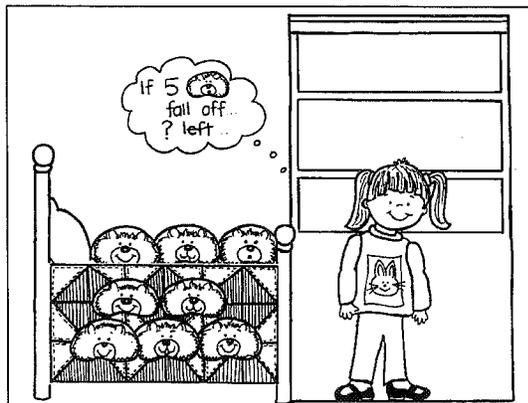
Each child will need...

- a chalkboard, chalk and eraser

You will need...

- 2 of your picture problems (We chose Number 1 because of the earlier discussion about writing it down and Number 3 since we had seen so many youngsters attempting to write notation for this sort of problem in The Burger Hut lessons.)

Teacher: What do you notice about this picture problem?



Children: She has a lot of bears. Some are going to go away when you move that quilt. I want to pull it. Me too. Can we peek? What does that bubble say? Have Mandy read it. I can do it. It's a five and a bear. That means five bears. What are those words? I know! It's... "will fall off... five will fall off". That's easy. There are going to be three left. You can tell. Move that quilt now so we can see. That's like when we were writing it down before—remember how Mandy showed us?

Teacher: Good job of examining the problem. I chose this one because you seemed so interested in ways to write it down. Let me read the story to you.

There are eight rainbow bears on the young girl's bed. She will have to take the quilt off to change her sheets. Five of those bears will fall off under the quilt. How many will be left?

Brian: It's easy. We can just write a three.

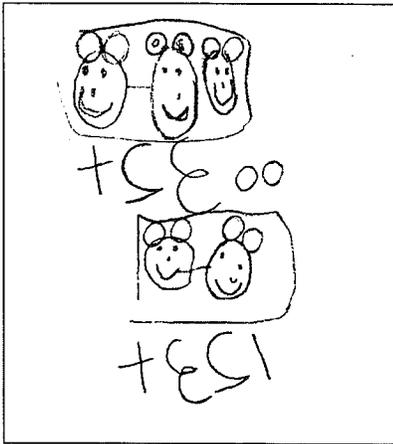
Teacher: That wouldn't be enough information to show all of us how you solved the problem. I'd like you to write enough on your chalkboards that you can show someone else how you figured it out.

Kyle: But I already know.

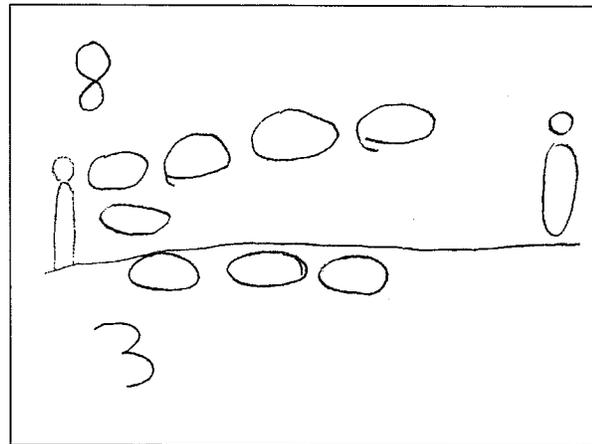
Teacher: I know you do, but maybe not everyone does. If you'll draw some pictures and write some numbers on your chalkboard, it might be very helpful to someone else. Perhaps you could even try writing a number sentence. We'll want to look at some of the chalkboard solutions when you're finished to see the different ways people worked it out.

Even when we work with adult learners on challenging problems in our workshops, many express solutions quickly but find they aren't quite sure how they figured things out. They often need to work backwards from their answers to communicate their thinking to others. Nearly always, adults tell us that they are amazed how much more they understand the problems when they have to explain their thinking. That's why we keep asking children like Kyle to record their ideas in some fashion. In trying to set their thinking down on paper, children and adults alike are obliged to examine their own thinking.

To answer the first picture problem, Jessica has drawn two groups of bears with loops around them (see top of following page). Between those groups, she has written $+ 2 3$. She has finished her work by writing $+ 3 2 1$. As she shares her work, the children determine that the looped bears represent the ones on the quilt in the picture problem and the numbers stand for the groups of bears she has drawn. They agree that these are the bears Jessica knows will get caught in the covers. At first, they are quite puzzled about her



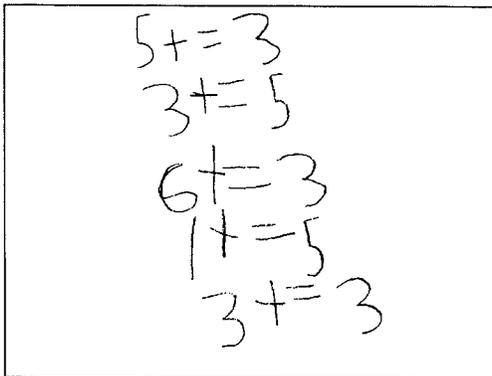
Jessica



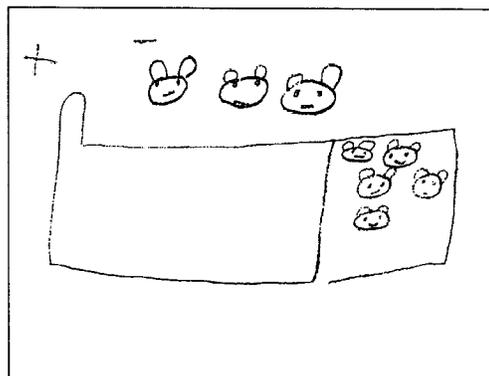
Jennifer

numbers at the bottom, and Jessica's limited knowledge of English doesn't permit her to explain. Then Kyle realizes that she started on the right and wrote one, two, three. The children all agree that Jessica must know three will be left. No one seems to question her use of the addition sign.

Jennifer explains that she wrote an 8 because that's how many are in the room. Then she points to the five circles she has drawn above the bed and explains that these are the ones that will get wrapped up in the blankets while the girl fixes her bed. She points to the other three circles and explains they'll just be sitting on the floor. She explains that the three she has written is for the bears on the floor



Andy



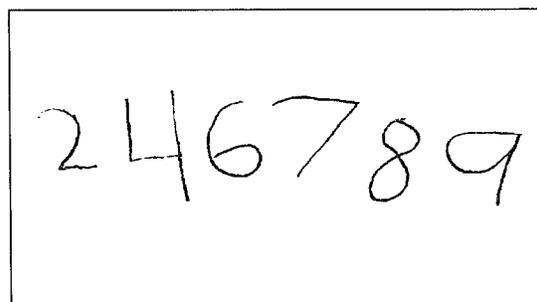
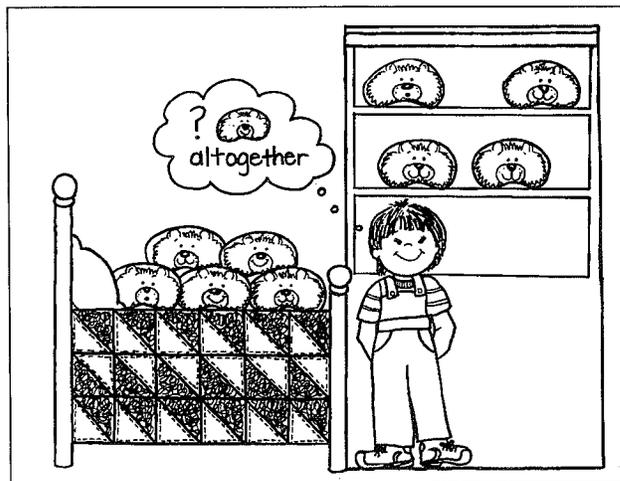
Terrilyn

Andy comes up with a chalkboard full of numbers, pluses and equals signs. He explains that he did it the "numbers way" and that three will be left after the bears on the quilt go away. Though his numbers don't come out quite right, only a few seem concerned about it; everyone agrees that Andy knows how many will be left. (We decide to leave well enough alone since Andy is so very proud of his work. We can see that counting numbers may no longer be enough for him and that he is seriously stretching toward new forms of notation. We're reminded that we trust children's spelling to evolve

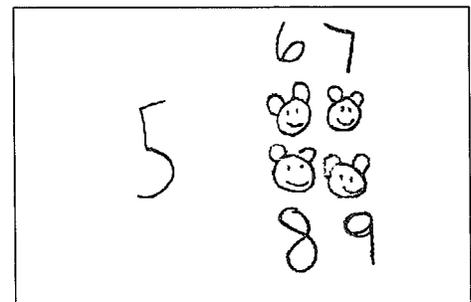
over time, and that Andy will have many more opportunities to explore mathematical notation in first grade.)

Terrilyn (see previous page) shows that she has drawn the three bears that are on top of the bed; when the quilt is pulled away, five bears will go with it. She has written a plus and a minus sign above her work but once again, no one seems concerned. When we ask, she says it's like Mandy does it.

These are truly the times that bring teachers up short. Almost every child has successfully solved this subtraction problem. We realize that our discussion about notation the day before has created some interesting new inventions with numbers and process signs. Since the children seem quite eager to show some sort of process notation with their work, we are glad we have saved an addition picture problem for our second challenge. Will they attempt to invent their own notation again? Will it be any easier with addition than subtraction?



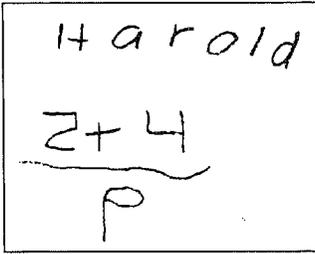
Vicky



Kyle

Vicky shows her chalkboard and demonstrates that she has counted by twos to six and then seven, eight, and nine, to determine there are nine bears altogether.

Kyle holds up his board and explains that he wrote 5 for the bears on the bed and then drew the two bears on each shelf. He explains that the six, seven, eight, nine, he has written are "how you figure it out."



Harold

Harold, on the other hand, tells us that "You write $5 + 4$." Then he points to the large nine he has written under the line and smiles proudly.

It's clear to us that many children are becoming very interested in writing number sentences, but we're not sure how much teaching we should do at this time. We remind ourselves that disequilibrium is often part of forging new territory. This

time we're feeling the disequilibrium. We decide to be astute observers throughout the remainder of the theme and see what other kinds of notation, if any, will appear.

Day 6: Creating Story Problems

Each child will need...

- his or her own storyboard
- construction paper bean shapes in pink, yellow, and green
- access to fine-tip Sharpie pens (separate from the glue)
- glue

You will need...

- the Rainbow Bears picture problems
- precut talking bubbles for children to add to their picture problems to pose the question
- a Sanford Sharpie pen so children can add question marks, etc., to their bubbles
- scotch tape and glue
- 2- or 3-hole punchers for the children to share for cutting their bear ears
- a few toothpicks to help put small droplets of glue in place as children add the ears to their bean shapes

Take a few minutes to review each of the Picture Problems and ask children to be thinking about which kind of problem each of them would like to pose for the class to solve. Remind them about glue and pens. You can usually tell who will need guidance and support to get started. Circulate to help wherever needed and encourage children to help one another. As students finish, have them show their problems to friends to help them figure out whether they are ready for their bubbles. When they think they're ready to pose their problems, help each youngster write on his or her bubble and add a question mark to the quilt flap if needed. Finally, have students set their problems in a safe area to dry.

Day 7 & beyond: Solving Student Picture Problems

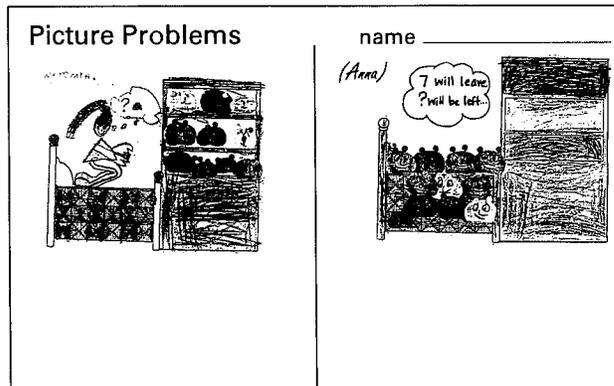
Each child will need...

- a problem-solving sheet (See instructions below for preparation.)
- a pencil and a hard writing surface such as a clipboard or the backside of an individual chalkboard
- access to the Rainbow Bear beans, storyboards, and Unifix cubes

You will need...

- children's completed picture problems

Before you present students' picture problems to the class, go through the collection and select two you feel would be appropriate to your children's current needs. Make the problem-solving sheets by reducing each chosen problem on your copy machine and leaving space at the bottom for student responses. Set the problems side by side on one sheet. Then run enough copies for your entire class.



These sheets take a bit of time to prepare, but if you've been keeping student responses in portfolios, you've already discovered that you need some way of identifying the problems children are solving in order to make sense of their work over the long term. When combined with other math work samples, observations and anecdotal records, these sheets provide wonderful windows into children's mathematical thinking and help in future instructional decisions, as well as in reporting on children's strengths and needs.

Begin the lesson by sharing *every* problem and taking time to admire each one. Then present the first problem to be solved and ask children to show their thinking on their problem-solving sheets. Remind them that you're interested in strategies as well as answers.

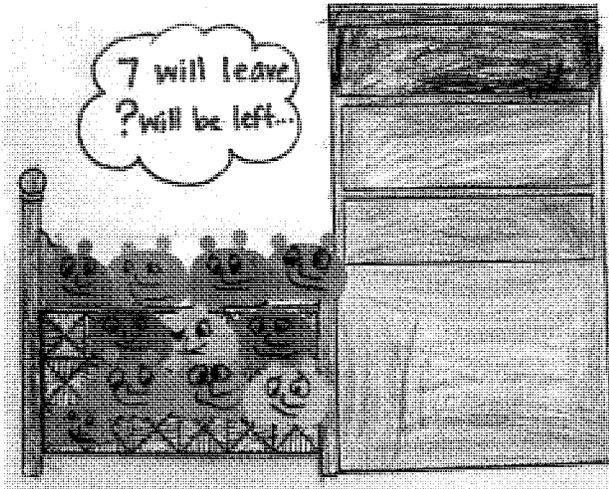
Teacher: Every one of these problems is fantastic! You worked so hard figuring out ways to challenge your friends. I can't believe how well you punched out those little tiny ears and managed to get them onto each of your bears. I noticed many of you helping one another with that tedious job.

Lovenisha: Do you like mine? Nayomi helped me with my ears.

Nayomi: The glue kept getting all over our hands and it was hard to put the ears on. Do you like how I made the girl on the bed?

Children: I hid my bears under the quilt. Just their ears show. Teacher helped me with my ears. She gave me some toothpicks to help with the glue. Show mine. Do mine.

Teacher: We'll try to solve everyone's problem eventually, but today we'll probably only have time for two. Here's Anna's problem. You'll notice there's a miniature version of it on your problem-solving sheet. What do you think she wants us to figure out?

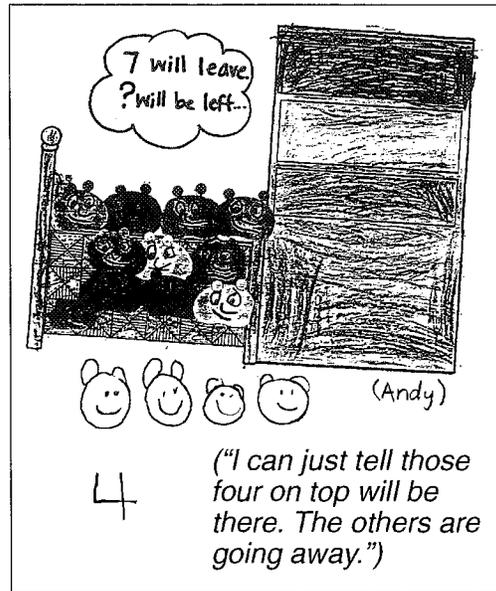


Children: There are a lot of bears on the bed. And the ones on the quilt are going to leave. I think there are seven on the quilt—one, two, three, four, five, six, seven. The ones on the top are still going to be there. There are going to be four.

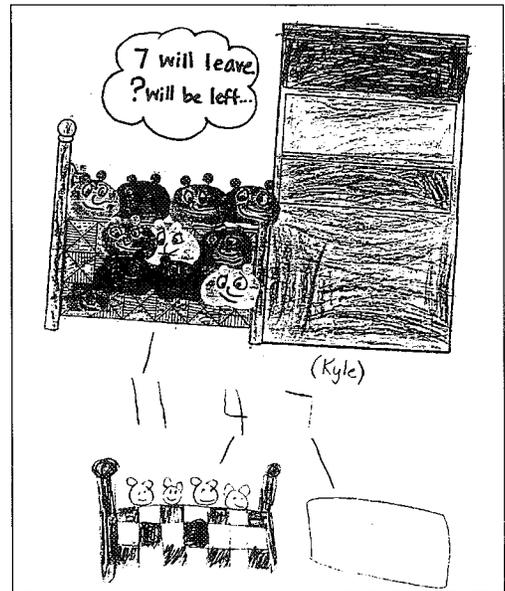
Teacher: Can you show us your thinking by making some drawings and numbers?

Andy (see following page) shows his thinking by drawing the four bears he says will still be there after the others go away. He also writes the numeral four. He seems quite confident about how this works.

Kyle writes numbers—eleven, four, and seven—and then uses lines be-



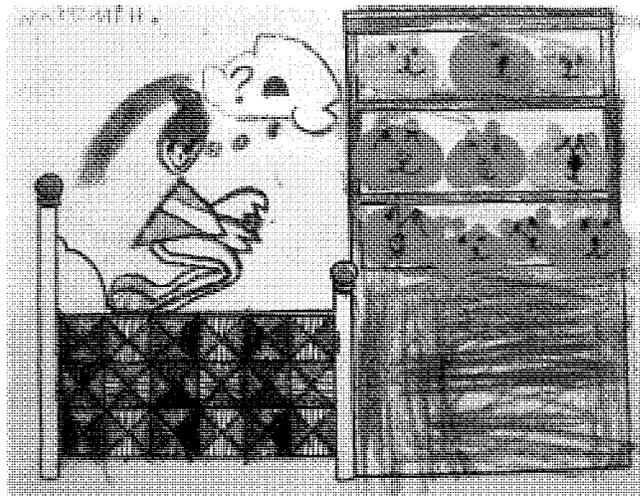
Andy



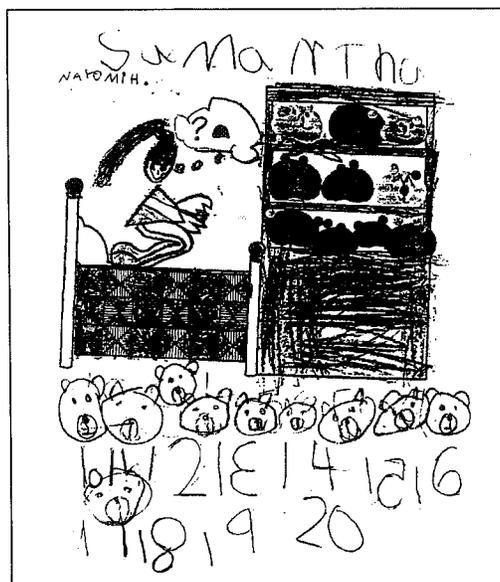
Kyle

tween the numbers and his drawings to show his classmates what each number means. He's quite an artist and shines in explaining his work this way.

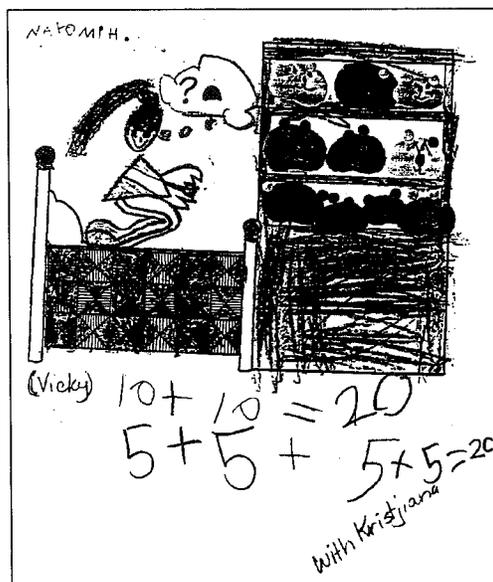
Teacher: Let's work on the second problem now. It's Nayomi's, and she's included a lot of bears to think about!



Even though "ten bears, how many ears" is quite a sizable problem for children so young, it is interesting to watch the many ways they try to help one another. Many of them are able to figure it out by counting but are determined to use the appropriate numbers to show their work. The numbers over ten stop many of them in their tracks until someone notices the calendar and begins pointing out various numbers that are needed. Those who need support move toward the calendar and diligently set to work to show how they are solving Nayomi's problem.



Samantha



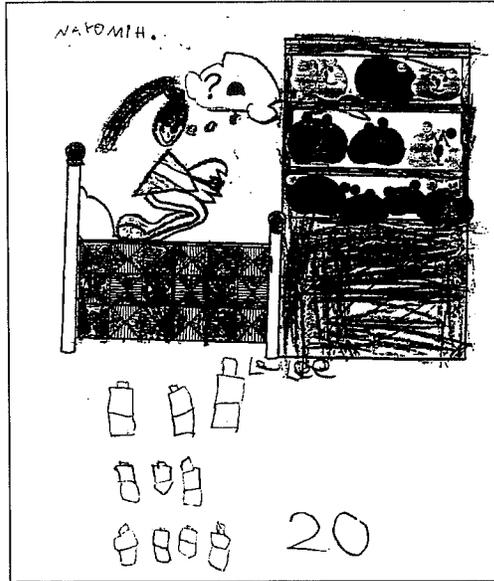
Vicky

Samantha begins by writing numbers but when she hits the teens, she erases and meticulously draws ten bears. By that time, many children have begun using the class calendar for numeral writing support. She moves in with that group, labels her last bear as ten and continues counting on with numerals to twenty. Her delight is unmistakable as she begins to share her finished work with others.

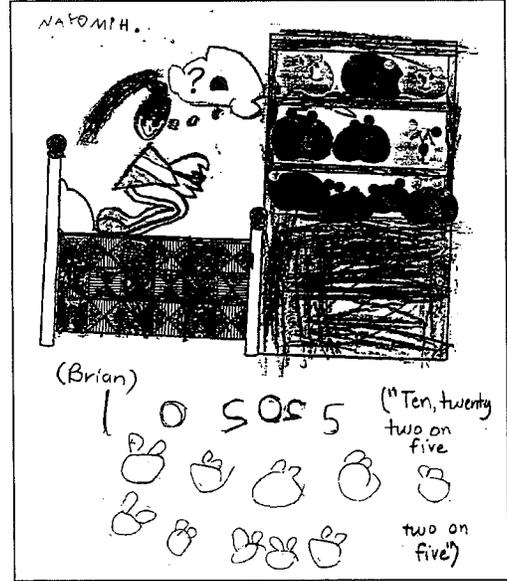
Vicky solicits a bit of help from her friend Kristjiana and they write the elaborate number sentences together. When asked what the numbers and symbols mean, she turns to Kristjiana to give the explanation, a thoroughly confident one indeed! Vicky nods happily and proceeds to count the ears, one by one to twenty to validate Kristjiana's work.

Lee (see following page) works with several friends to build pairs with Unifix cubes. At first they aren't sure whether to set out ten cubes or twenty cubes. After some experimenting, they decide the five pairs they have out aren't enough and they need to keep building.

Brian (see following page) writes 10 20 2 5 and then draws two rows, each with five bears. Upon questioning, he points and says, "ten, twenty, two on five," and then moves his finger down to the second row of five bears and once again repeats "two on five," meaning, we assume, two ears on each of five bears.



Lee

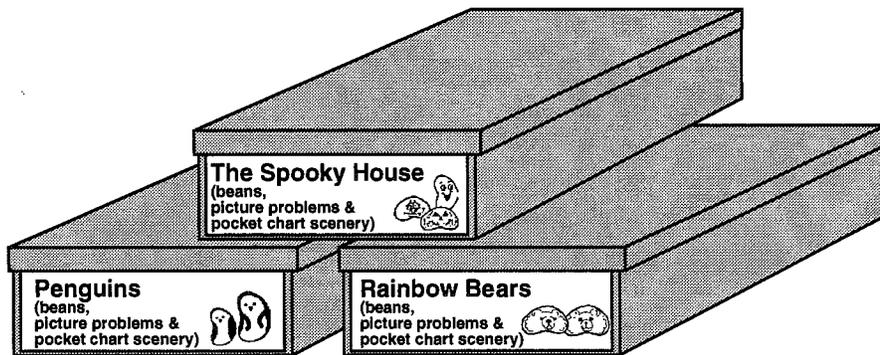


Brian

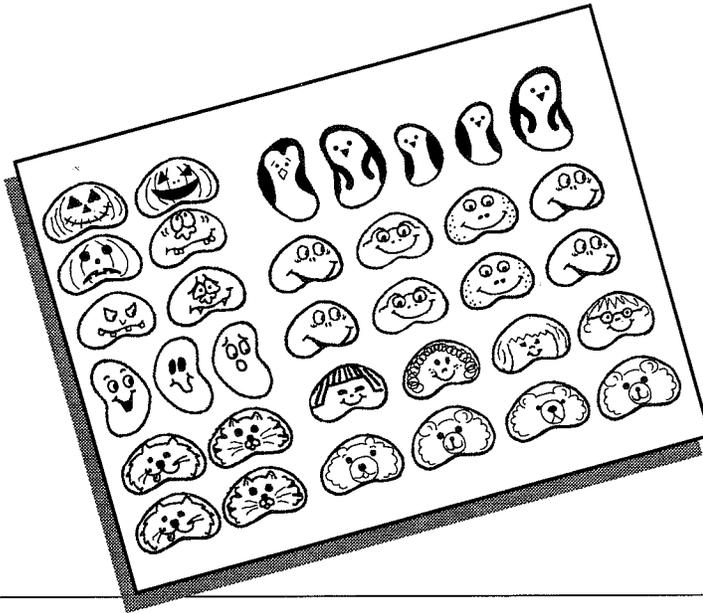
WHAT HAVE WE LEARNED?

Have we learned enough? Not *nearly* enough! But we are so amazed at the problem-solving and communication skills our students have developed during these past two years that we can finally send this final theme off to our publisher. We hope you'll accept this work as another step in our search for better ways to help every child love math and grow to his or her fullest potential while under our guidance. We will undoubtedly change things a bit each year to match each new group's needs but we feel certain that story problems deserve a good share of time during a kindergarten year.

NOTES



Preparation of Materials



Preparation of Materials

The materials needed to implement these units include six story boxes each containing about three hundred to five hundred forty teacher-produced counters (for a class of thirty), paper cutouts of characters and scenery for the pocket chart, picture problems, individual chalkboards, and such basic classroom materials as paper, scissors, crayons, glue, and the like.

While the preparation of these materials will require some work beforehand, we've included many blacklines to make your life easier, as well as a set of instructions we hope will make you chuckle. You can simply run copies of the **picture problems**, **pocket chart characters**, and **pocket chart scenery** for each theme. With some coloring, door taping, and gluing, they'll be ready. **Story Box counters** will require much more time because all six of the story boxes call for spray-painted lima beans with hand-drawn faces. You'll also need to gather classroom arts and crafts supplies for the children to use when they create their own storyboards and story problems for each theme.

Story Box Counters

Flash! Colored punchout cardboard “lima bean” characters are now available from MLC Materials (see p. 154 for details).

We'll begin with the toughest part first and apologize up front to those of you who detest craft work. Painting lima beans takes some time. First you have to shop for the right colors. After the first coat or two of spray paint, you have to get the blooming things turned over so you can spray the other side. Then you have to pretend to be a real artist and draw a face on each of the beans, and finally spray on a coat of clear gloss varnish so those charming features will endure longer. You'll find yourself dreaming about beans! Worse yet, your fabulous creations won't last forever. Three years of looking good and then the wear begins to show if your children use them often.

We'll try to make it as easy as we can in our directions below; if you truly hate this kind of work, we suggest you organize an assembly line of parent volunteers or sixth graders to help, or even call on relatives or friends who owe you a favor. If you have fellow teachers who will be doing this also, it's much cheaper if you buy paint to share. We hope after all your work, you'll believe as we do, that it was absolutely worth it!

LIMA BEANS

Buy large (not baby) dry lima beans for all of the counters except the baby penguins. If your grocery store offers beans in more than one grade, buy the more expensive packages—you'll almost always have fewer broken beans to throw away. We find one pound of lima beans gives us about 375–400 unbroken beans to paint. To make the counters for all six themes, you'll need five pounds if you have twenty to twenty-four children in your class. If you have more students, buy six pounds. For the baby penguins, you'll need a pound of baby lima beans.

SPRAY PAINTING TIPS

Purchase fast drying gloss or matte finish spray paint for each color recommended (see below). We find WalMart, K Mart, Target, Sears, Payless Drugs, Venture, hardware stores, paint stores, or home improvement stores to be good sources. One can of spray paint (not the small craft cans) will usually cover at least three pounds of beans, front and back.

Spread out more newspaper than you think you'll need and spray away from buildings, cars, etc., in order to keep your good reputation intact. (The paint does drift a bit.) We find it best to spray a light coat, let it dry a few

minutes and then spray again for good coverage. It dries more thoroughly than if you spray on one heavy coat.

With the exception of the penguins, the beans have to be painted on both sides, but turning them over can be a real pain. The easiest way is to have two identical cookie sheets protected by foil or two identical sheets of heavy cardboard available. Spread the lima beans out flat on one sheet and spray them lightly (usually two coats). When dry, place the extra sheet over the painted beans and hold the two sheets tightly while you flip them over. If you hold on tightly enough, most of the beans should be turned over when you remove the top sheet.

The other way is to just let the first coats of paint dry, then lightly toss handfuls of beans and hope at least half of them come down with the unpainted side up. You'll have to hand turn those that don't. Keep a mint julep, espresso coffee, or your favorite soft drink nearby.

We like to leave painted (and dried) beans in an open container for a day or two so the paint fumes diminish before we draw on them.

DRAWING FACES ON BEANS

Use ultra-fine Sanford Sharpie pens (available by the dozen at discount office/business supply places). We keep two or three pens beside us along with a scratch pad. After drawing with a pen for a few minutes, we scribble on a scratch pad and then replace the cap. (There's a bit of paint residue on the beans that can clog the tips, so it's important to clean them off on paper fairly often.) We trade pens frequently to keep them from drying out. Place finished beans on a sheet of cardboard for easy varnishing.

When all the faces have been drawn, place your cardboard tray of beans on newspaper and spray a coat of inexpensive clear gloss fast-drying varnish on the face side. The varnish keeps little fingers from rubbing off those incredible details you drew. Don't leave the beans outside overnight. Climate changes and heavy moisture can cause major deterioration.

SPRAY PAINT COLOR NEEDS AND QUANTITIES OF BEANS

Note: The quantities suggested below are based on a class of 30. Be sure to use large (not baby) dry lima beans for everything but the baby penguins. The baby penguins are made of baby lima beans.

The Spooky House

1 can green spray paint

1 can orange spray paint

add unpainted white beans for ghosts

Spray about 180 (roughly 1³/₄ cups) large limas per color and leave about

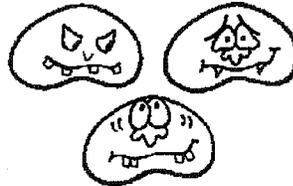
PREPARATION OF MATERIALS

180 white. You'll want to end up with six of each character for each student. Once the paint has dried and aired, start drawing simple faces.

Face Samples:



pumpkins



goblins



ghosts

Cats for The Cat Cottage

1 can yellow-orange spray paint

1 can gray spray paint

Spray about 180 (roughly $1\frac{3}{4}$ cups) large limas per color. After the beans have dried and aired, start drawing. You'll want to end up with six of each color for each student.

Face Samples:



Penguins

1 can black spray paint

Spray about 240 (roughly $2\frac{1}{2}$ cups) large limas black *on one side only*. Do the same with about 240 (roughly $1\frac{3}{4}$ cups) baby lima beans. You'll want to end up with eight of each size for each student. After the beans have dried and aired, draw on the faces and wings. We suggest using a black fine-tip Sharpie pen for the wings and eyes and an orange fine-tip Sharpie for the beaks. You won't believe how cute the babies are!

Face Samples:



Frogs and Toads

1 can tan spray paint

1 can green spray paint

Spray about 210 beans (2 heaping cups) per color. After the beans have dried and aired, start drawing. You'll want to end up with seven of each color for each student.

Face Samples:



Burger Hut Kids

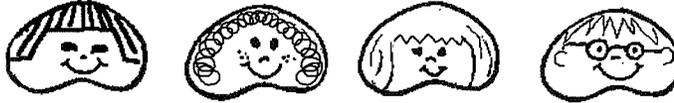
1 can tan spray paint

1 can brown spray paint

1 can peach spray paint (or unpainted white beans)

Spray about 100 (roughly 1 cup) per color. After the beans are dried and aired, start drawing. You'll want to end up with a total of ten kid beans for each student.

Face Samples:



(If you're totally compulsive, use a Q-tip or small paint brush with a bit of diluted red-orange paint to blush cheeks onto the bean faces before you apply the final varnish coat. We pick up a touch of paint, blot our Q-tip or brush on a paper towel and then "blush" about ten beans before picking up more paint. The drier the paint brush, the better! We find diluted acrylic paints work well.)

Rainbow Bears

1 can pastel green spray paint

1 can yellow spray paint

1 can pink spray paint

Spray about 120 (1 heaping cup) beans per color. You'll want to end up with four of each color for each student. Once the paint has dried and aired, start drawing simple faces.

Face Samples:

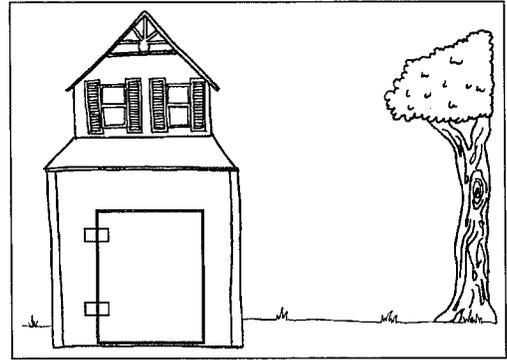
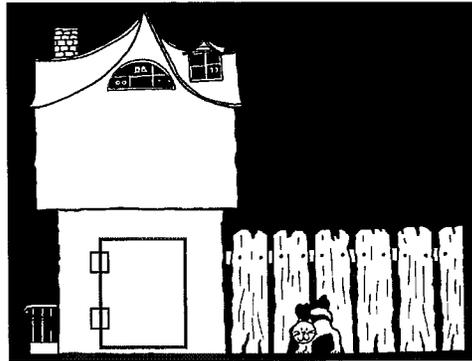


Storage Boxes

We use six Standard Boxes (which can be ordered from MLC Materials, P.O. Box 3226, Salem, OR, phone 503-370-8130), one for each theme. Each box is used to house the beans, picture problems, and pocket chart materials for a particular theme. We cover the tops and bottoms of our boxes with Contact paper so they will last a very long time. You'll find Story Box Labels on Blackline B79.

Storyboards

One of the features of *Invitations* is that the children make their own storyboards. The storyboards for the first two themes, *The Spooky House* and *Cat Cottage*, are to be made from student milk cartons, construction paper, and poster board. We've written directions for these storyboards in their respective chapters, and they're very charming. If you decide you don't feel like fooling around with three-dimensional boards, however, we've included pictures of the spooky house and the cat cottage to use instead (see Blacklines, pages B12 and B27). To prepare these for classroom use, run copies and have the children color them and tape construction paper flaps on for doors. (You may need to help with the door flaps. The idea is to create a door that will open and shut by attaching a 2" x 3" piece of construction paper to the house with pieces of scotch tape on one side.)



The Penguin and Frog and Toad storyboards are two-dimensional, and we have children make them out of construction paper. Again, you'll find complete directions in each chapter, but we've also included optional color-in type storyboards for these two themes in the Blacklines (see pages B39, B40, B50, and B51). If you decide to use these instead of having children make their boards from scratch, run copies and have children color them. For the Penguins board, you'll also need to run copies of the water and rock flaps (see Blacklines), and have children color and attach them to their boards with scotch tape at one side to create flaps that open and shut. The Frog and Toad boards have log and pond flaps to be colored and attached also (see Blacklines).

The storyboards for the last two themes, *The Burger Hut* and *Rainbow Bears*, are located in the Blacklines on pages B62-B64 and B74-B75. To prepare these, run copies and have the children color them. The Burger Hut boards each need a construction paper flap taped onto the ball cage and The Rainbow Bears boards need quilt flaps colored in by the children and taped to the beds. As with the other themes, you'll find illustrated instructions for having your students make these storyboards in chapters 5 and 6.

Picture Problems

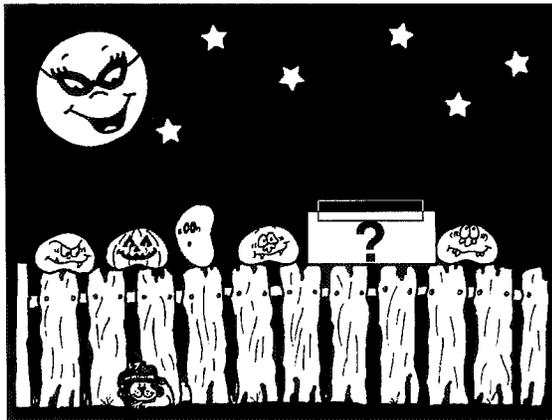
Locate the picture problems for each theme in the Blacklines and run one copy of each on white cardstock. (We choose cardstock because we want them to be more durable than paper.) These can be prepared a few days prior to implementation of each new theme or you can do them all beforehand. Because the problems sometimes refer to colors, you'll need to shade in the bean characters for *The Cat Cottage*, *Frogs and Toads*, and *Rainbow Bears*. The picture problems for the other three themes can be left in black and white, but if you're like us, you'll find a friend or two to help you color everything. The pictures are prettier that way! Before you color them in, though, be sure to locate the picture problem teacher text for each theme in the Blacklines. Run these stories on white paper, cut them apart, and glue them to the backs of the corresponding picture problems; in some cases, they'll help you decide how to color the bean characters.

Finally, you'll note that many of picture problems need corresponding doors or other types of flaps. Locate the doors or flaps by problem number to add where needed. Tape each door or flap in place with a hinge of scotch tape as described below.

The Spooky House

Locate the door, fence, and window flaps for Picture Problems 1, 3, and 6 in the Blacklines. Make a copy of each flap on cardstock to cut and tape over the corresponding picture location. The fence for Picture Problem 3 is best taped at the right side so it swings aside, removing three goblins as it goes.

Next, locate Spooky House Picture Problems 7, 8, and 9 in the Blacklines. Make a copy of each. Cut a small construction paper "secret door" to tape over the top of one or two characters on each fence. Place one of the doors at the beginning of the first pattern, one in the middle of the second pattern, and one near the end of the third pattern. Write a question mark on each door, and make sure to tape them so they'll lift easily.

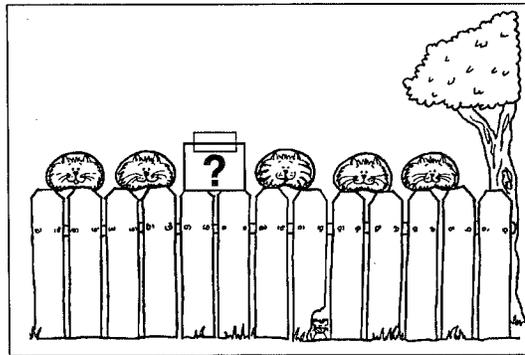


If you decide to color the Spooky House picture problems, be sure to make the pumpkins orange, the goblins green, and the ghosts white.

The Cat Cottage

Locate the door flaps for Picture Problems 3, 4, and 6. Make a copy of each door on cardstock to cut and tape over the corresponding door in the picture so it will swing open.

Next, locate The Cat Cottage Picture Problems 7 and 8 in the blacklines. Make a copy of each. Cut a small construction paper "secret door" to tape over the top of one or two of the characters on each fence. Place one of the doors near the beginning of the first pattern and one near the end of the second. Write a question mark on each door, and make sure to tape them so they'll lift easily.



The bean cats in these picture problems need to be colored. Color the striped ones yellow-orange and the plain ones gray, and everything will work out just right.

Penguins

Locate the rock or water flaps for Picture Problems 2, 4, and 6. Make a copy of each flap on cardstock to cut and tape over the corresponding picture location. Tape each flap with a hinge of scotch tape at the side so it swings open.

Frogs and Toads

Locate the pond or log flaps for Picture Problems 3, 5, and 6. Make a copy of each flap on cardstock to cut and tape over the corresponding picture location. Tape the pond flaps for problems 3 and 5 with hinges of scotch tape at the side so that they swing open. Place the log flap for Picture Problem 6 over the log in such a way that the twelve eyes still show. Tape this flap at the bottom so it swings down to show the six hidden toads.

The paper bean-shaped frogs and toads in these picture problems need to be colored. If you color the ones with larger spots brown and the ones with tiny freckles green, everything will work out just right.

The Burger Hut

Locate the ball cage, door, and car flaps for Picture Problems 1, 3, and 5 in the Blacklines. Make a copy of each flap on cardstock to cut and tape over the corresponding picture location. Tape the ball cage flap with a hinge of scotch tape at the right side in Picture Problem 1. In Picture Problem 3, glue the right-hand door down, and tape the left-hand door with a hinge of scotch tape at the left-hand side so the flap swings out and opens to the left, taking three of the kids with it. The car for Picture Problem 5 is most easily taped at the top so that it swings up, showing the six children inside the car.

Rainbow Bears

Locate the quilt flaps for Picture Problems 1, 2, and 5. Make a copy of each quilt on cardstock to cut and tape over the corresponding bed. Position the quilts for Picture Problems 1 and 2 over the beds and attach each with a hinge of scotch tape on the left-hand side so it will swing open to the left. Position the quilt over the bed in Picture Problem 5, but attach it with a hinge of scotch tape at the bottom so it will swing down to show the five hidden teddy bears.

The only bears that really have to be colored are in Picture Problem 4, which makes reference to three pink bears on the top shelf and six yellow bears on the lower shelves. The bears in the other pictures can be colored pink, green, or yellow at random.

Pocket Chart Materials

We find that having large paper cutouts of the bean characters, along with some of the storyboard scenery for each theme that can be used in the pocket chart makes it easier for some of our students to share their thinking with others. It also makes it easier for children to see one another's ideas. We have included characters and scenery for each theme in the Blacklines. All you have to do is run copies on cardstock, color as specified below, cut them out, and you're all set to go. You might also choose to laminate these materials because they will be handled frequently by the children.

The Spooky House

Run two copies of each sheet of The Spooky House characters so you wind up with eight pumpkins, eight goblins, and eight ghosts. Technically, you only need six of each character, but if you can, run the pumpkins on orange cardstock, the goblins on green cardstock, and the ghosts on white. That way, you won't have to color them in, and you'll have extra of each in case of loss or damage (perish the thought!).

In addition, run one copy of the spooky house on white cardstock and

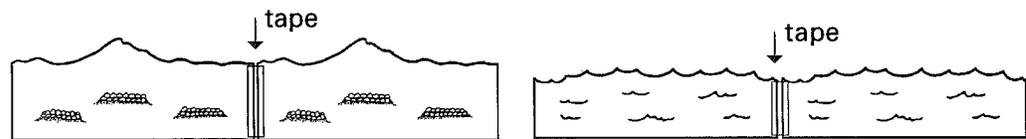
leave it in black and white, or color it if you're compulsive. Don't worry about making doors that swing open and shut—nothing's really going to fit behind them anyway. You just want the suggestion of a spooky house so children can place the paper characters around or near it if necessary. After running copies of the characters and scenery, color as needed, cut, and laminate.

The Cat Cottage

Run two copies of each sheet of cats so you wind up with eight of each type. Once again, if you're someone who doesn't like to color, run the plain cats on gray cardstock and the stripy ones on orange. Although you really only need six of each, it's nice to have a couple extra. Run a copy of the cottage on white cardstock and see the remarks under The Spooky House for more advice. Color as needed, cut, and laminate.

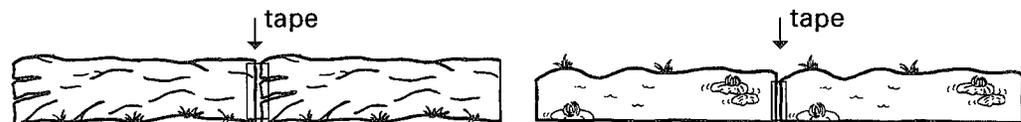
Penguins

Run four copies of the penguin sheet on white cardstock, color the beaks orange, cut the figures out, laminate, and you're set to go. The rocks and water could really stand to cover a little more territory, so you might consider running two copies on white cardstock, cutting the water apart from the rocks at the wave line, and then taping the two water areas and two rock areas together as shown below, so they'll stretch out along two pockets in your pocket chart. Color and laminate.



Frogs and Toads

Run two copies of the frog sheet (the ones with the tiny little freckles), and two copies of the toad sheet (the ones with the larger dots). You can either run them on white cardstock and color them, or run the frogs on green cardstock and the toads on light brown and save yourself some work. Cut the figures out and laminate them. The tree is fine, but you might want to consider running two copies of the scenery sheet on white cardstock so you can extend the log and the pond, as shown. Color and laminate.



The Burger Hut

Run three copies of the kids on white cardstock and get creative with hair and skin tones. Then cut them out and laminate. You really only need ten kids, so you'll wind up with a couple extra. Run copies of the Burger Hut, the slide, and the ball cage on white cardstock and color them if you wish. Cut and laminate. Again, these pieces of scenery aren't really big enough to accommodate the paper characters, but the cutout bean kids can be placed near the slide or below the Hut to show their location in a story problem.

Rainbow Bears

Run three sheets of these cute bears on white cardstock and color four of them pink, four of them light green, and four of them yellow. Or, save yourself the trouble and run one sheet on pink cardstock, one on pastel yellow, and one on light green. Voila! Run the shelf and bed on white cardstock to use for reference on the pocket chart. While these aren't big enough to actually accommodate the bears, they can be used to suggest location. Color as needed, cut, and laminate.

General Materials

Along with the pocket chart materials, the student-made storyboards and lima bean characters, children use individual chalkboards, chalk, and erasers to help solve teacher- and student-posed story problems. Some of your children may also opt to use Unifix cubes, especially later in the year when the quantities get larger and there's increased need to organize in arrays rather than in piles. These materials can be ordered from many different math and early childhood supply catalogues, but we find The Math Learning Center has both excellent prices and service. The address is:

MLC Materials
P. O. Box 3226
Salem, Oregon 97302
Phone 503-370-8130

To create their own story problems for each theme, students use typical classroom arts and crafts supplies. These include:

- scissors
- glue
- colored construction paper
- marking pens
- crayons

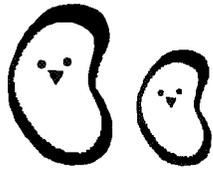
PREPARATION OF MATERIALS

We purchase:

- a dozen or more ultra-fine Sanford Sharpies for the children to use when drawing faces on their construction paper beans (NEVER use near glue).

We precut (or ask parents to precut):

- construction paper beans in appropriate colors for the children to use when adding the characters to their story problems (We've included a blackline of the bean shapes in case you want to staple four sheets of appropriately colored construction paper beneath a copy of the bean shapes to send out to a parent—community service! Four sheets of each color in a theme should get you through most chapters depending upon your class size.) If you're cutting the paper beans freehand, which we find to be fairly quick, cut four 9" x 12" sheets of each needed color. We use a small, sharp pair of scissors—it's easier on our fingers and faster. In order to make the adult and baby penguins, you'll need to cut big and small black bean shapes a bit larger than the white pieces. Children will use both colors for each penguin.



The punchout cardboard "lima bean" characters can be ordered from MLC Materials (address and phone number on p. 153). They're colored and the faces are all drawn for you! A kindergarten set (adequate for a class of 30 pupils) is approximately \$40. Sets for individual themes may be purchased separately. Call MLC Materials for more information.

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Blackline Masters

Themes

1 The Spooky House **B1**

2 The Cat Cottage **B17**

3 Penguins **B31**

4 Frogs & Toads **B43**

5 The Burger Hut **B55**

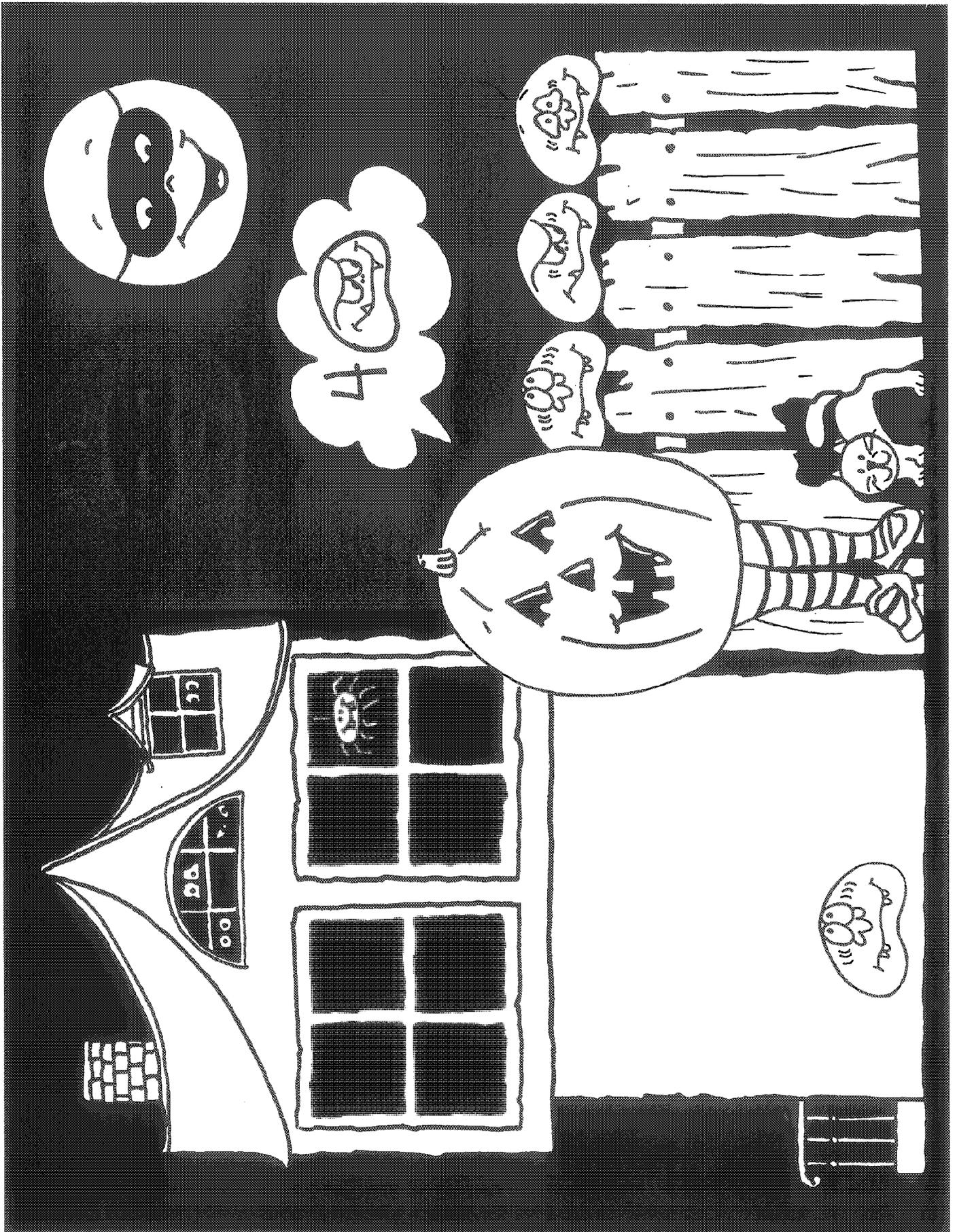
6 Rainbow Bears **B67**

Preparation of Materials B79

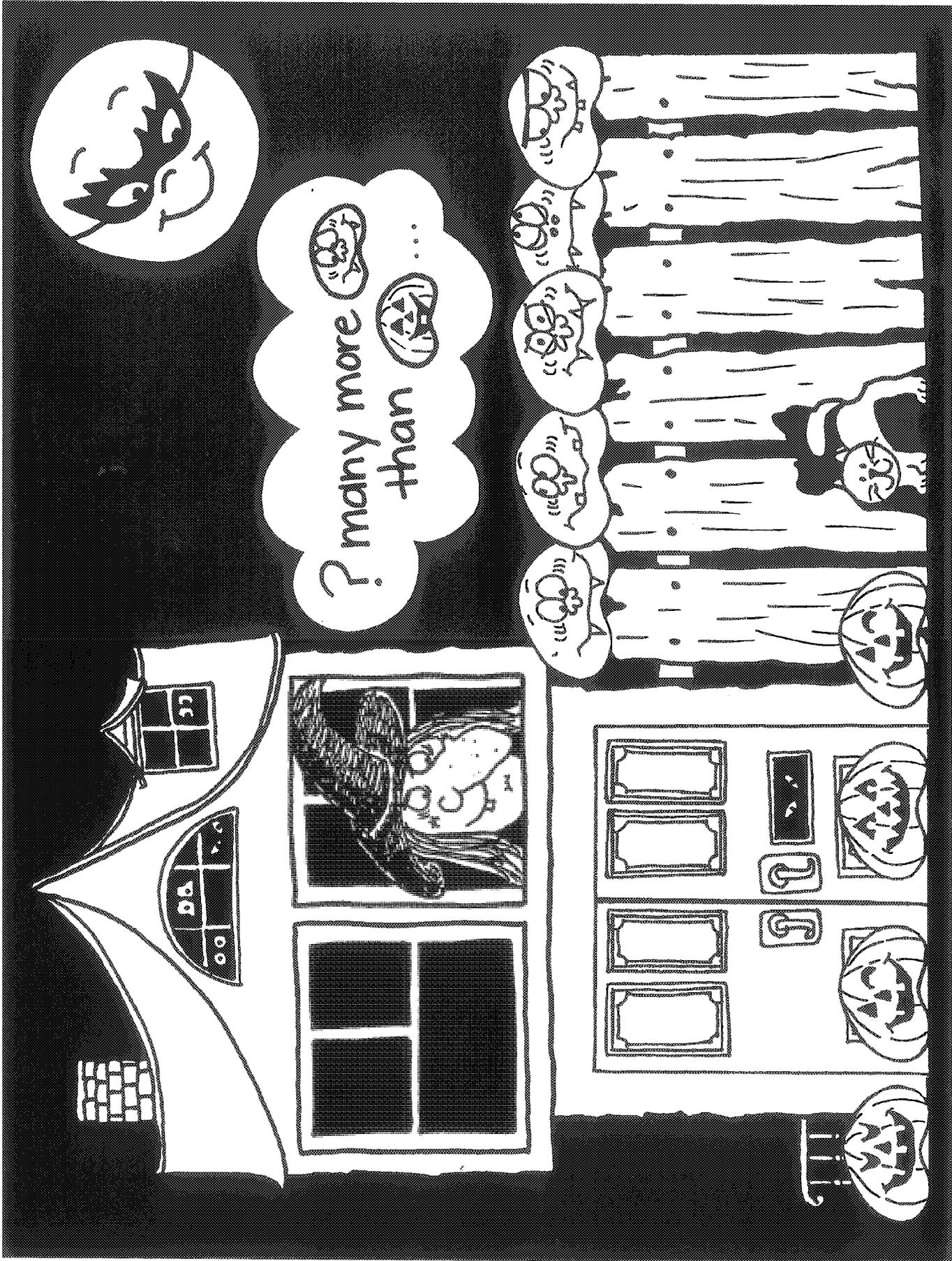
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Picture Problem 1
Tape Door 1 on house.

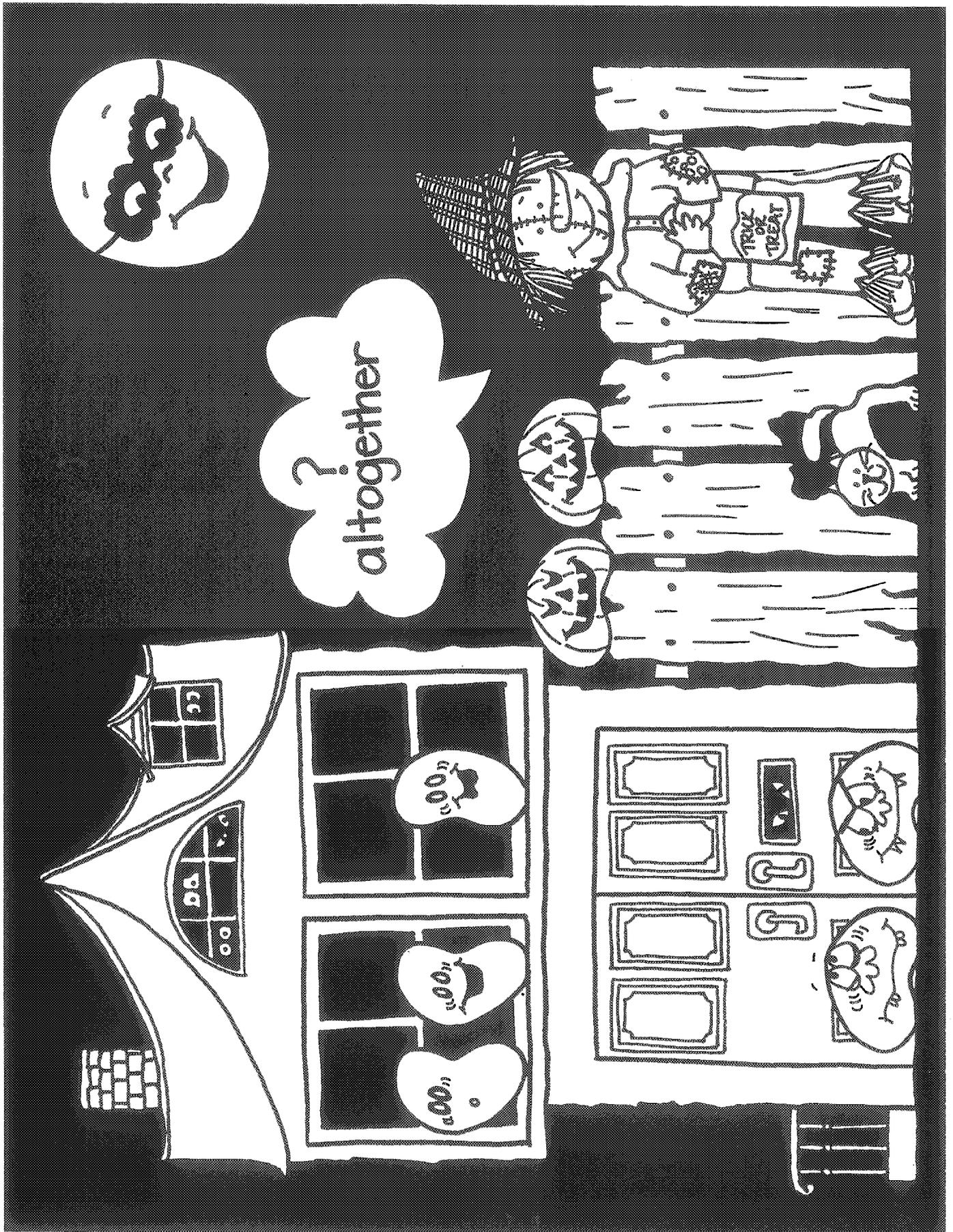
The Spooky House B1

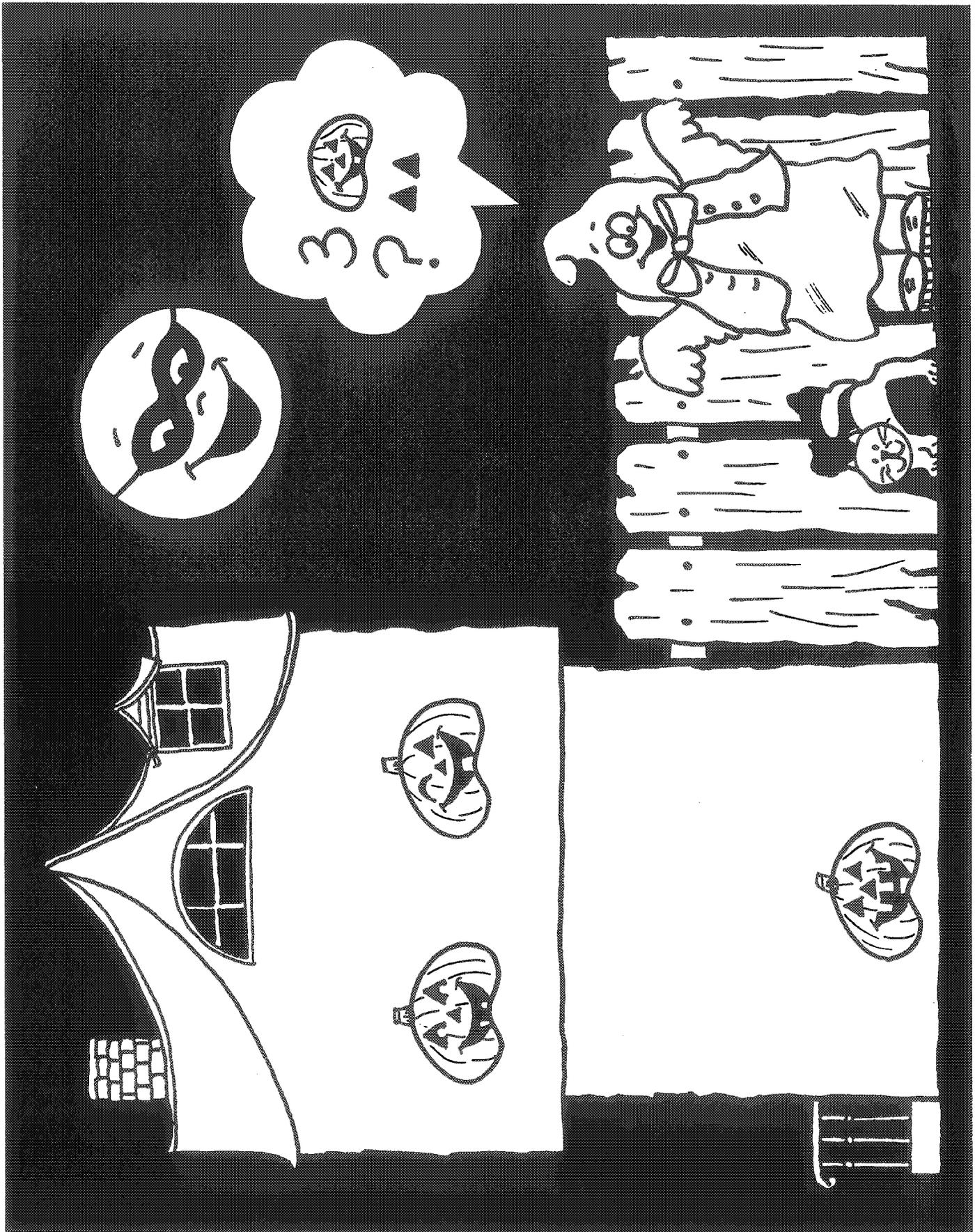






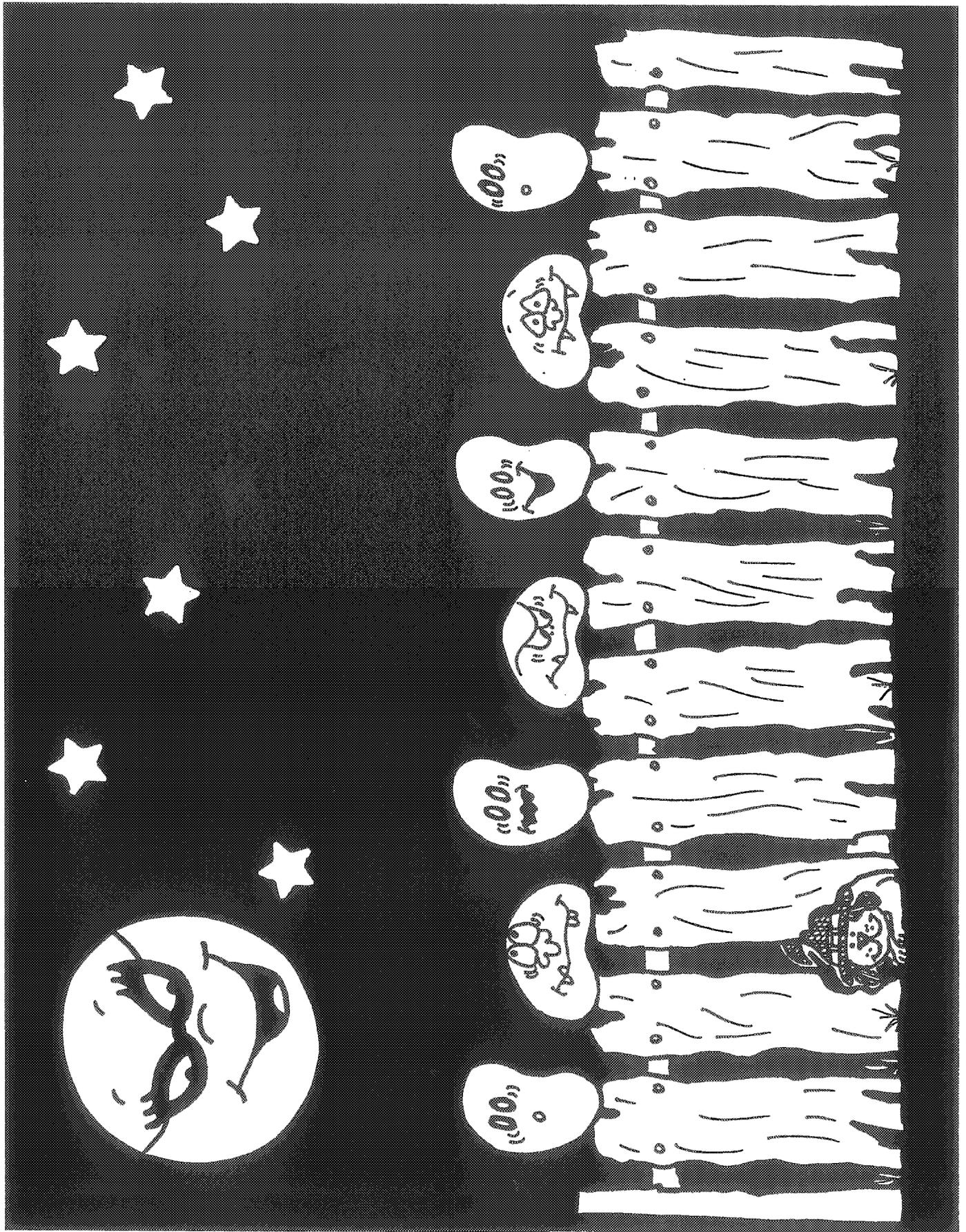
How many more than ...





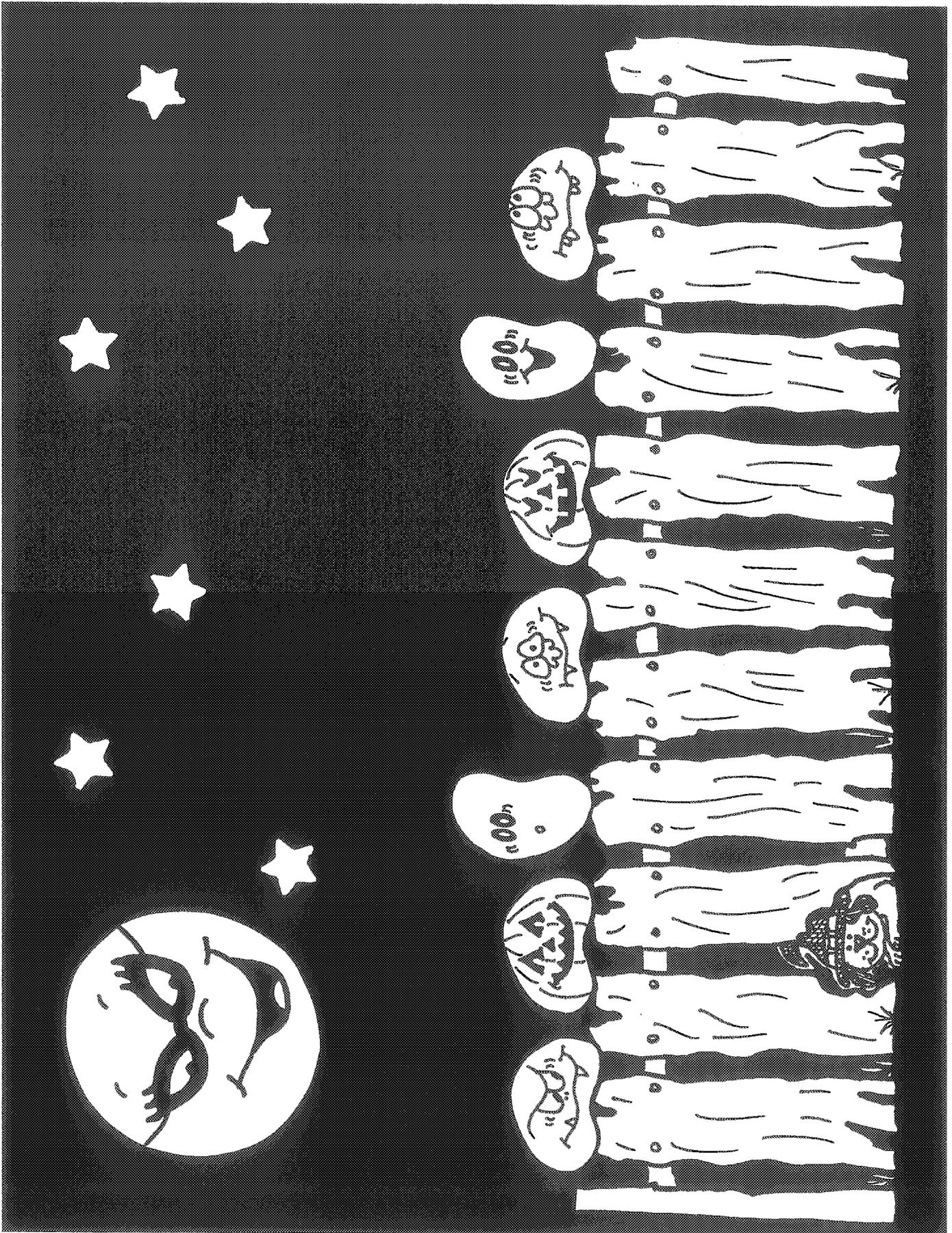
Picture Problem 7

Tape small construction paper door (with "?" on it) over a figure (or two) near the beginning of the pattern.



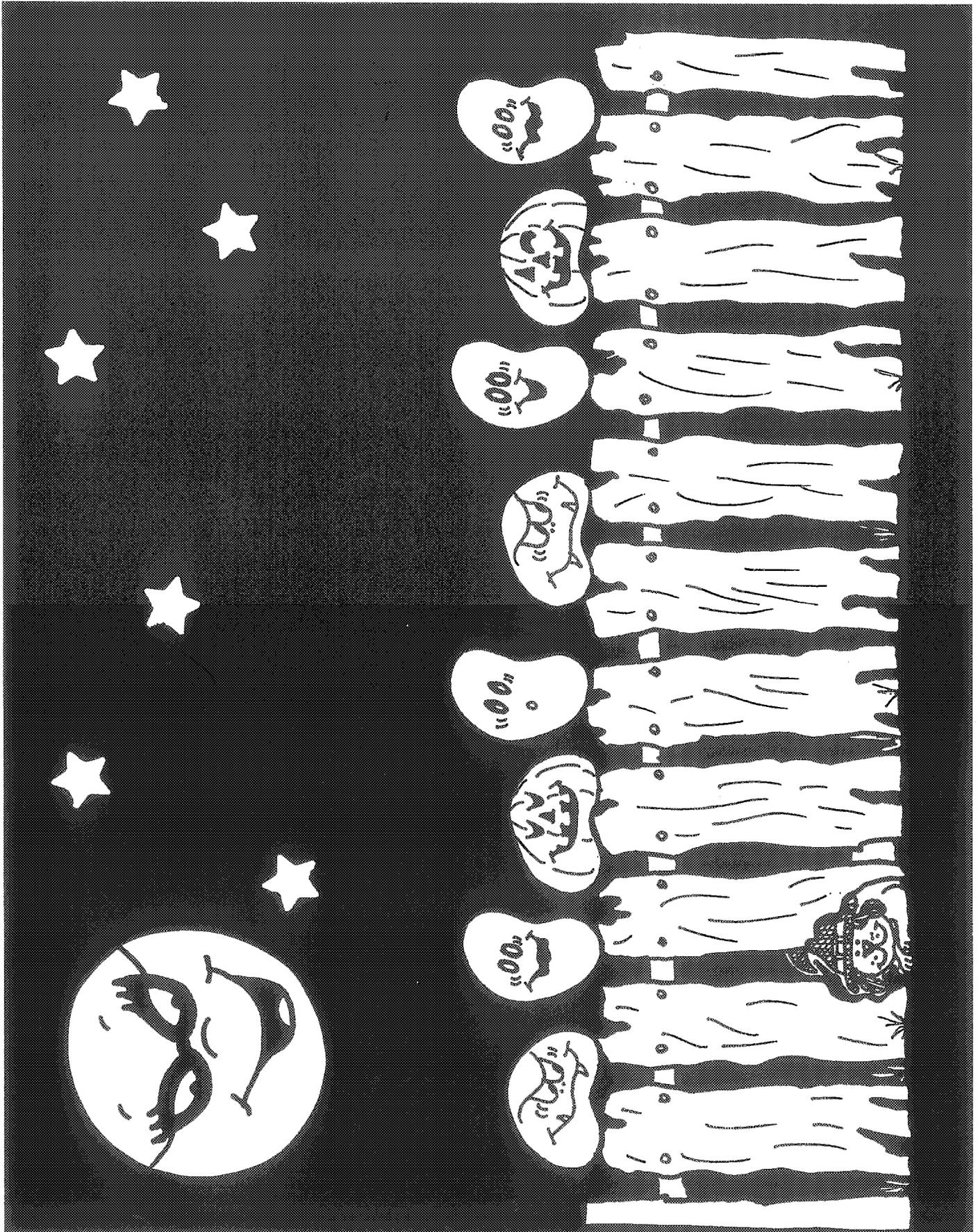
Picture Problem 8

Tape small construction paper door (with "?" on it) over a figure (or two) in the middle of the pattern.

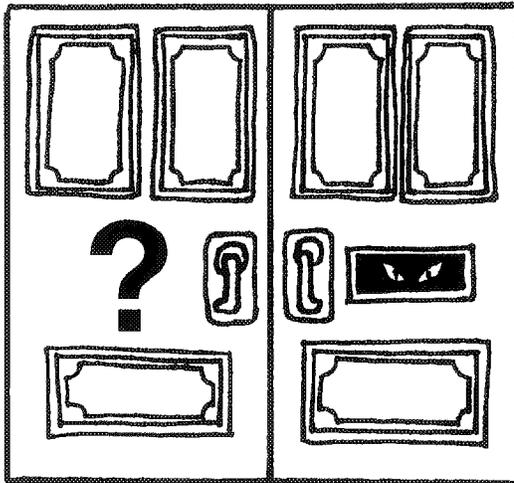


Picture Problem 9

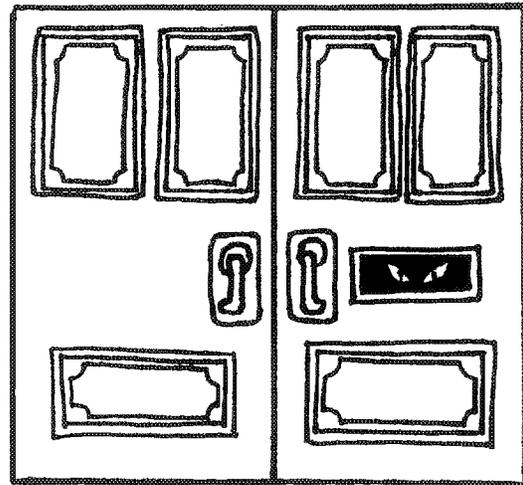
Tape small construction paper door (with "?" on it) over a figure (or two) near the end of the pattern.



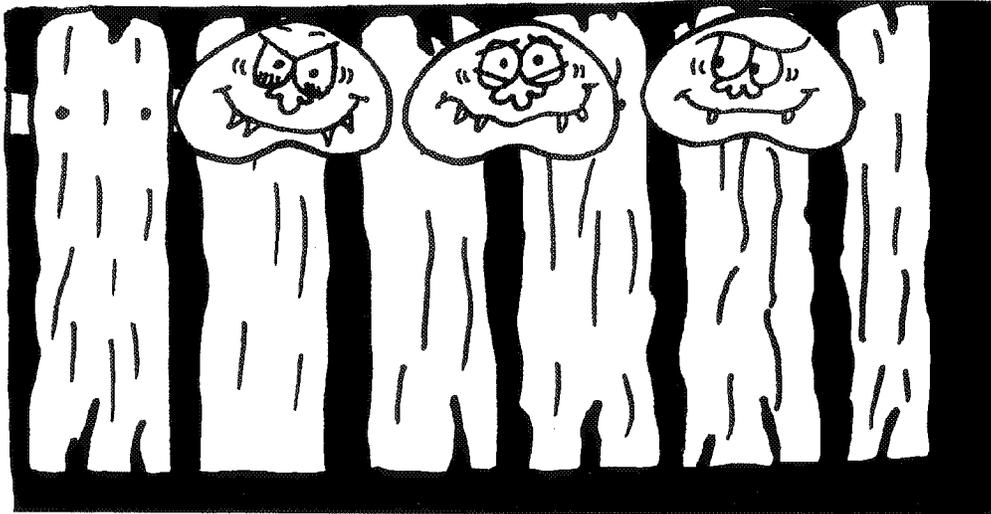
Flap 1



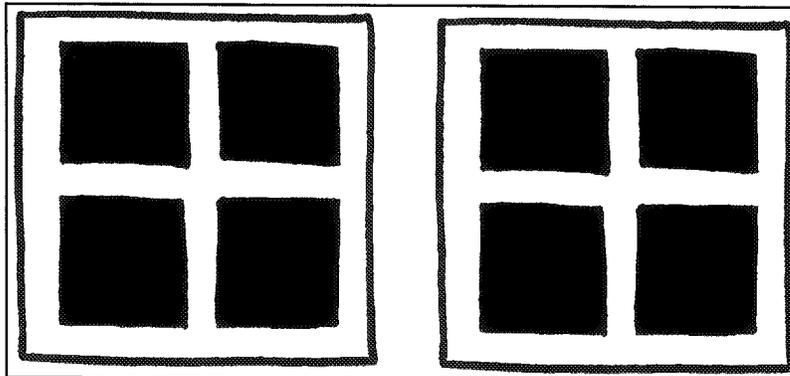
Flap 6

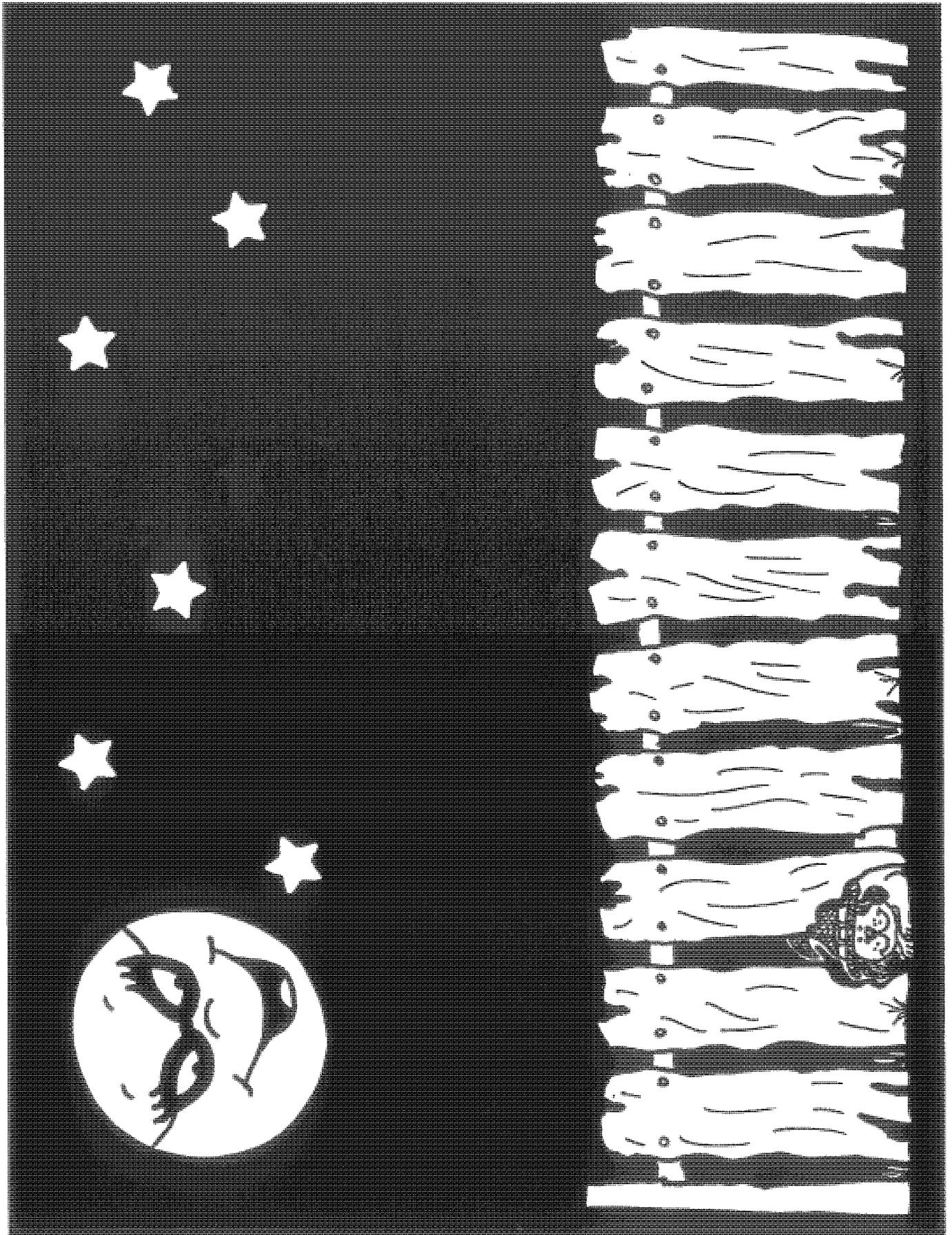


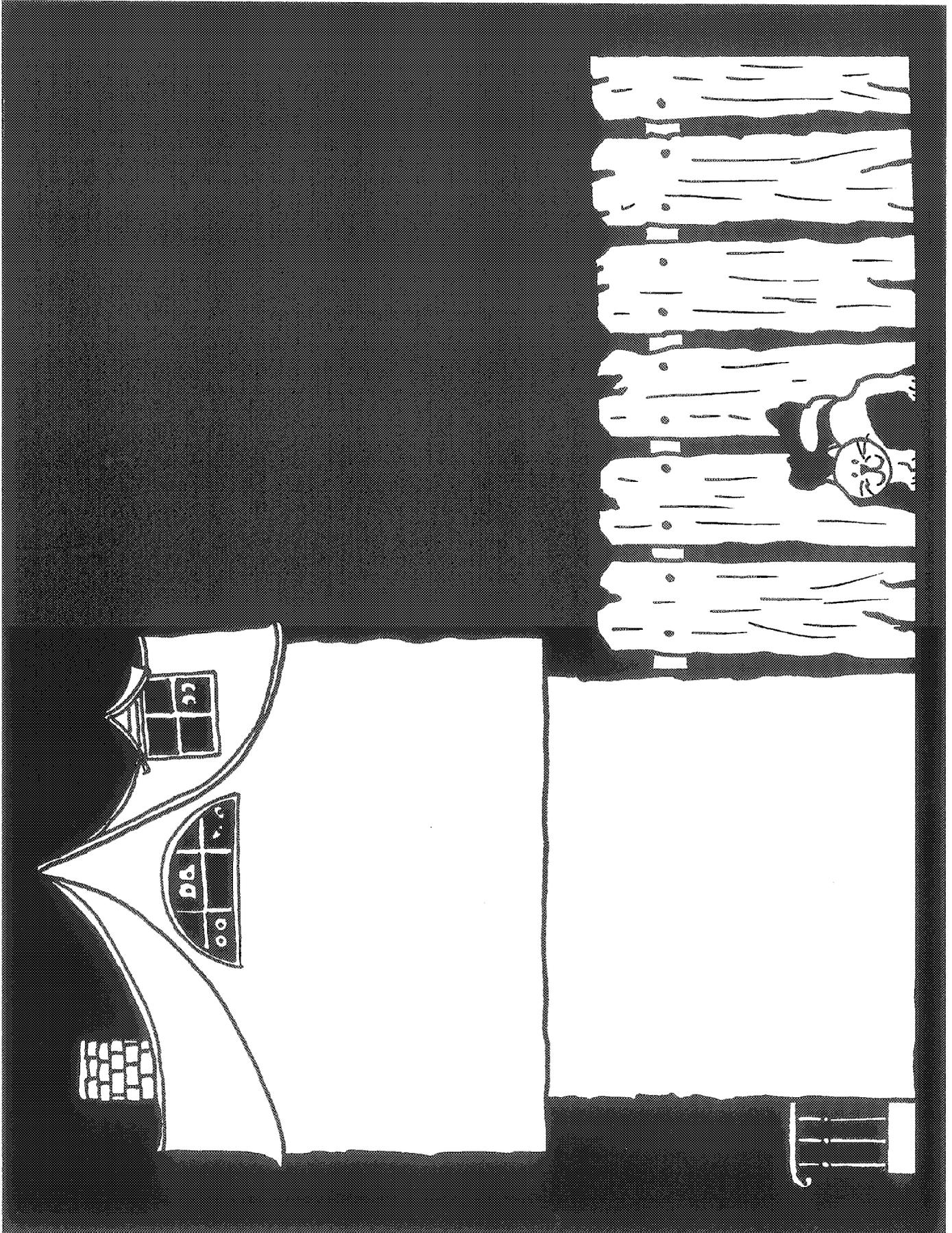
Flap 3



Flap 6







(Glue problem text to the back of each picture problem as teacher tips for having students figure out what is being asked by the picture problem.)

Picture Problem 1

The little girl was all dressed up for Halloween. When she first walked up to the spooky house, she thought she saw four green goblins sitting on the fence. When she turned around to look again, there were only three. How many of those goblins had disappeared into the house?

Picture Problem 2

Perhaps he was imagining things. The trick-or-treater could see some ghosts on the roof. He was trying to count how many. Then he saw some goblins peering from the windows. How many could he see? Finally he noticed some flickering pumpkins near the doorway. How many pumpkins did he see? Can anyone figure out how many Halloween characters he saw altogether?

Picture Problem 3

As the trick-or-treater stood beside the fence, he could see five goblins. Some seemed to be hooked onto a gate that was swinging back and forth. Oh, oh! Something seemed to be pulling the gate open. Three goblins were disappearing. How many would the child still be able to see?

(Glue problem text to the back of each picture problem as teacher tips for having students figure out what is being asked by the picture problem.)

Picture Problem 4

Four jolly jack-o'-lanterns had been set in front of that spooky looking house. Five green goblins were smirking on the fence. How many more goblins than pumpkins did the funny witch see?

Picture Problem 5

Trick-or-treating was so much fun. Lots of people had decorated their houses for the children. The trick-or-treater saw that the house she was approaching had two flickering pumpkins on the fence, three white ghosts in the windows and two green goblins by the door. How many Halloween characters did she see altogether?

Picture Problem 6

His mom had told him there were three wonderful pumpkins hidden behind the windows and doors of the spooky-looking house. How many pumpkin eyes will he see?

(Glue problem text to the back of each picture problem as teacher tips for having students figure out what is being asked by the picture problem.)

Secret Door Pattern 7

Halloween night was so much fun. As the neighborhood trick-or-treaters were returning home, they noticed some ghosts, pumpkins, and goblins on their fence. Part of them seemed to be covered by a secret door. The kids were trying to figure out what was hiding. Can you help them figure it out?

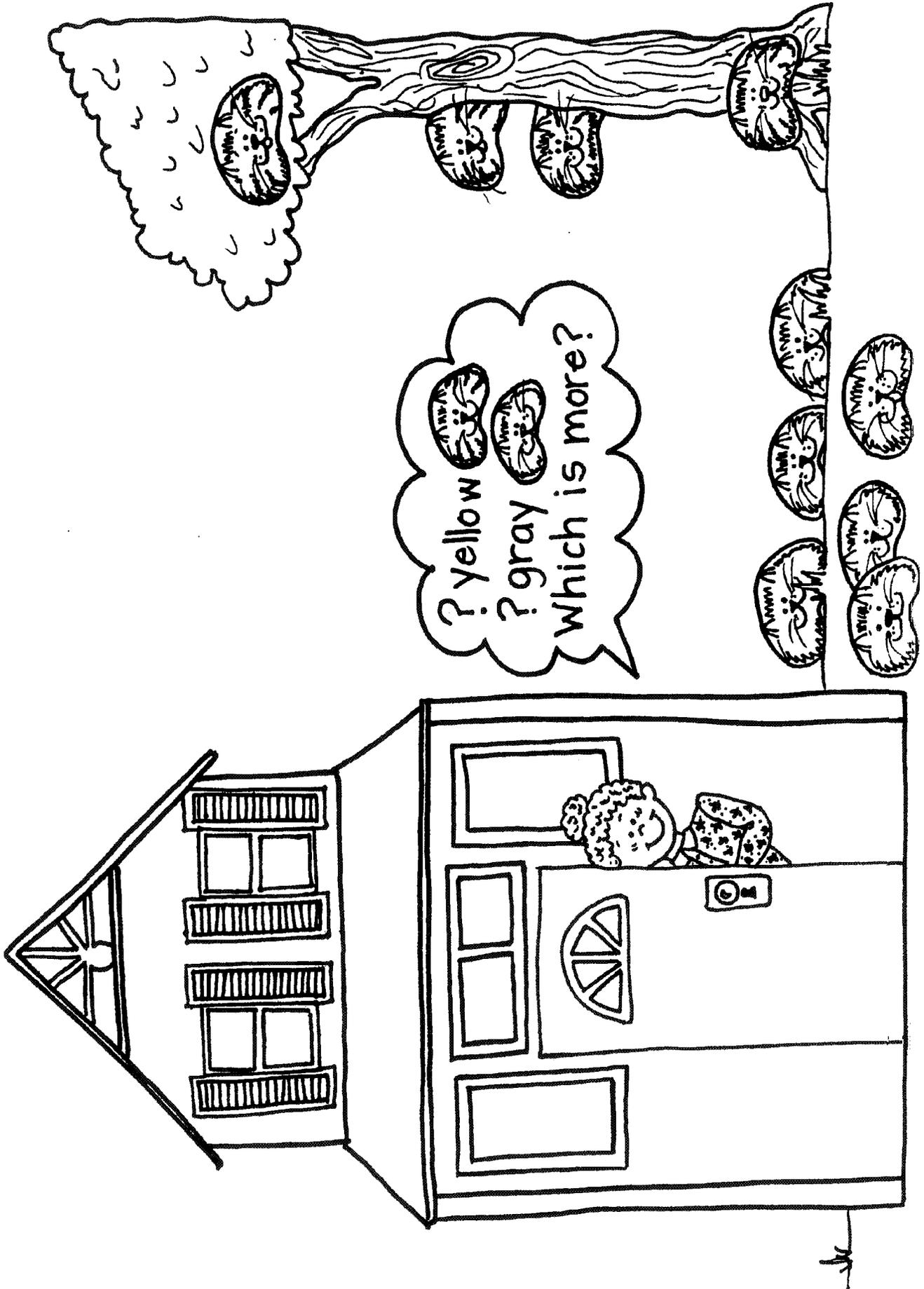
Secret Door Pattern 8

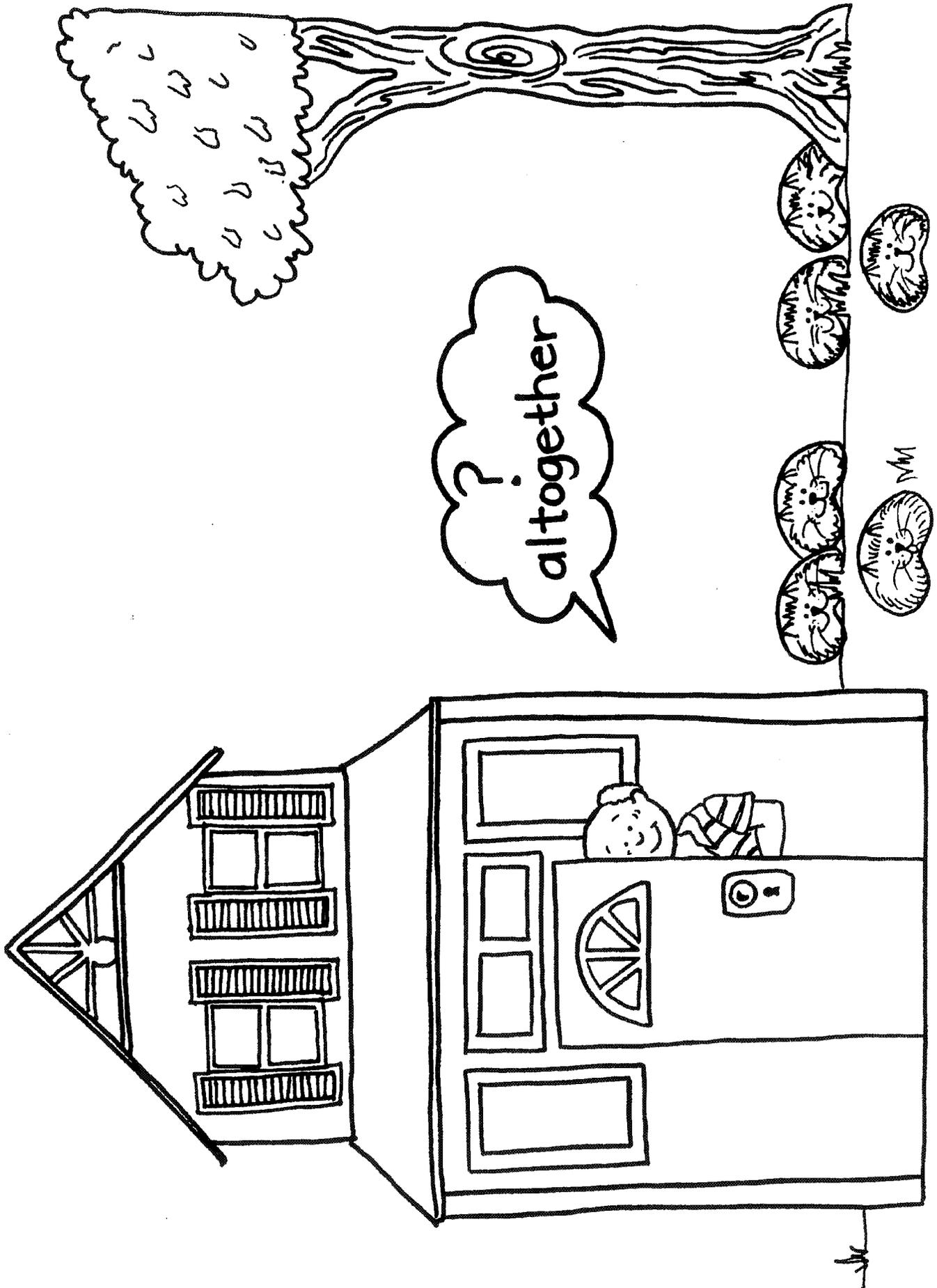
The kids kept on walking and saw another spooky-looking fence with some goblins, pumpkins, and ghosts. There was another secret door. What do you think is under the door? How can you tell?

Secret Door Pattern 9

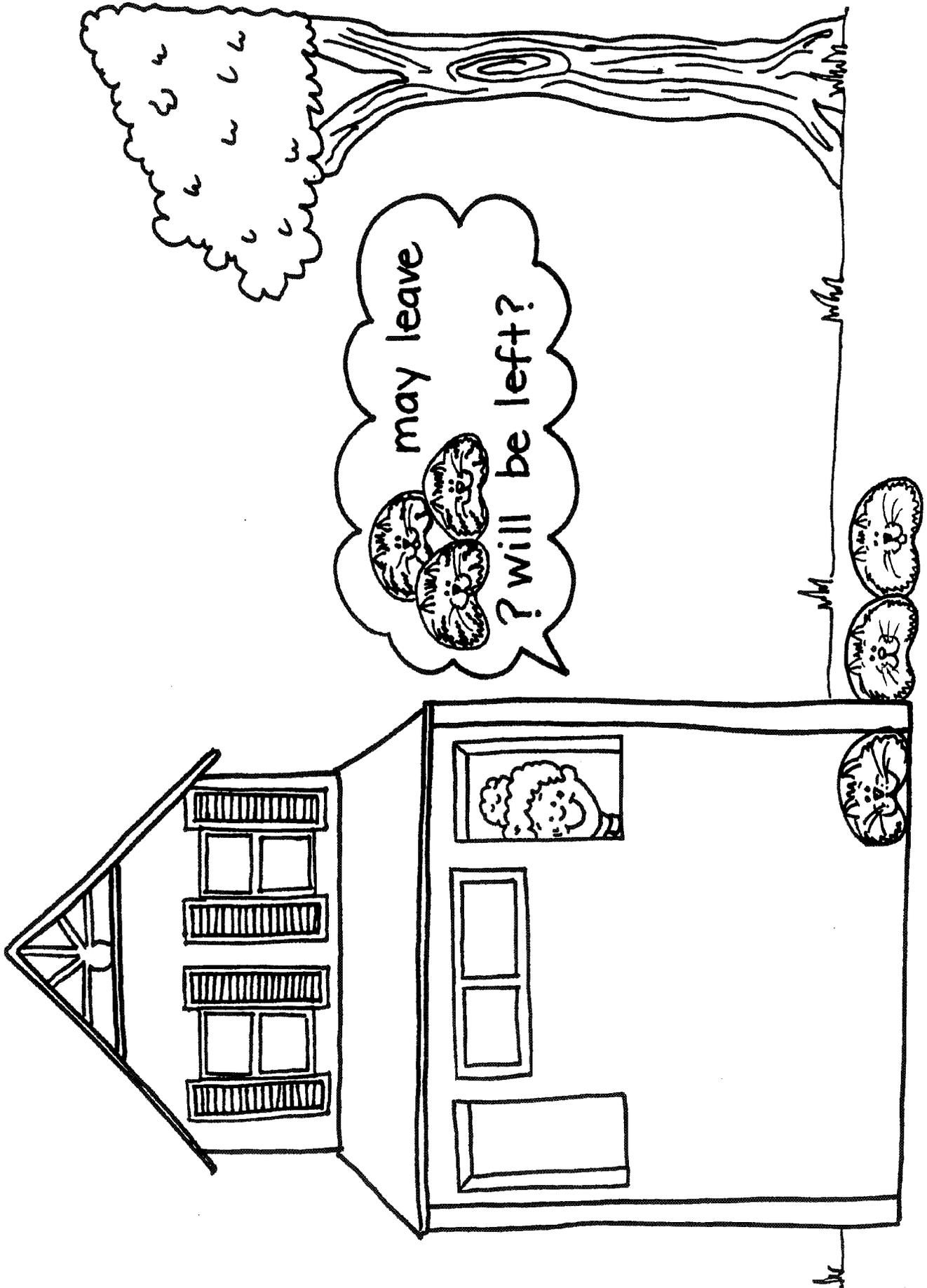
Oh no! The fence was covered with goblins, ghosts, and pumpkins. The trick-or-treaters couldn't figure out what was behind the secret door. Can you help them?

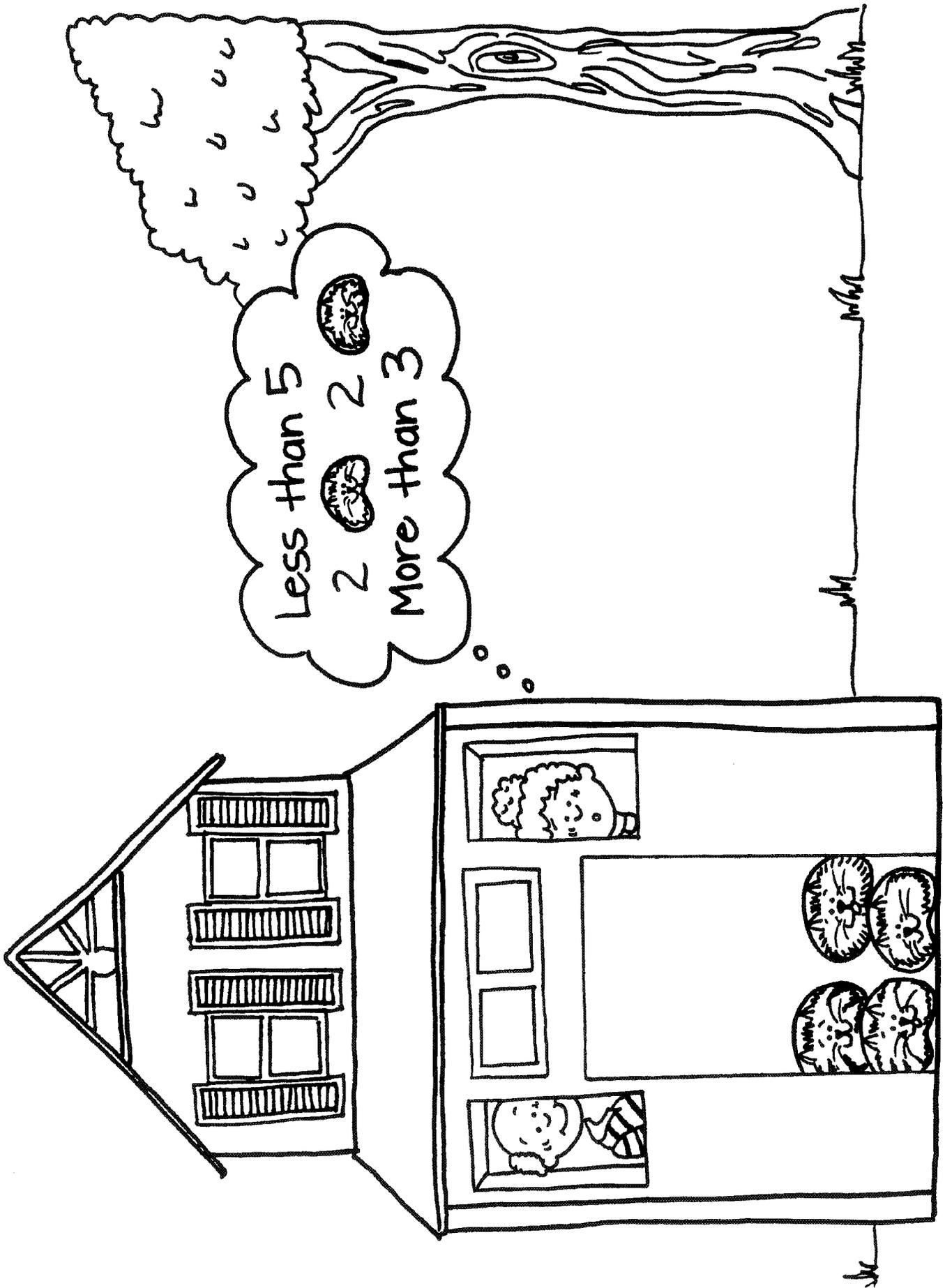
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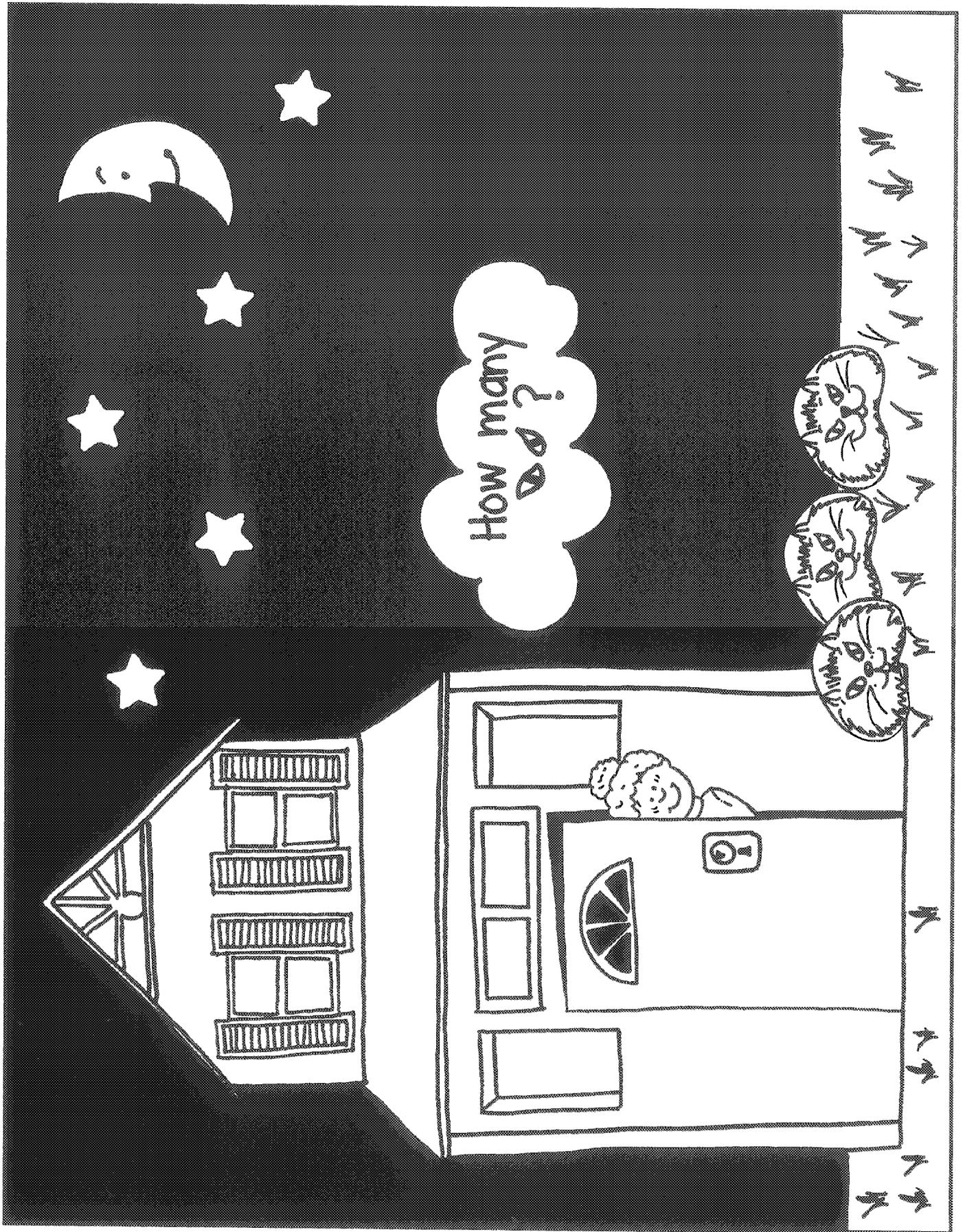


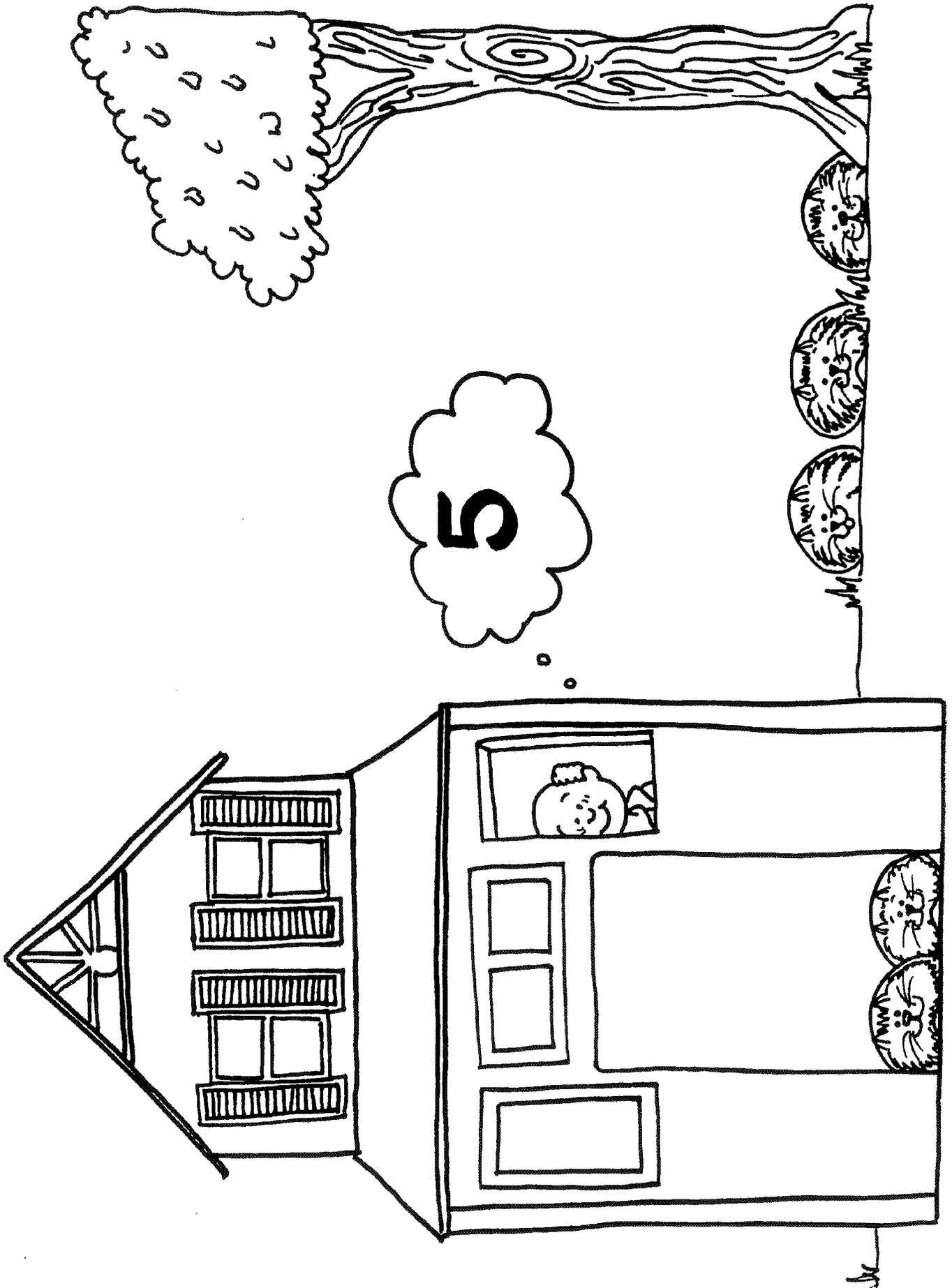


Tape Flap 3 on the house.



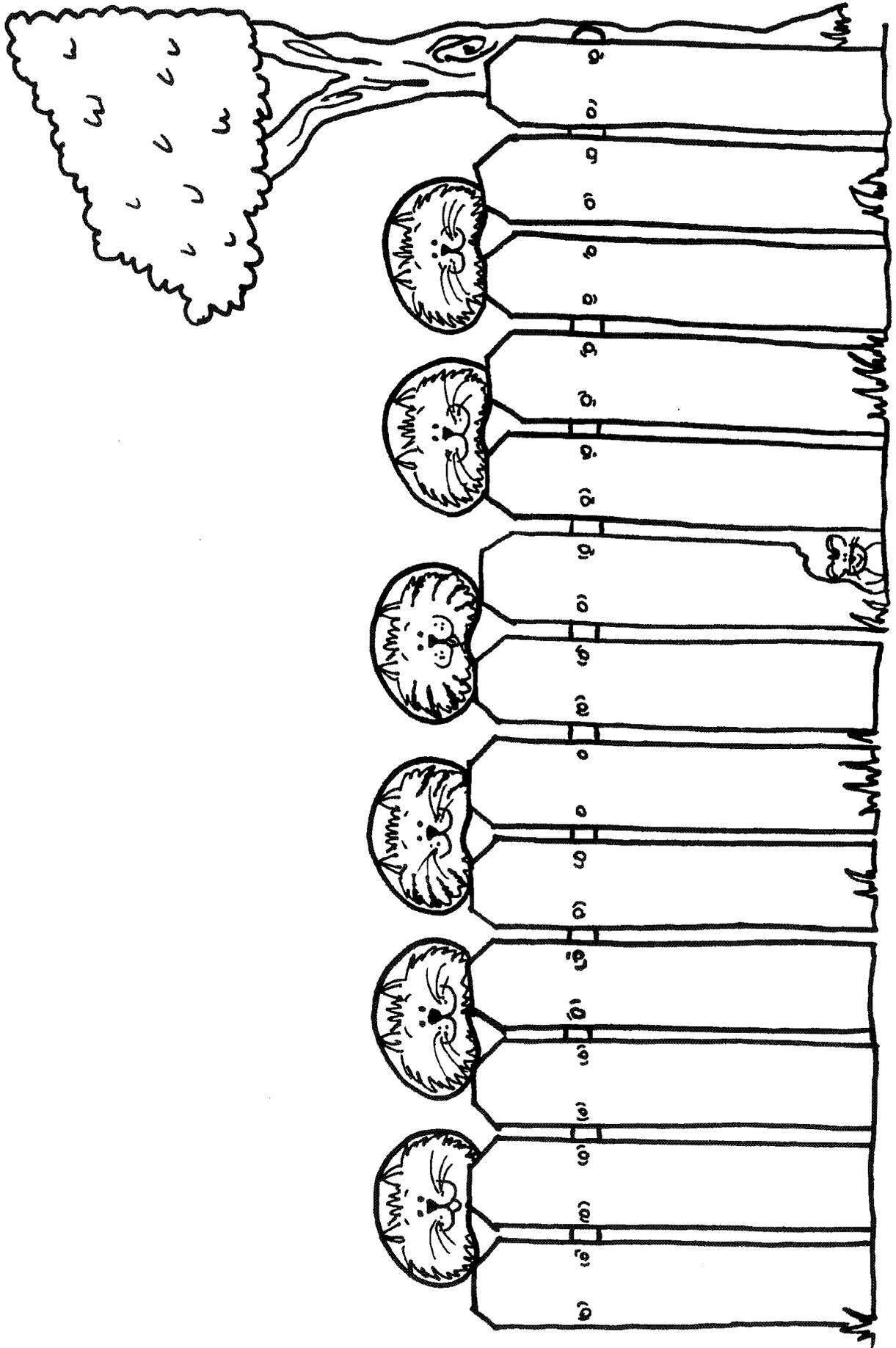




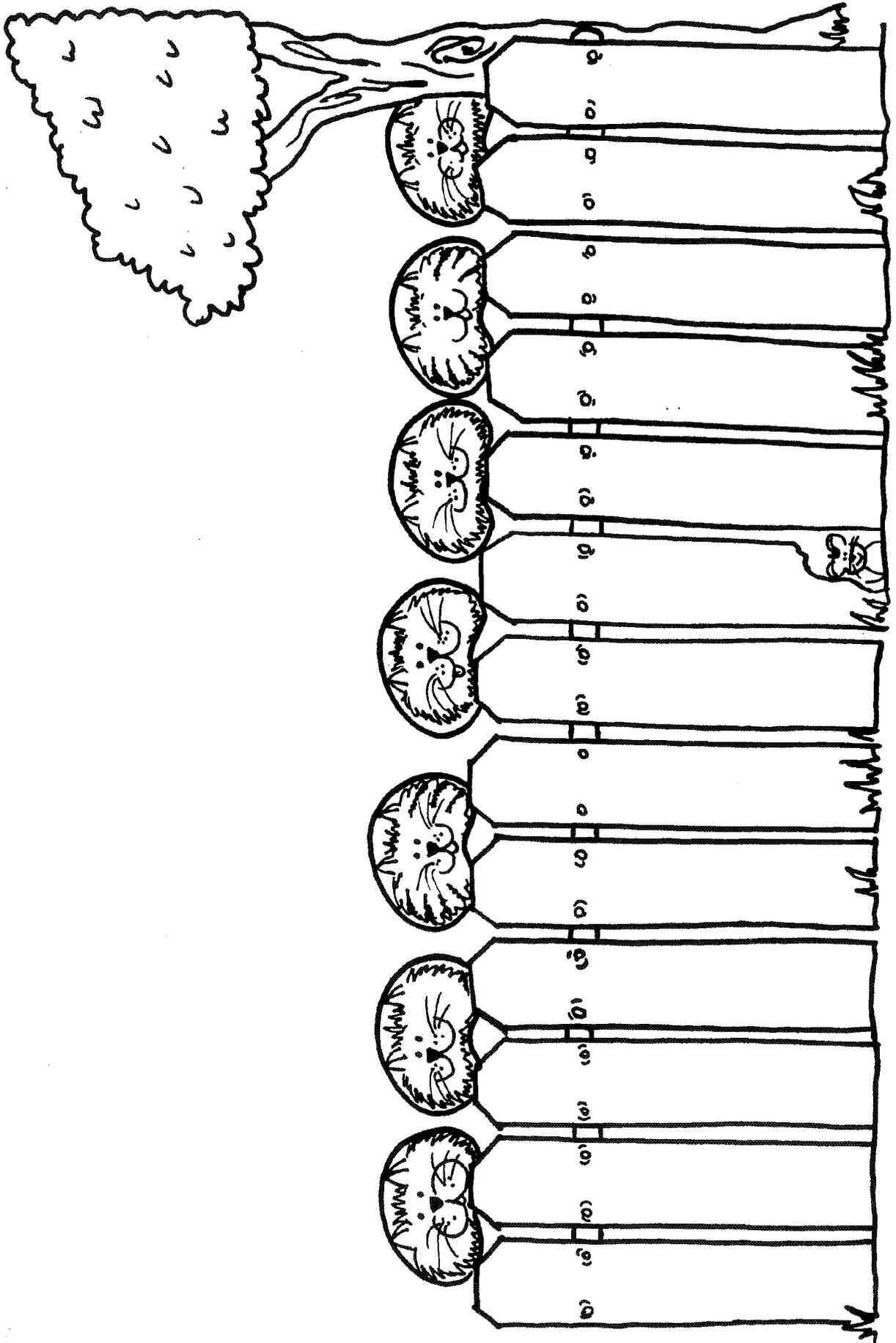


Picture Problem 7

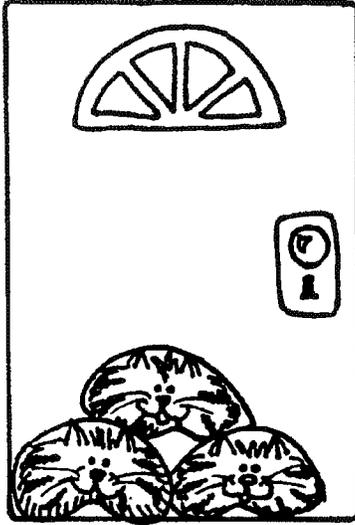
Tape a construction paper flap over one or two of the cats.



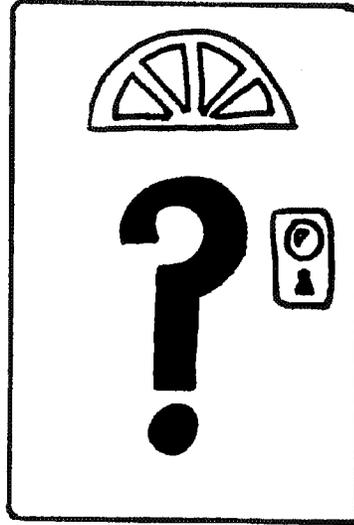
Tape a construction paper flap over one or two of the cats.



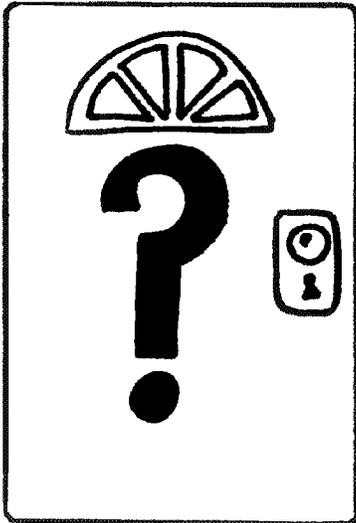
Flap 3

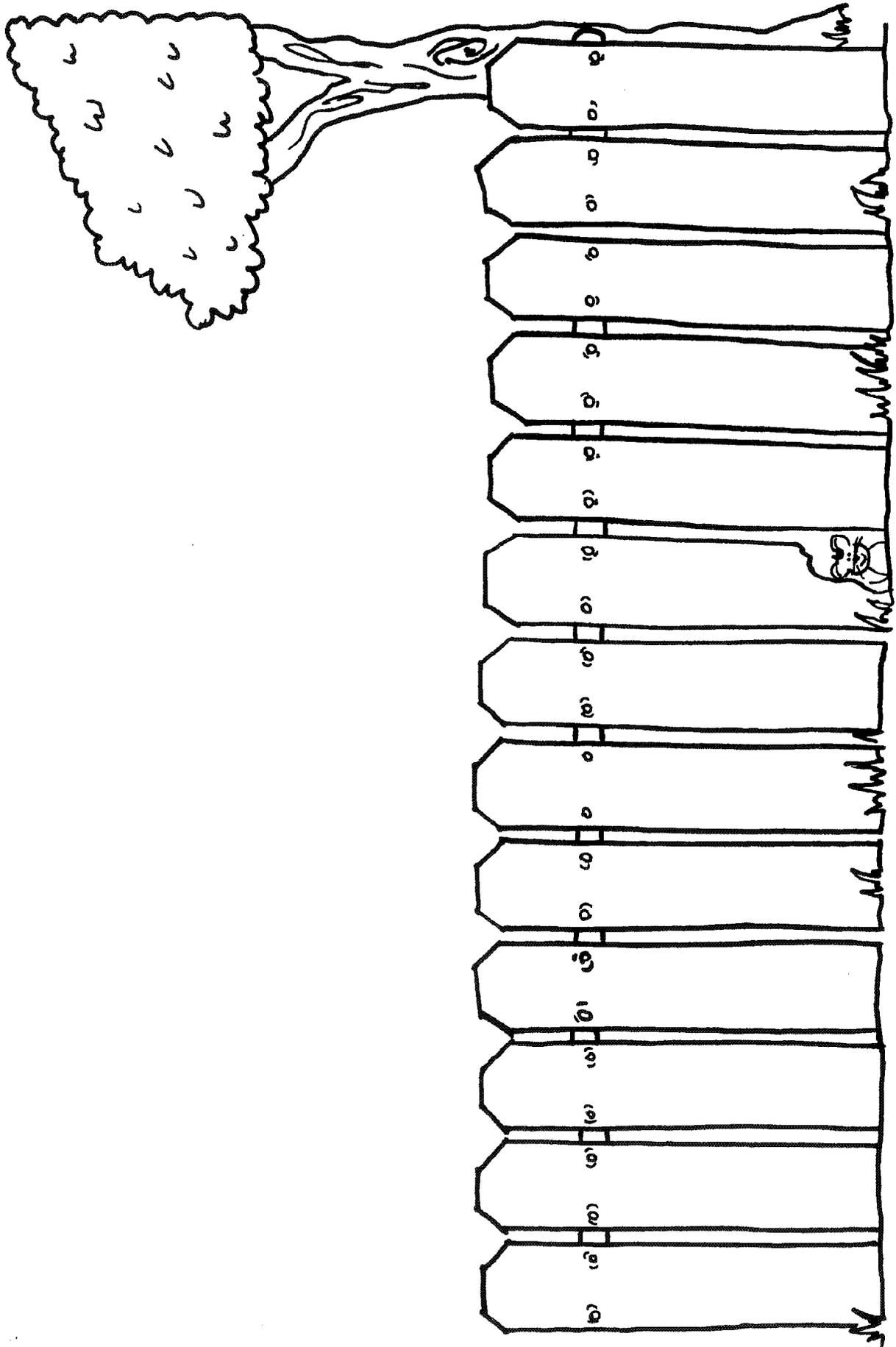


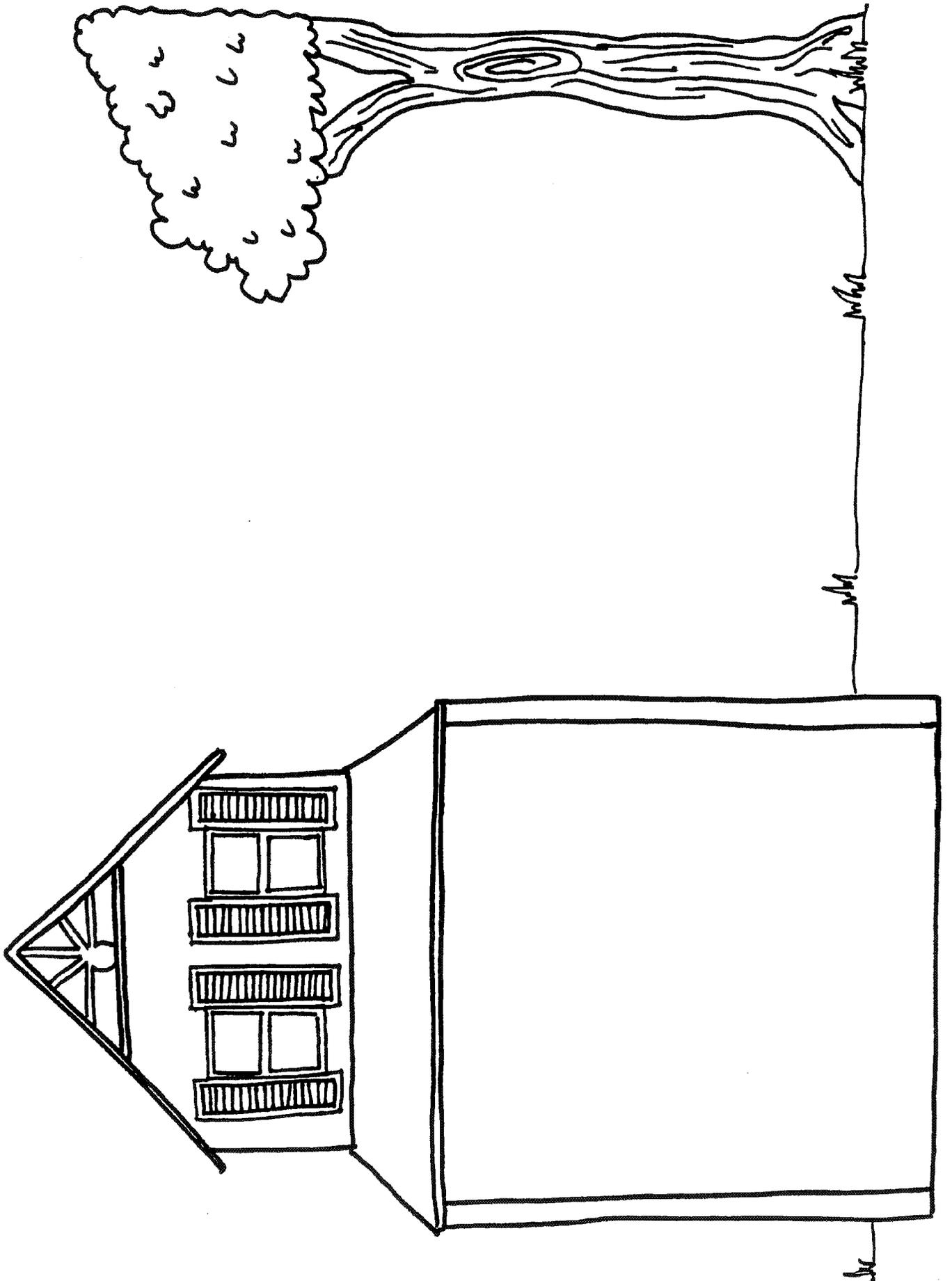
Flap 4



Flap 6







(Glue problem text to the back of each picture problem as teacher tips for having students figure out what is being asked by the picture problem.)

Picture Problem 1

It seems that more cats have come to visit the friendly people who live in the little cottage. Look! The lady has a bubble over her head. What do you think she's trying to figure out? Can you help her count how many yellow cats are out there? How many gray cats have come to visit? How many *more* gray cats than yellow cats does she see?

Picture Problem 2

The kind old man peeked out the door to see if any cats had come to visit. He saw three yellow cats on the grass and three gray cats by his house. How many cats did he see altogether?

Picture Problem 3

Early one morning, the kind old lady looked out the window and noticed that six cats were waiting by her house. If she had looked more carefully, she might have realized that three were so close to her door they would get pushed away when she opened the door. How many will she still be able to see?

(Glue problem text to the back of each picture problem as teacher tips for having students figure out what is being asked by the picture problem.)

Picture Problem 4

The little old man was playing a trick on the little old lady. He wanted her to guess how many cats he had let into the house. He told her it was less than five. *(Pause and let children discuss what the possibilities could be.)* The he told her there were two of each color. Finally he told her it was more than three cats altogether. How many do you think are behind the door?

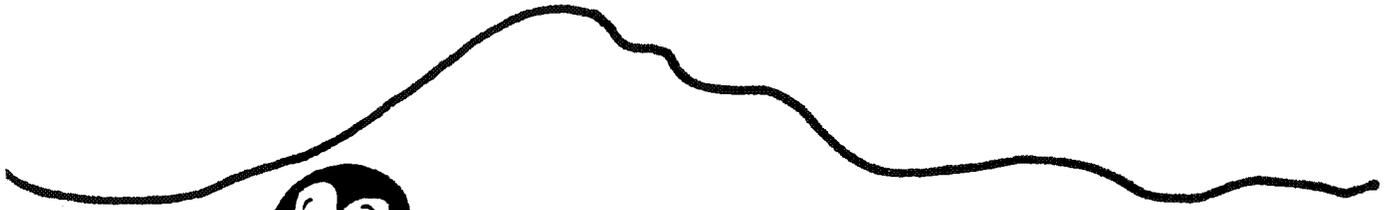
Picture Problem 5

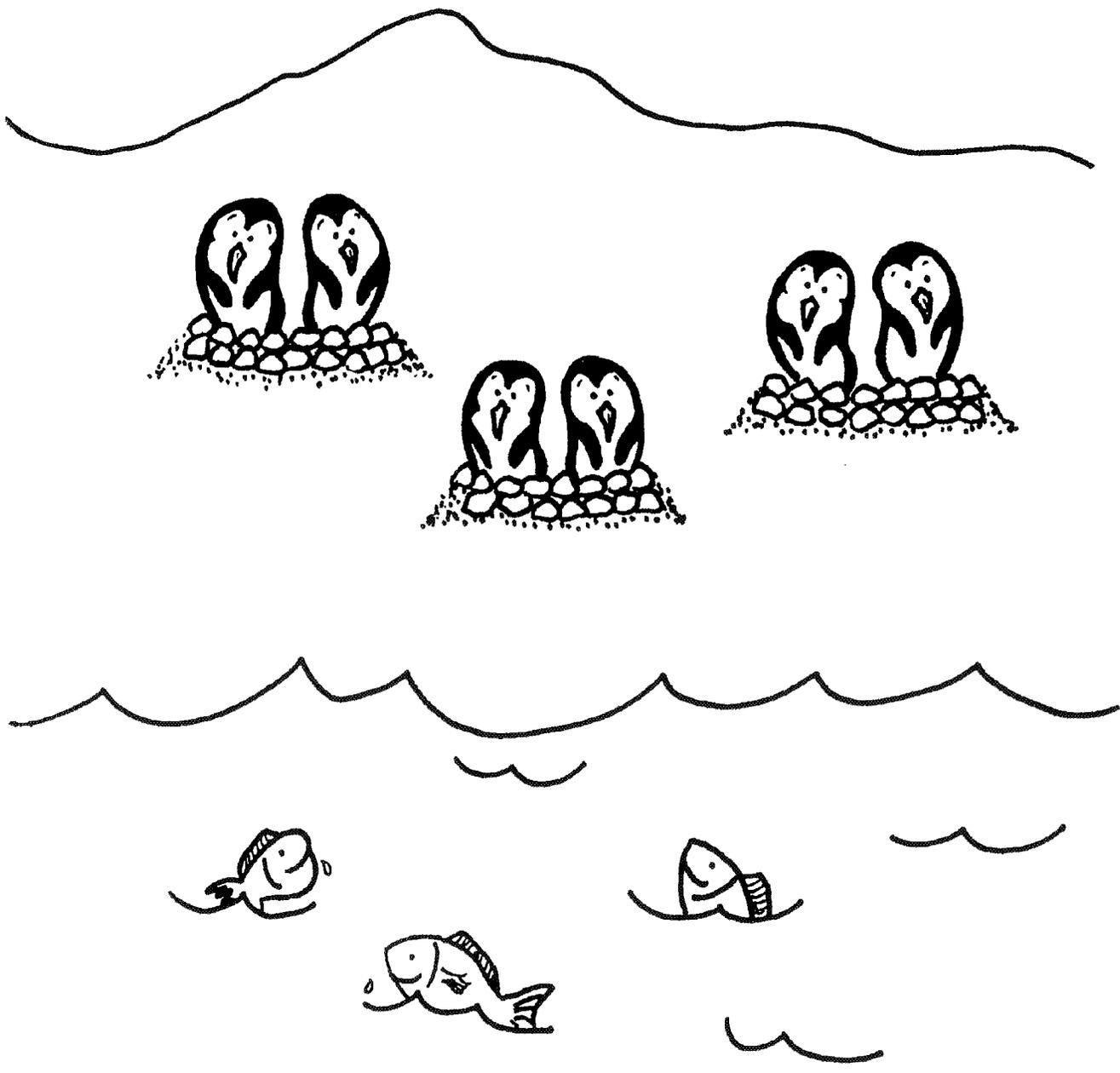
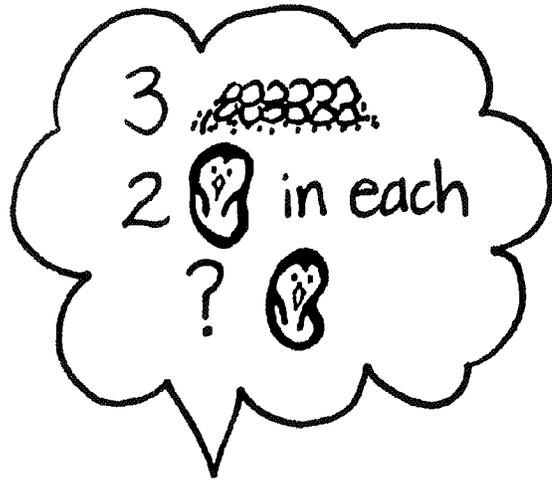
The moon was shining brightly. The kind old lady peeked out the door and saw three cats near the cottage. How many eyes were glowing in the light of the moon?

Picture Problem 6

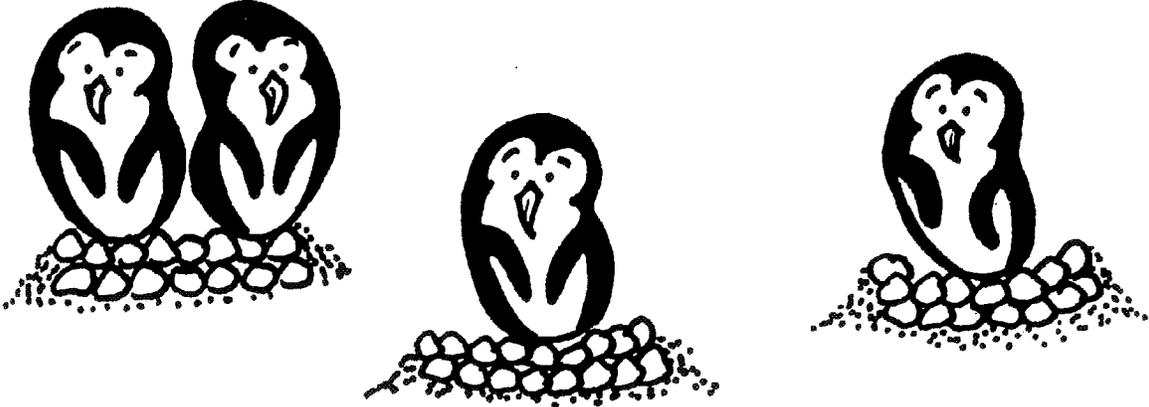
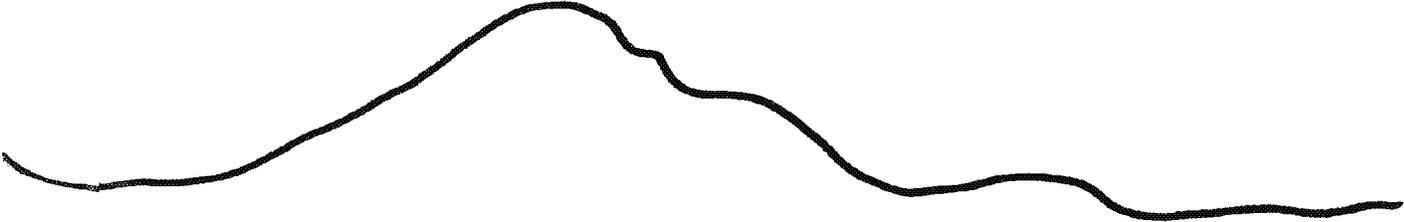
The kind old man slept a little later than his wife. When he asked her how many cats had come to visit, she told him there were five. When he looked out the window, he could only see three. Perhaps the little old lady had let some of them inside the house. How many cats do you think are inside?

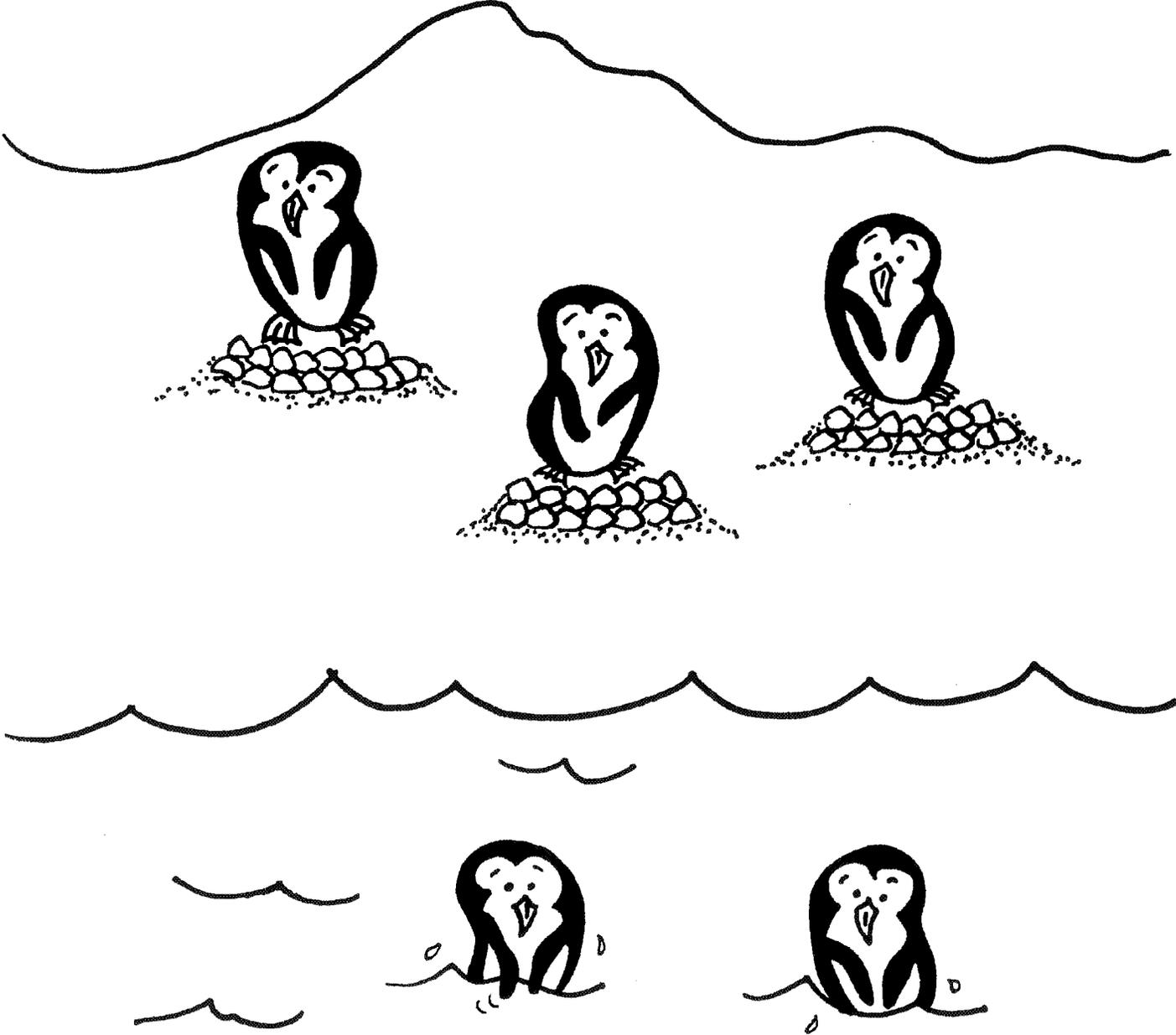
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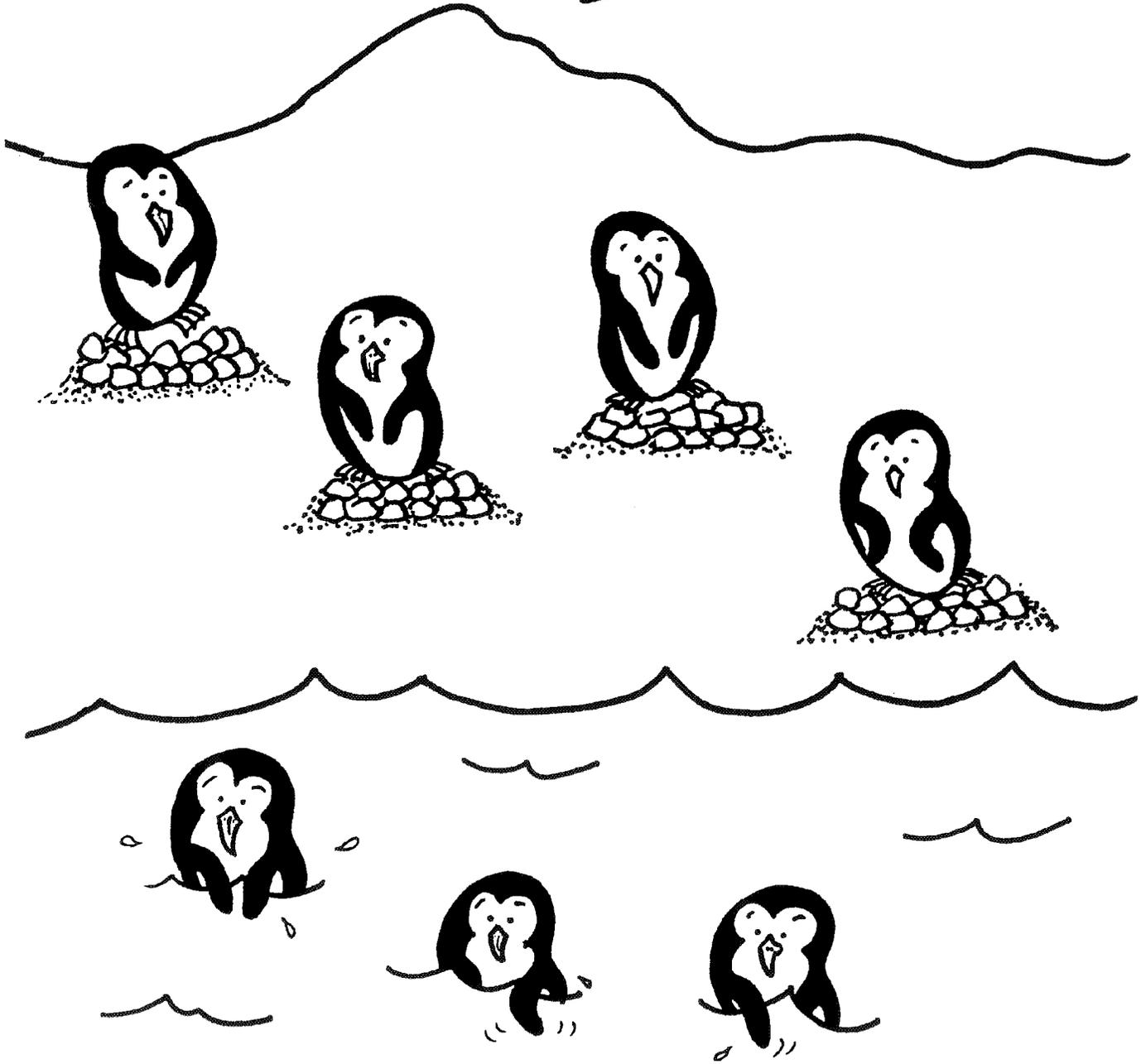




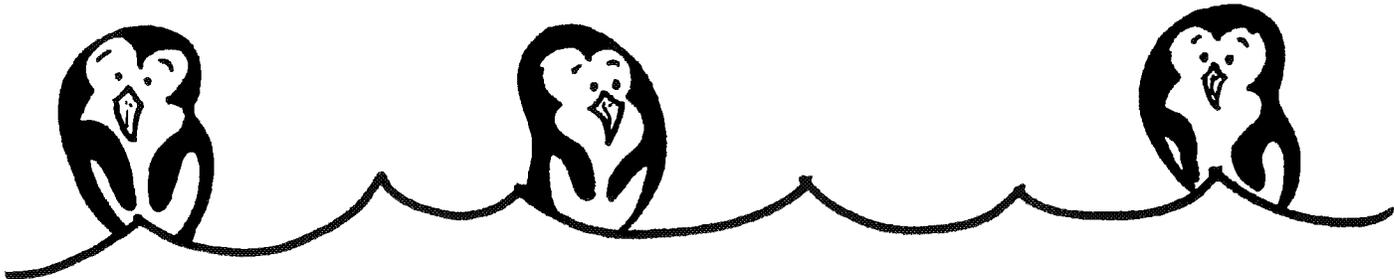
? more in the 
than on the
rocks 



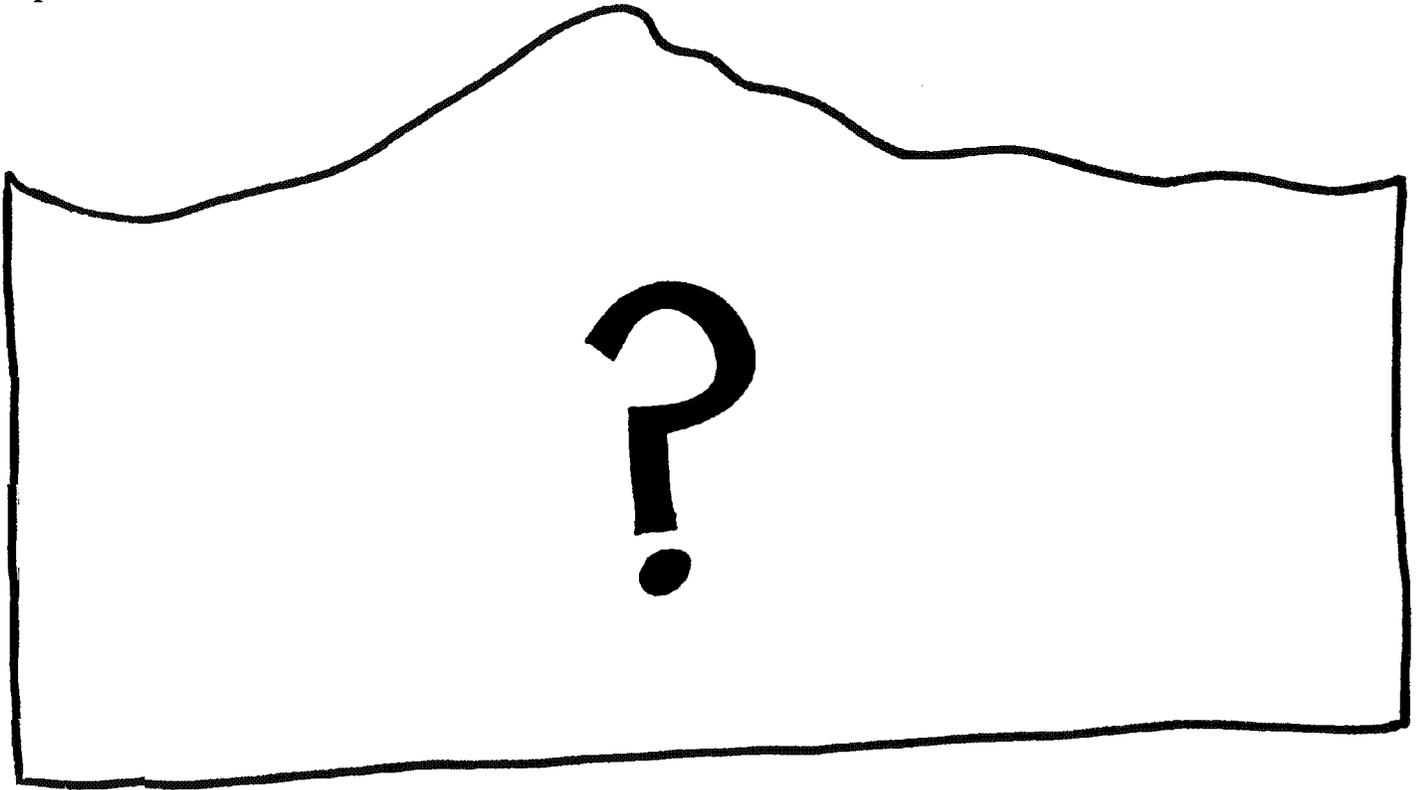




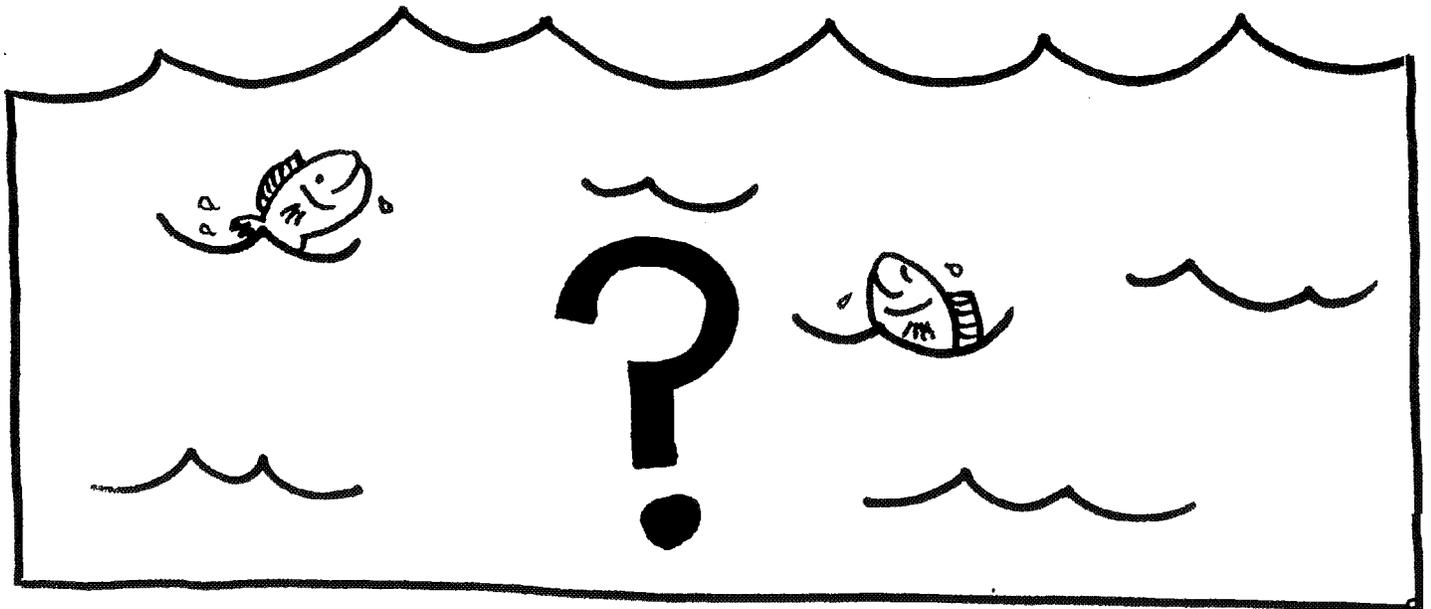
3 will swim away...
? will be left...



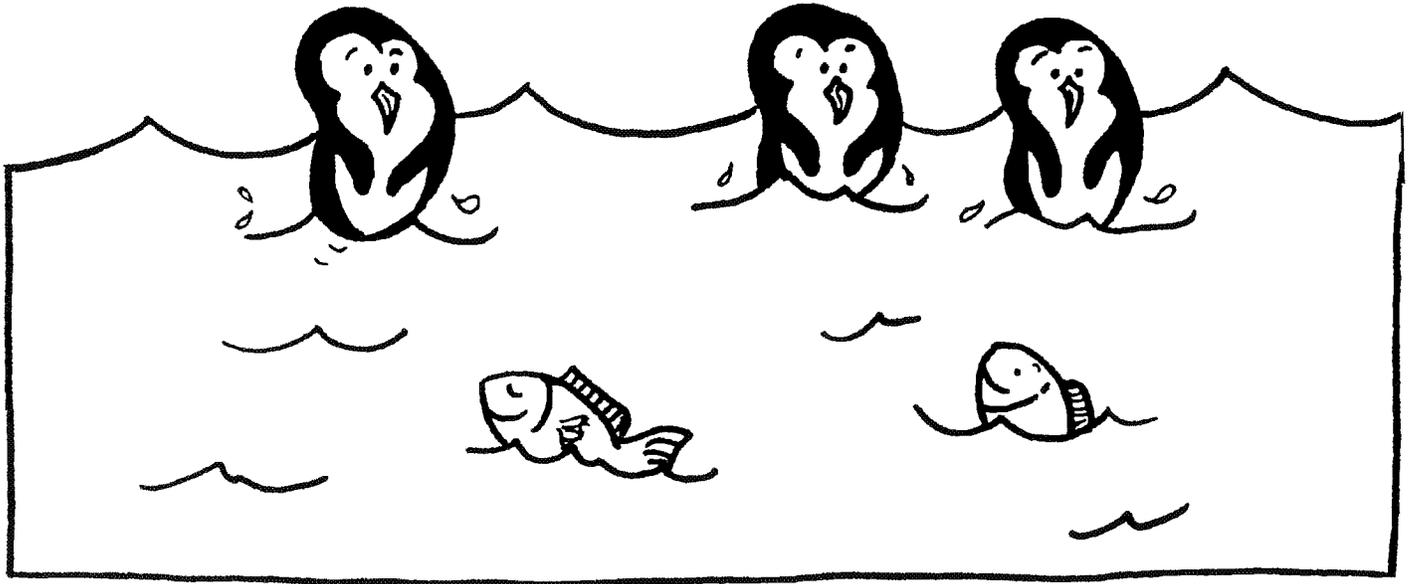
Flap 2

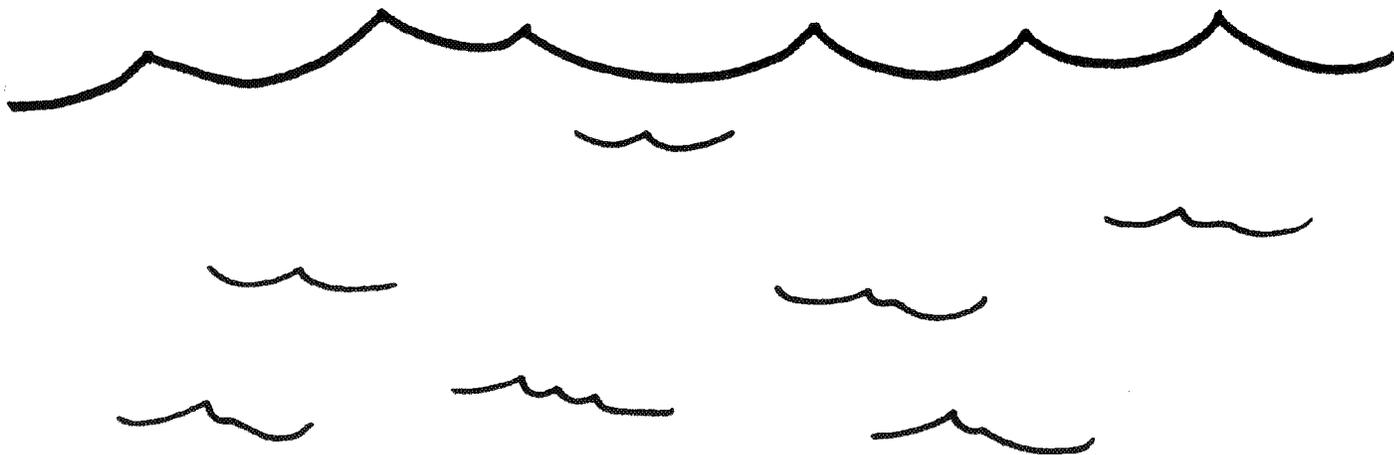
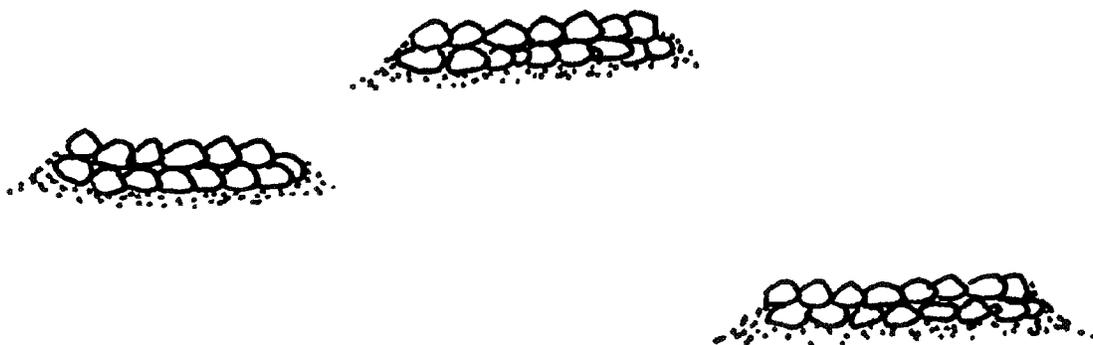
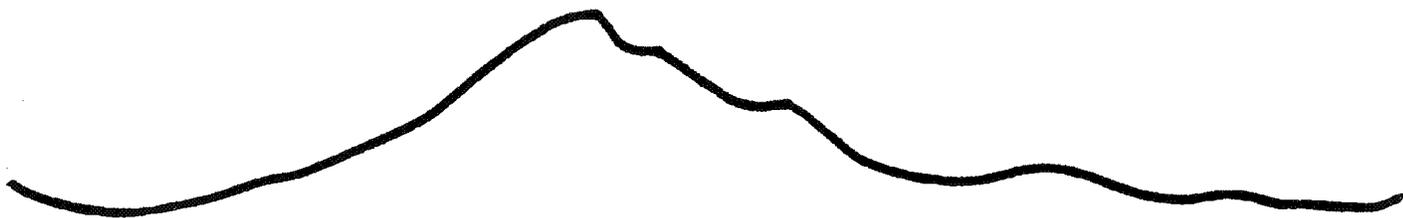


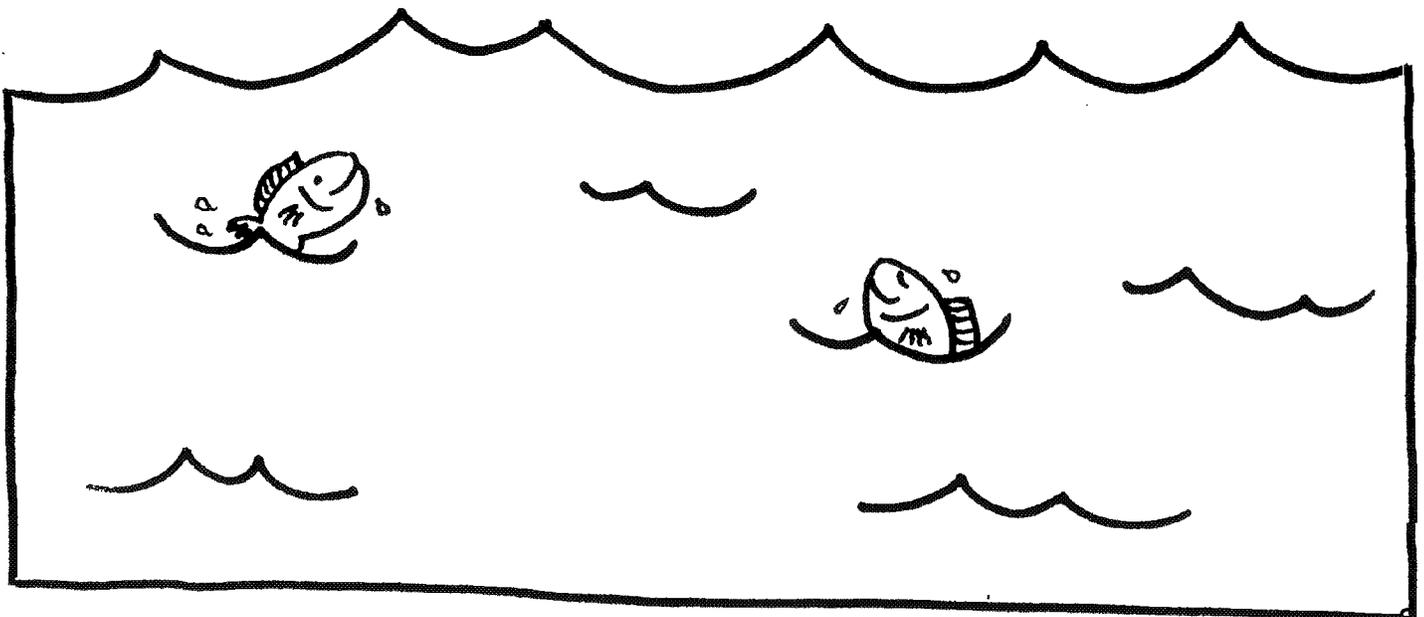
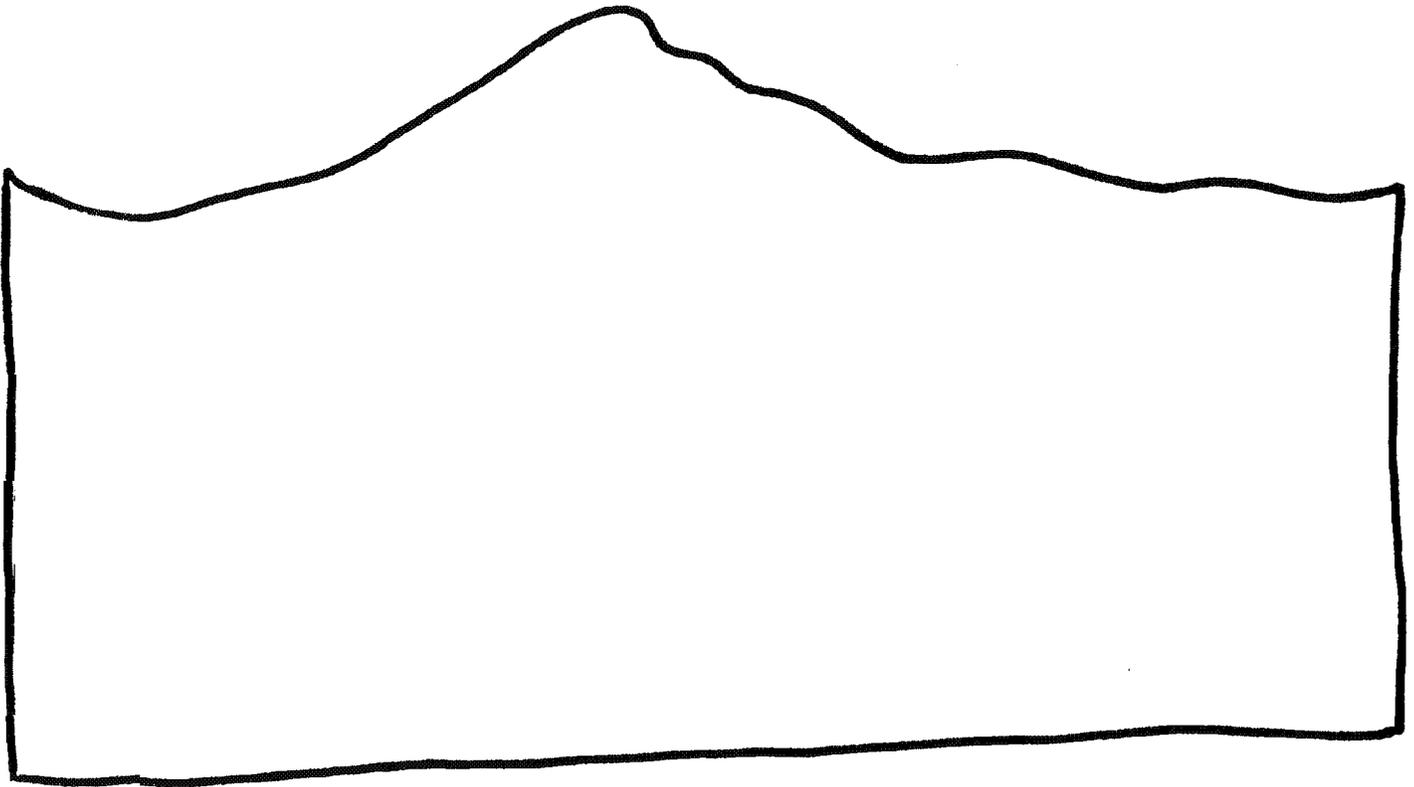
Flap 4



Flap 6







Glue problem text to the back of each picture problem as teacher tips for having students figure out what is being asked by the picture problem.

Picture Problem 1

There were three adult penguins sitting on their nests. Their feet seemed to help cover the eggs. How many feet altogether?

Picture Problem 2

There were three penguin nests safely hidden from view of predators. There were two baby penguins in each nest. How many babies were in the three nests altogether?

Picture Problem 3

There were four penguins on the rocks and five in the water. Were there more penguins on the rocks or in the water? How many more?

Picture Problem 4

The naturalist looked through her binoculars and thought she saw five penguins on the rocks. Suddenly, there was a splash and when she looked again, she could see that only three remained on the rocks. How many had paddled into the water?

Story Flaps

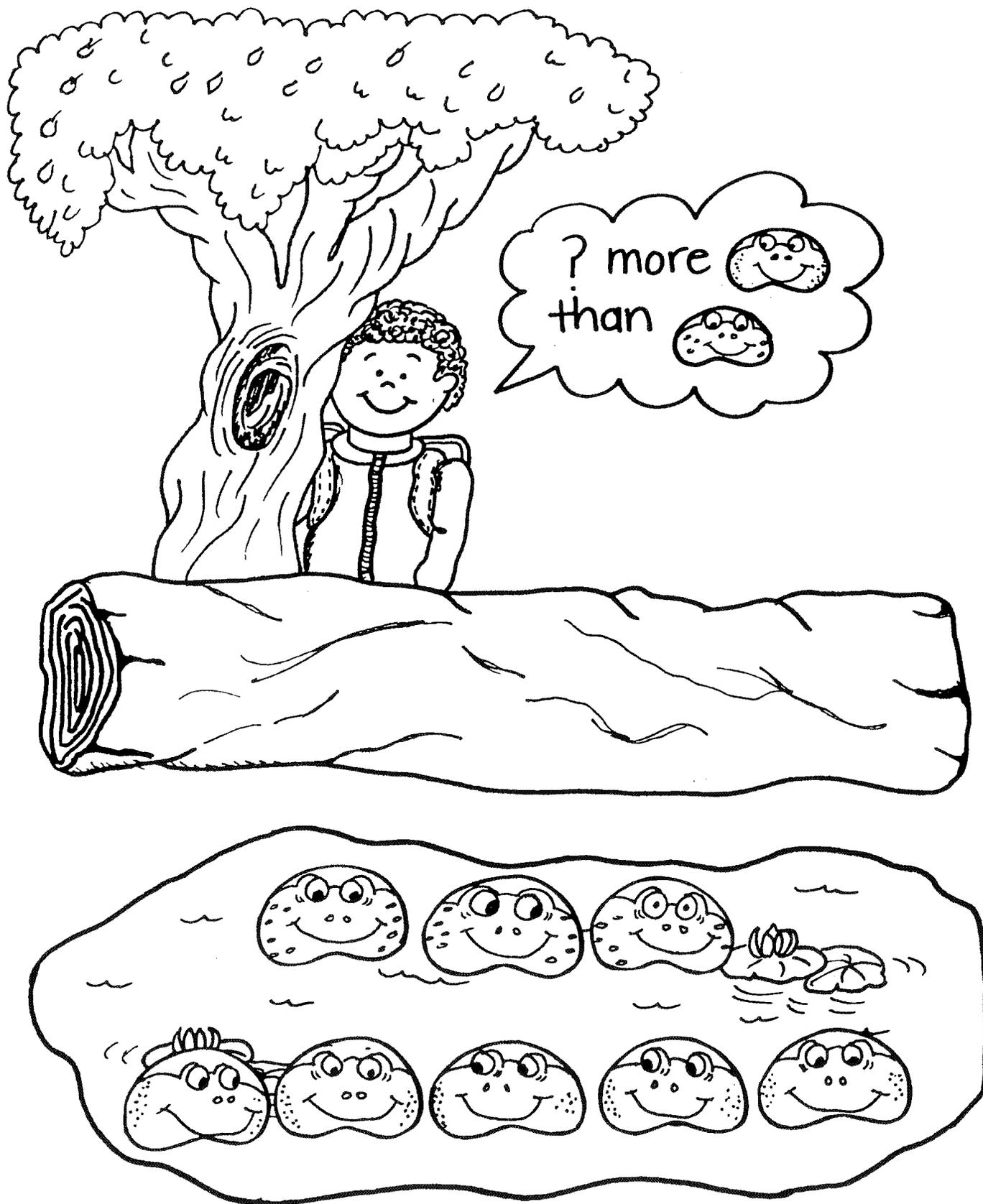
Glue problem text to the back of each picture problem as teacher tips for having students figure out what is being asked by the picture problem.

Picture Problem 5

There were four penguins on the rocks and three swimming in the water. How many penguins were there altogether?

Picture Problem 6

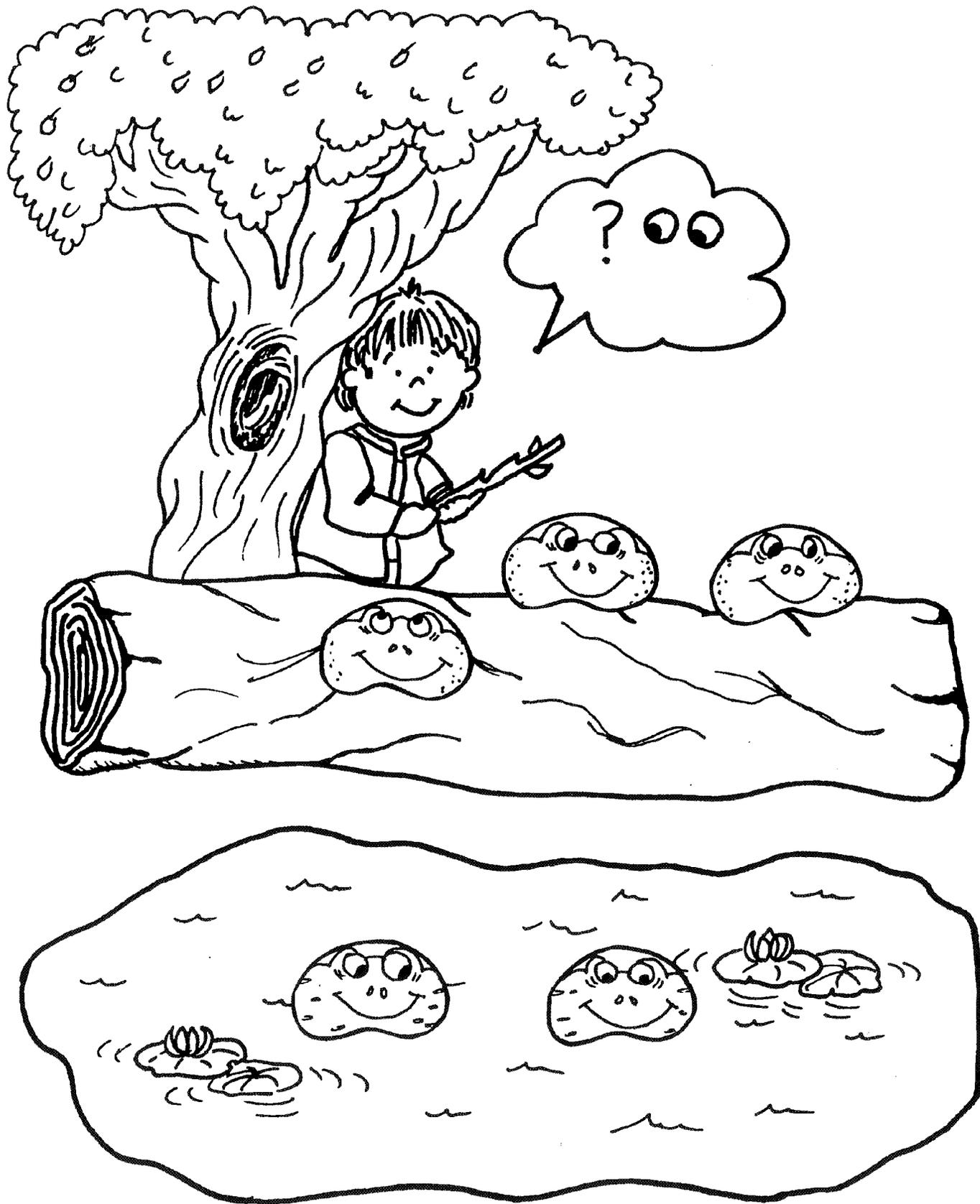
There were six penguins in all, three on the rocks and three in the water. Soon, three will swim away in search of food. How many will be left?



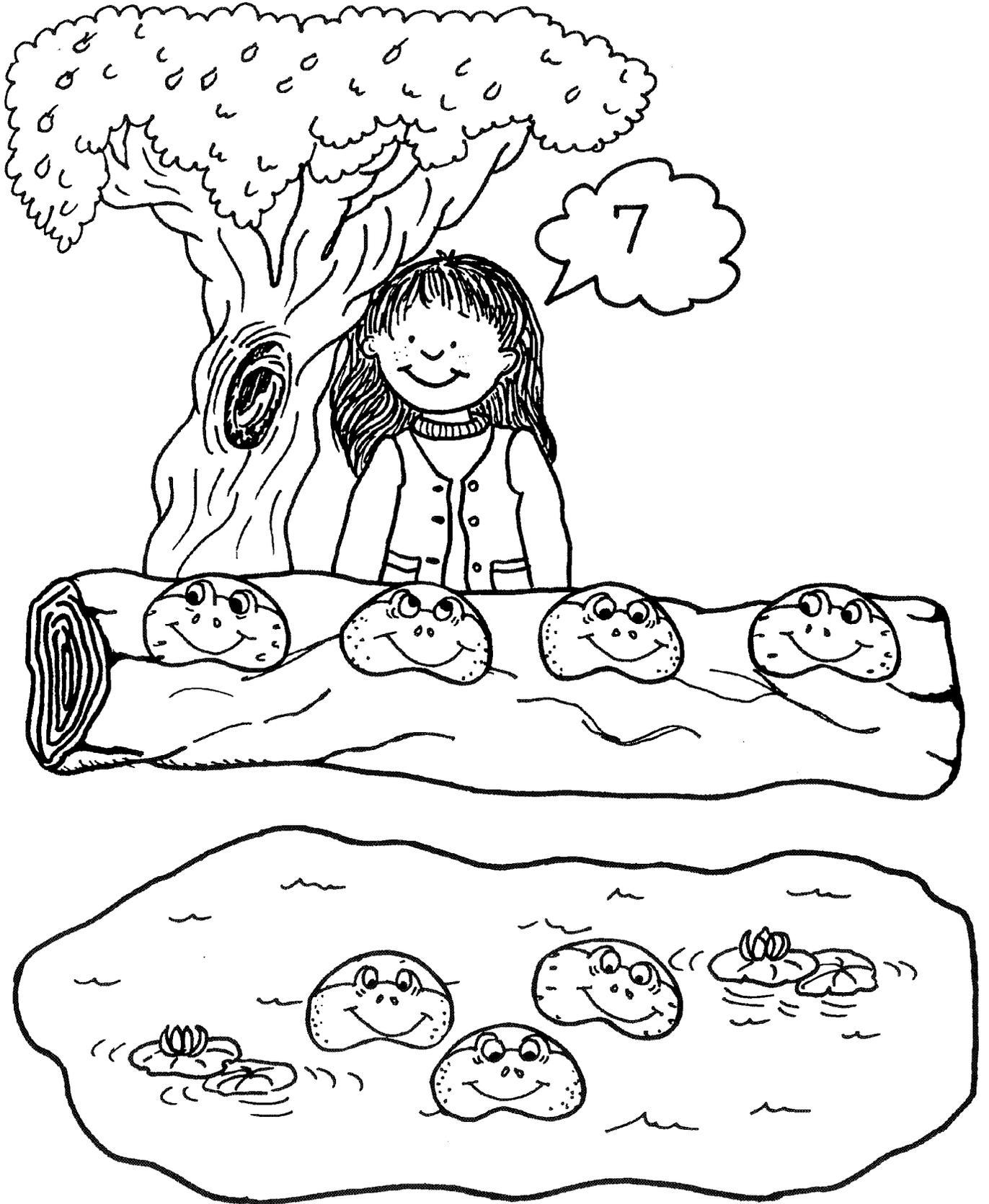


Picture Problem 3
Tape Flap 3 over pond.

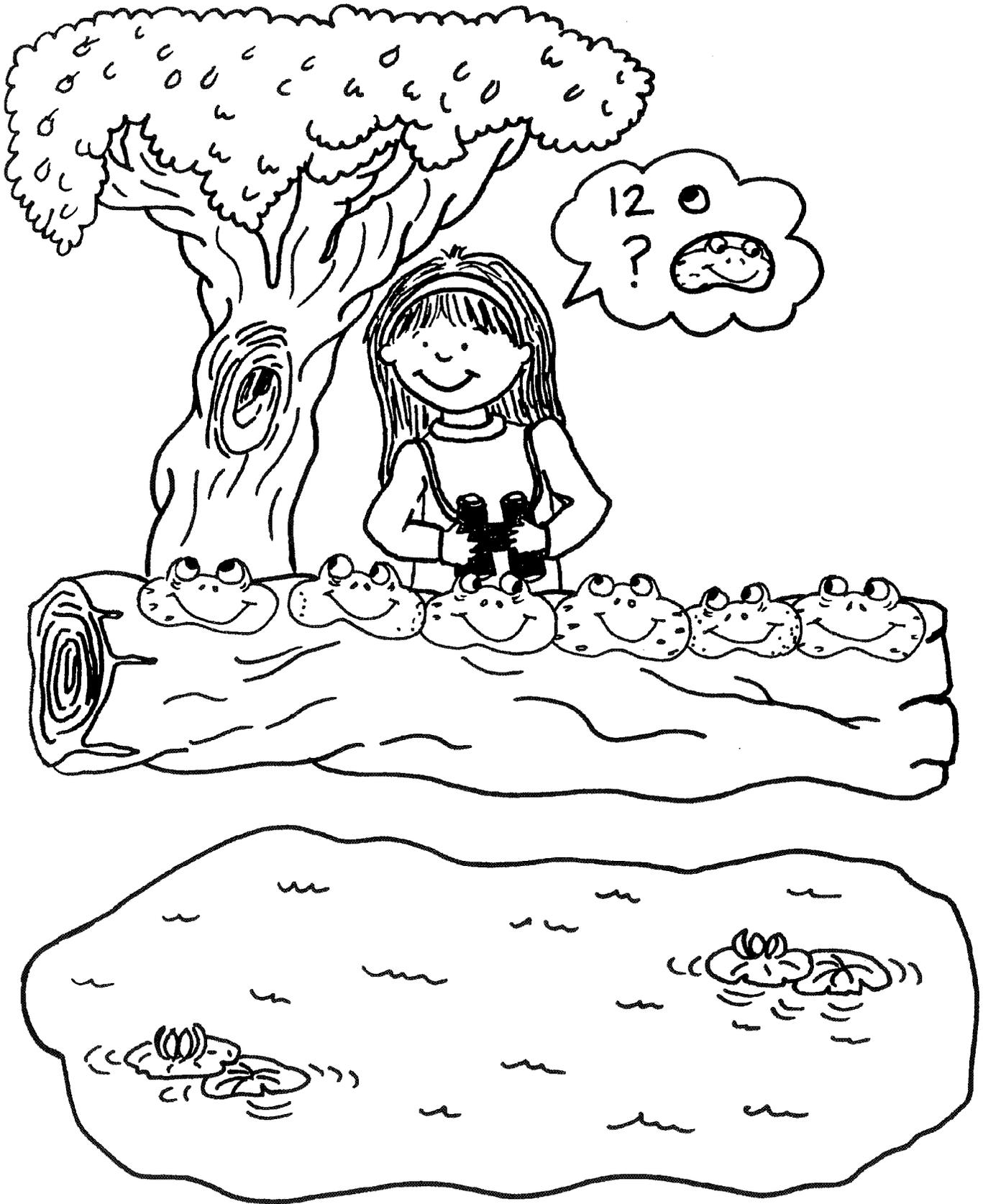




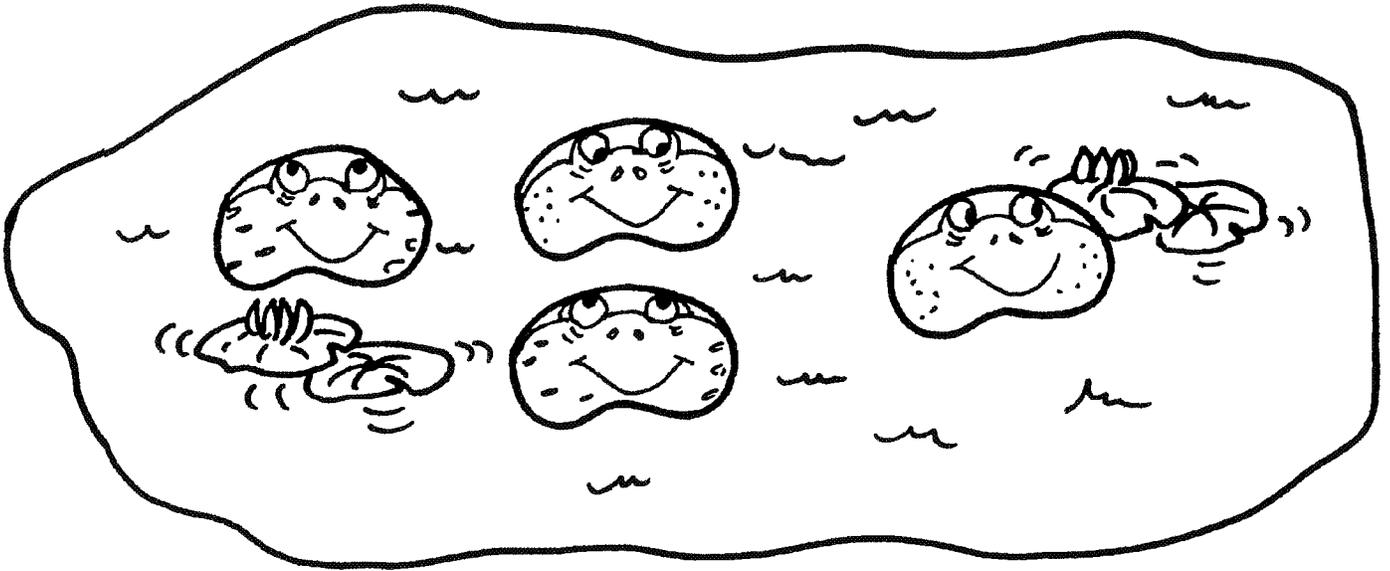
Picture Problem 5
Tape Flap 5 over pond.



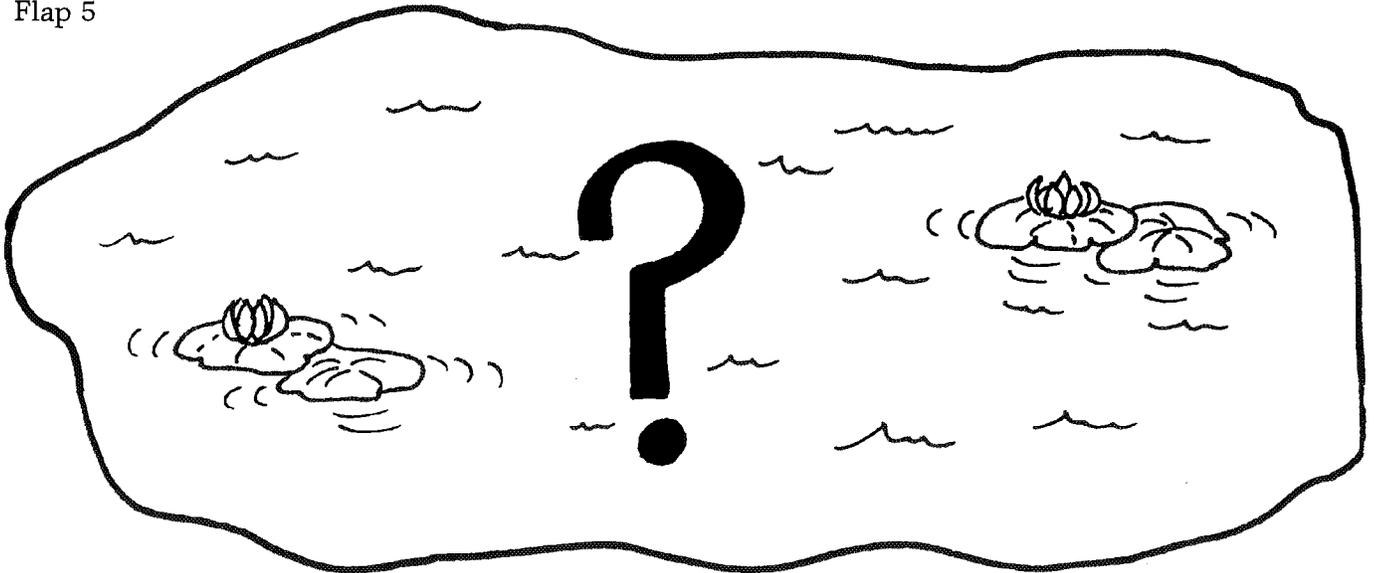
Tape Flap 6 over log, allowing just eyes to show.



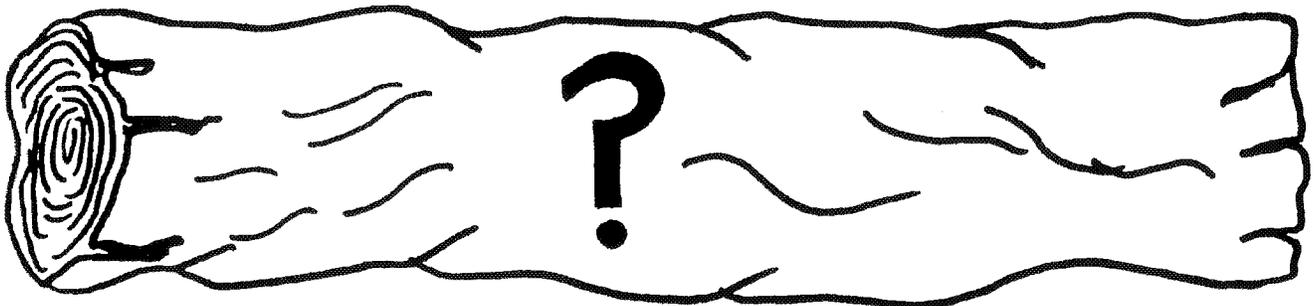
Flap 3

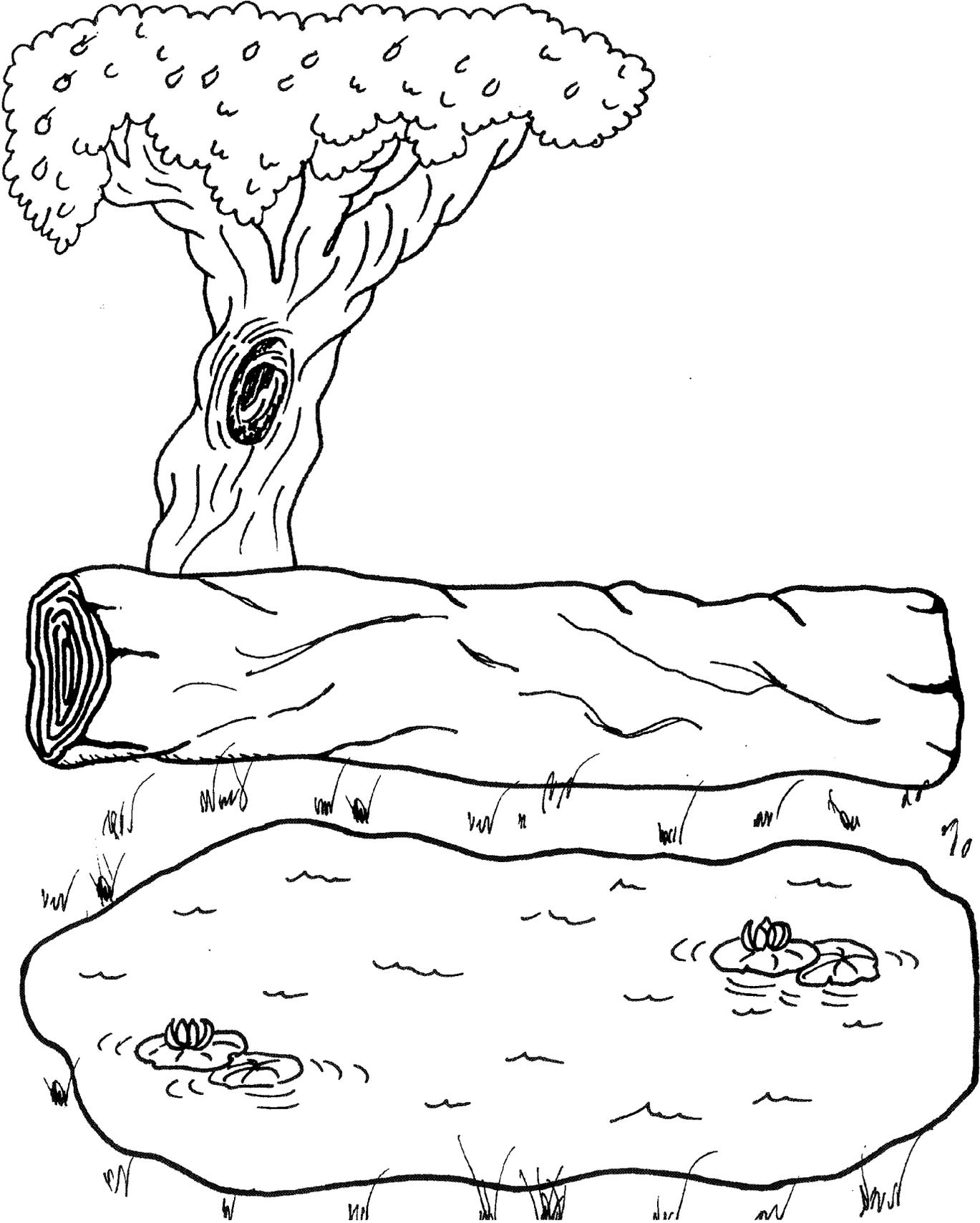


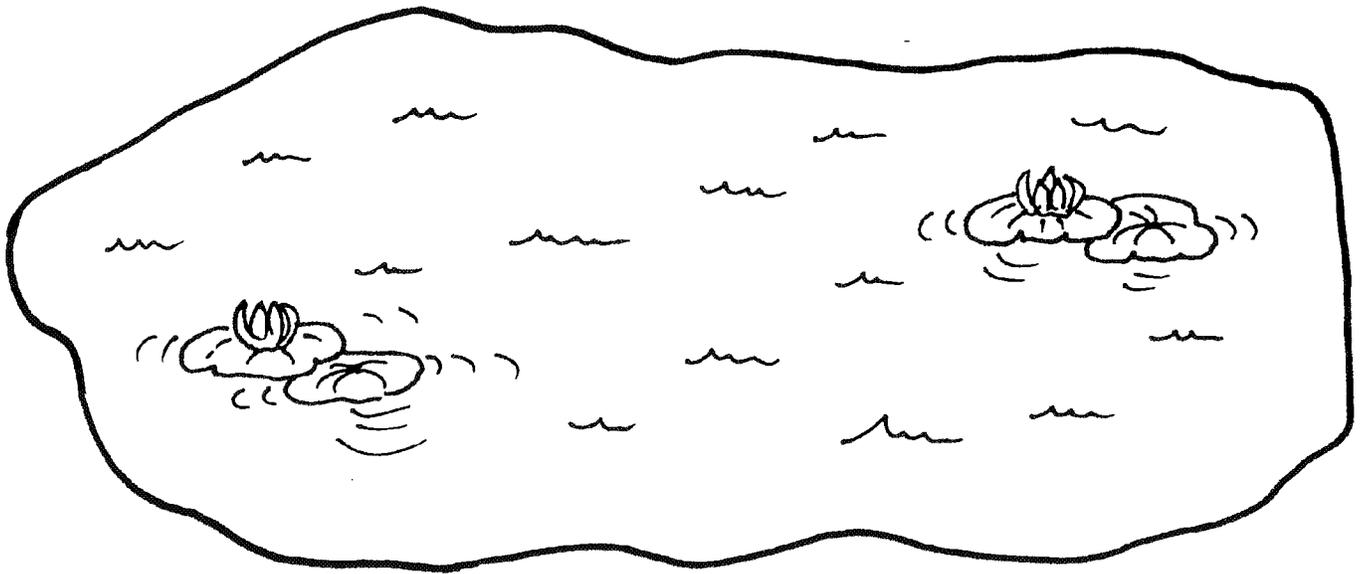
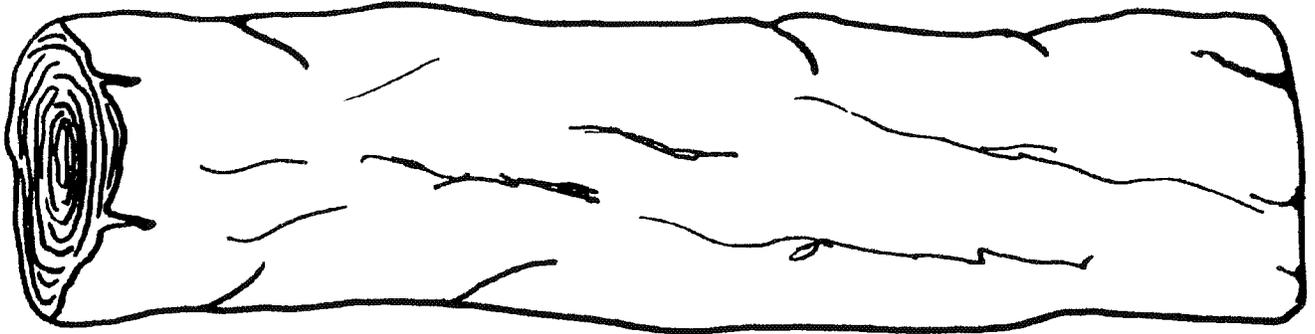
Flap 5



Flap 6







(Glue problem text to the back of each picture problem as teacher tips for having students figure out what is being asked by the picture problem.)

Picture Problem 1

The young boy was hoping to find some frogs and toads. He peeked out from behind a tree and saw three brown toads and five green frogs swimming in the water. How many more green frogs than brown toads?

Picture Problem 2

A park ranger was studying the park's frogs and toads. He saw four green frogs on a log and three brown toads in the water. How many frogs and toads did he see in all?

Picture Problem 3

The woman thought she could see seven frogs and toads in all. Suddenly, a big wave hit the water. Perhaps a boat had gone by because four of the frogs and toads just seemed to disappear. How many were left? *(Swing water flap away to have them disappear.)*

(Glue problem text to the back of each picture problem as teacher tips for having students figure out what is being asked by the picture problem.)

Picture Problem 4

The little boy couldn't believe what big eyes those frogs and toads had. He could see five frogs and toads altogether. How many big eyes did he see?

Picture Problem 5

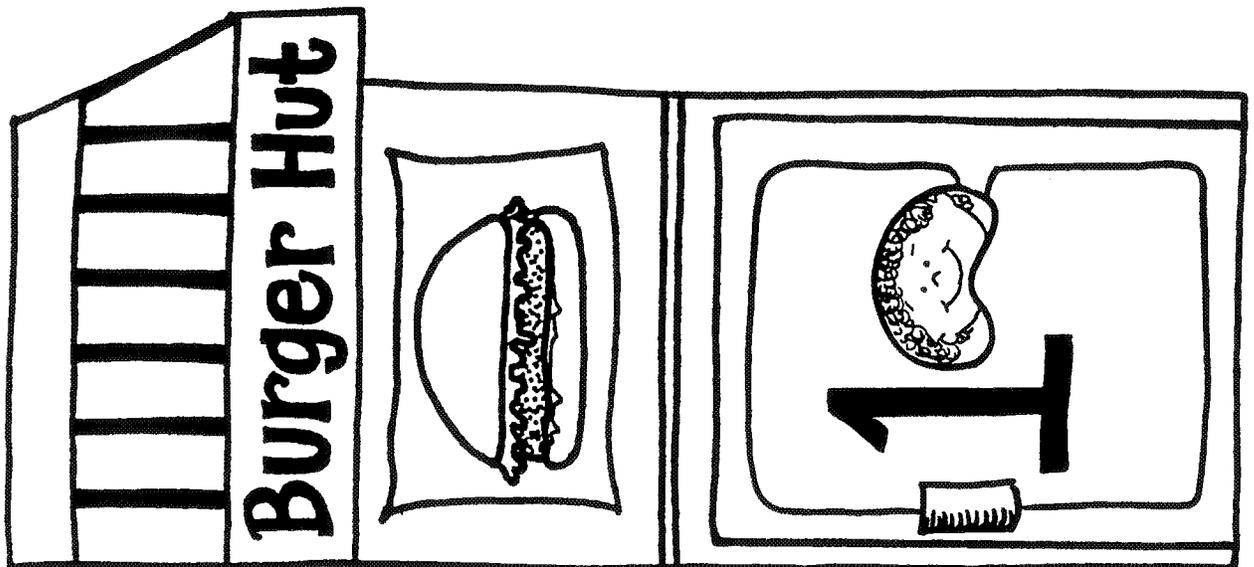
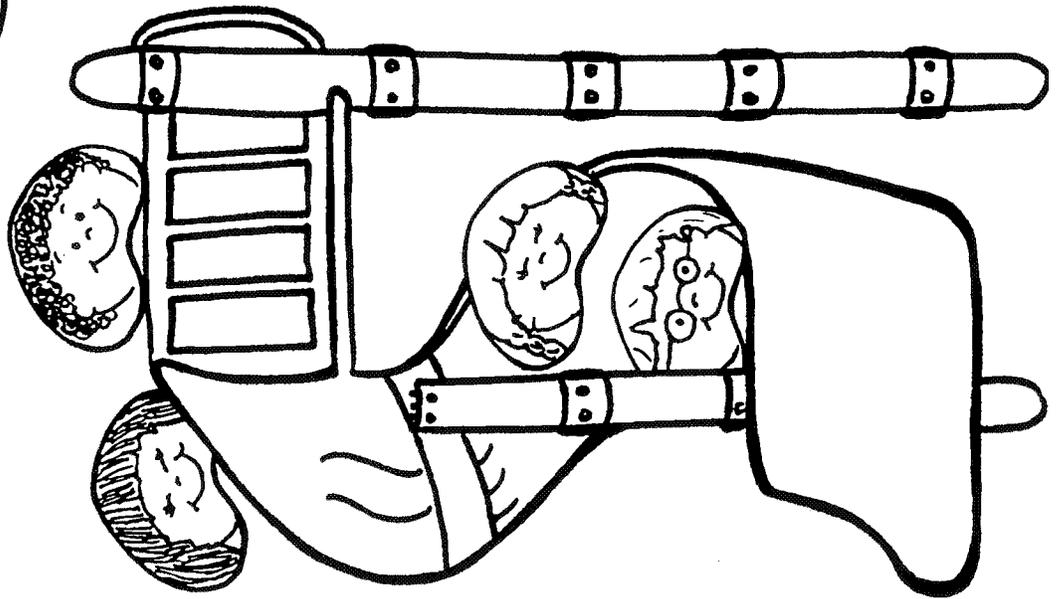
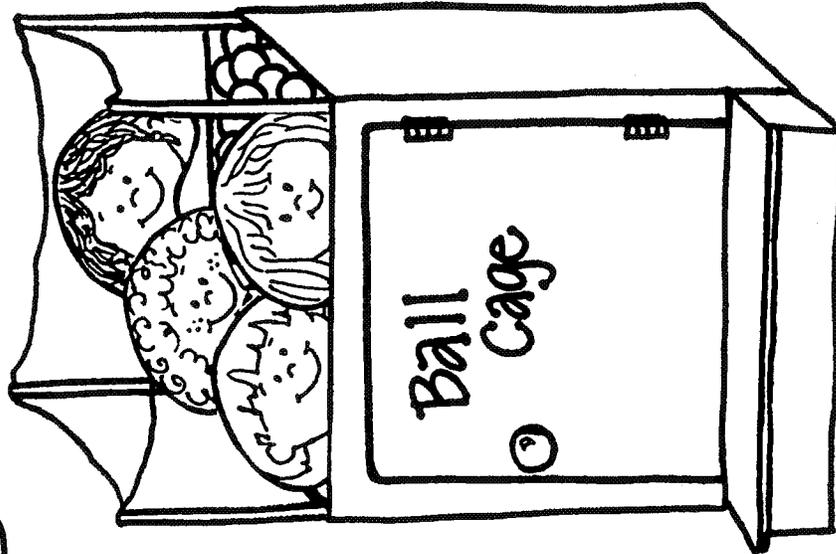
The biologist thought she had seen seven frogs and toads on the log, but when she looked again, some had apparently jumped into the water. Only four were still on the log. How many are in the water?

Picture Problem 6

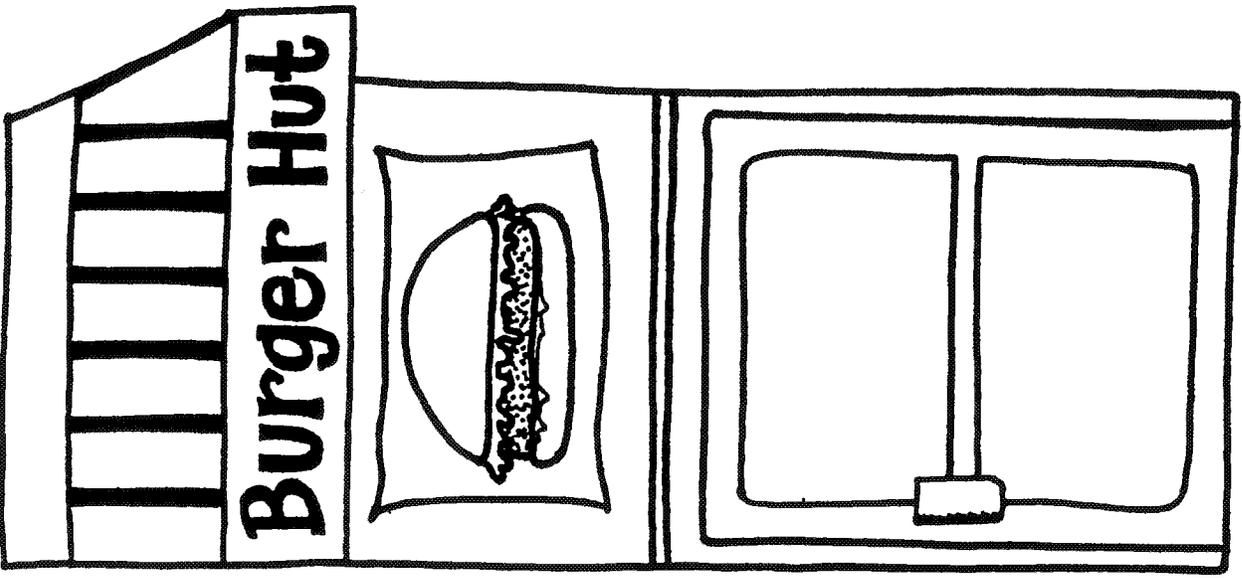
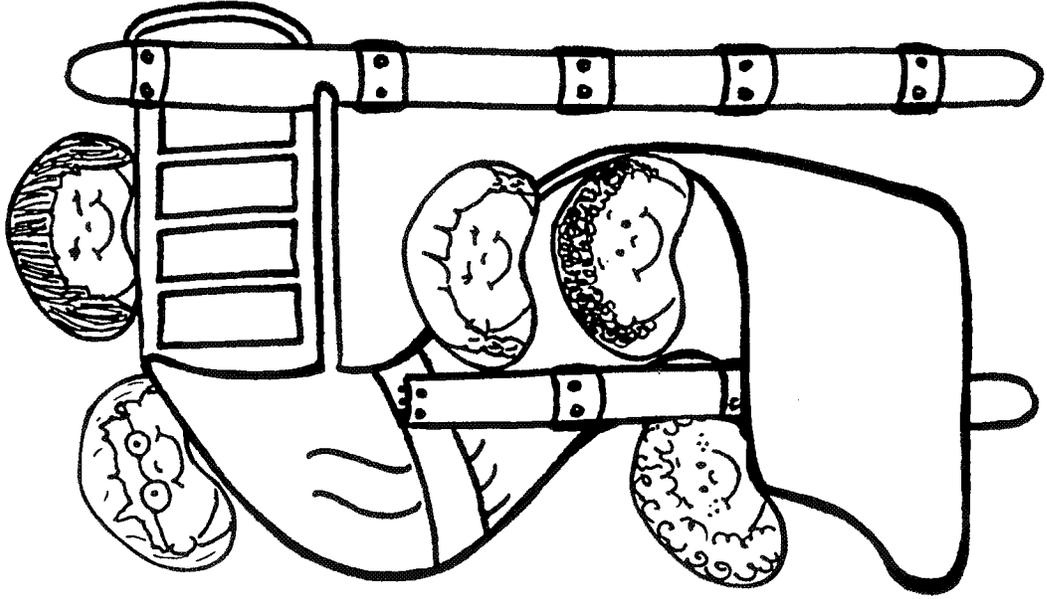
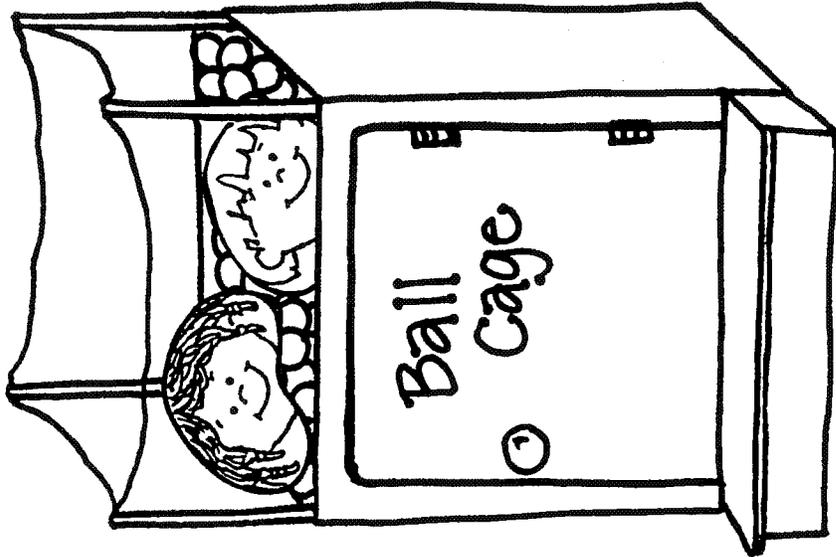
The young girl loved frogs and toads. She noticed that twelve eyes were peering up at her from on top of the log. She grabbed her binoculars to have a closer look. How many frogs did she see?

NOTES

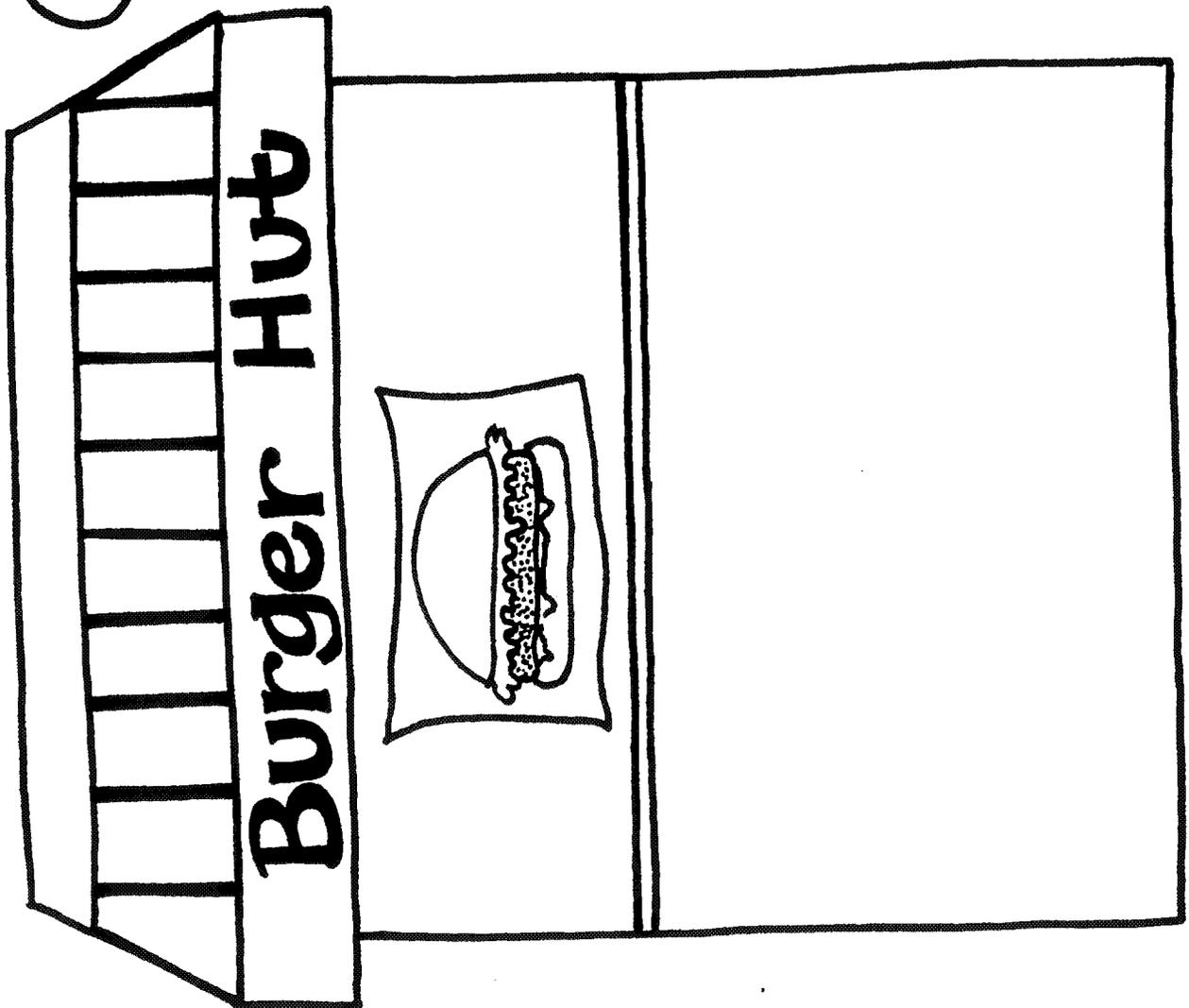
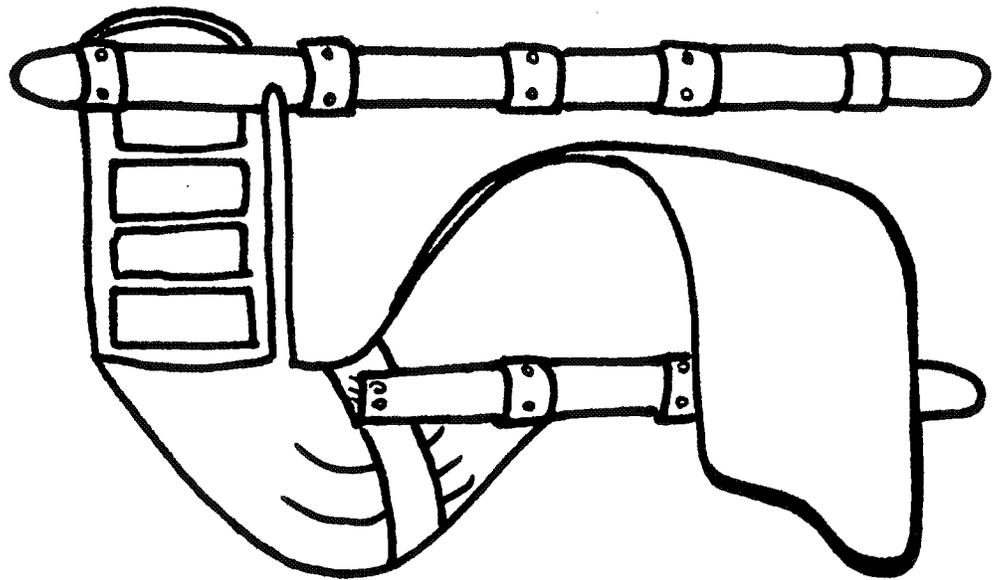
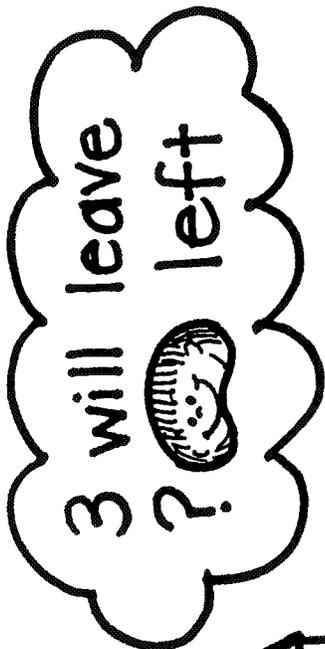
How many altogether?
?

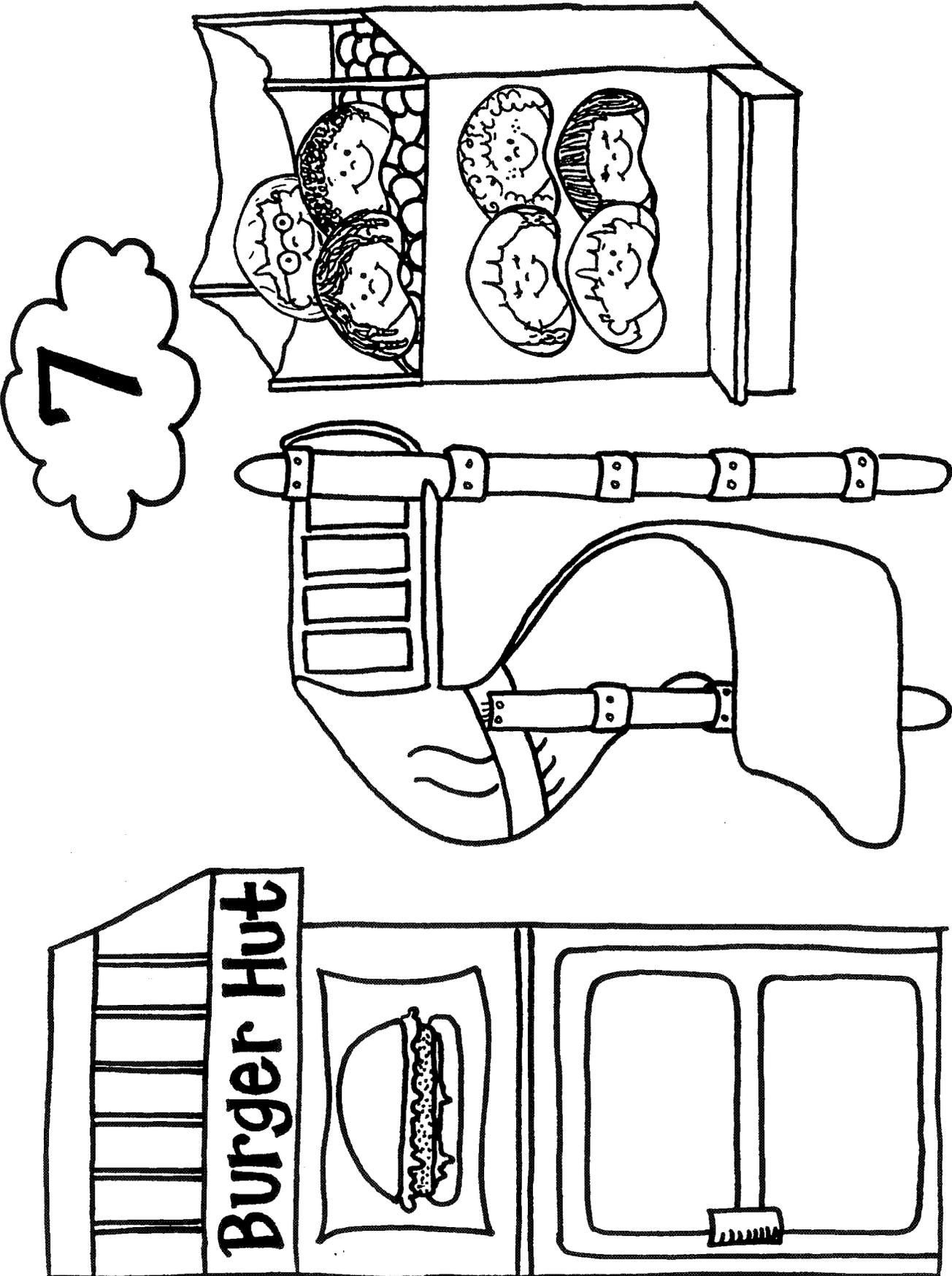


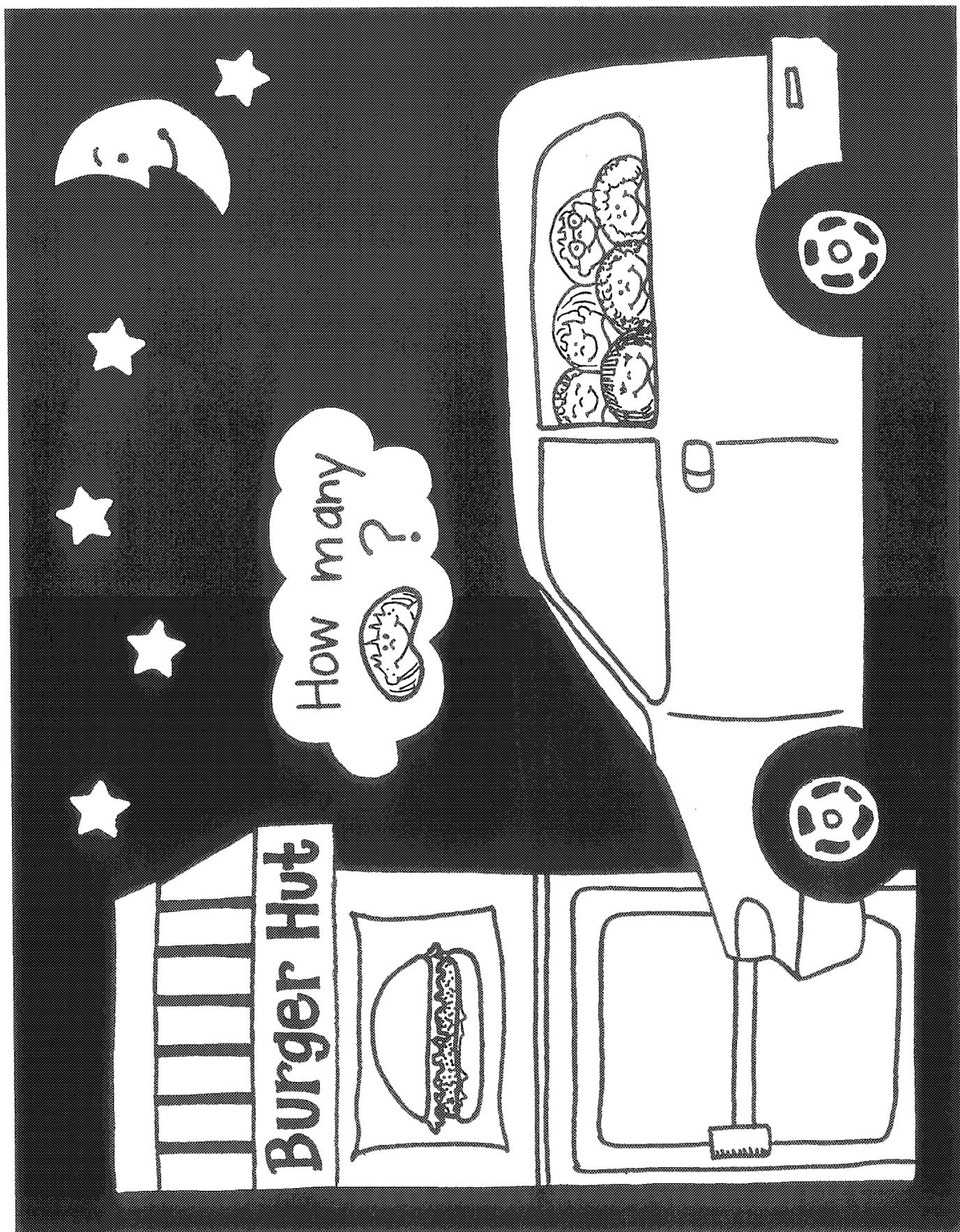
Which is more?
How many more?

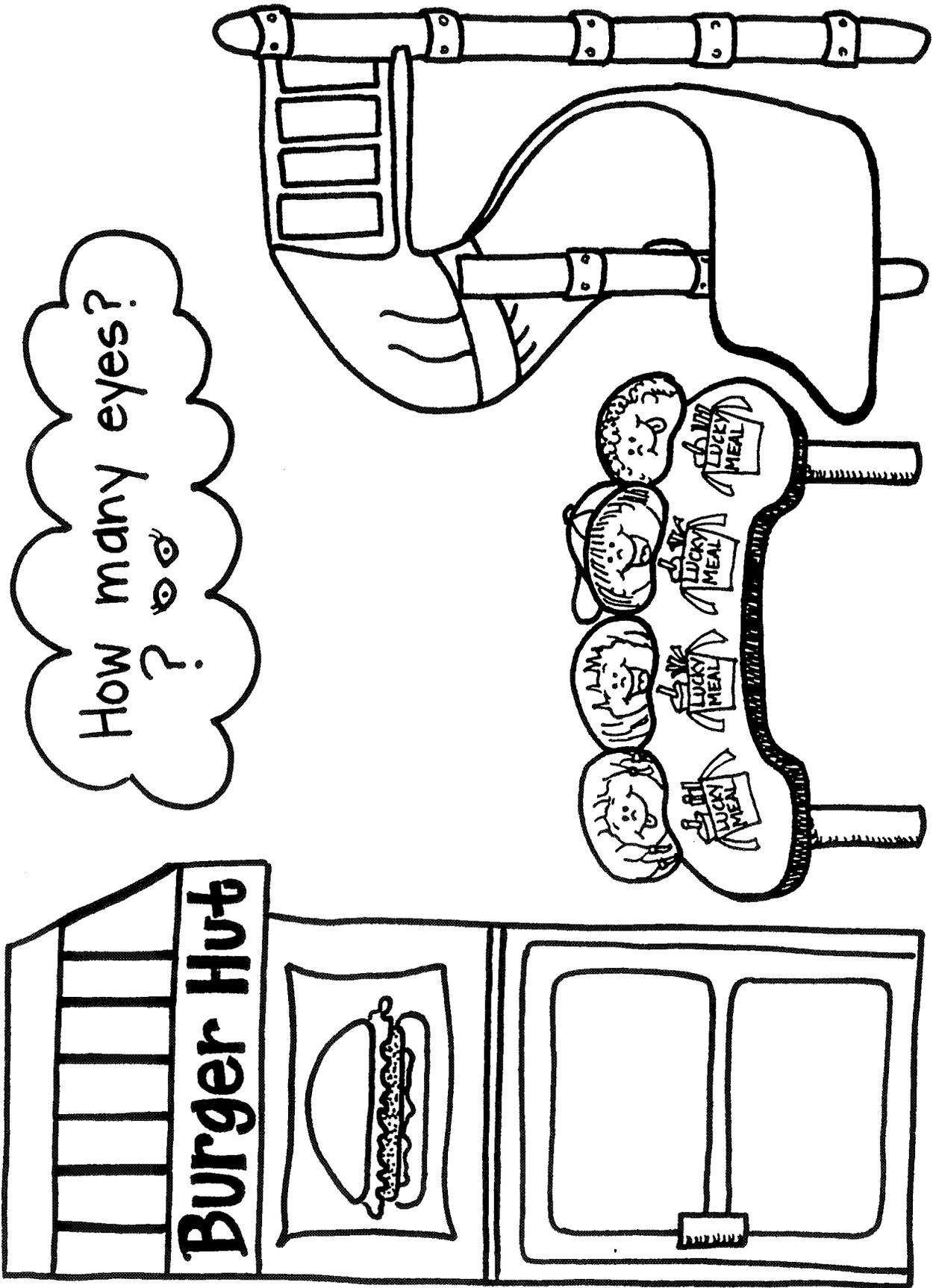


Tape Flap 3 over Burger Hut.





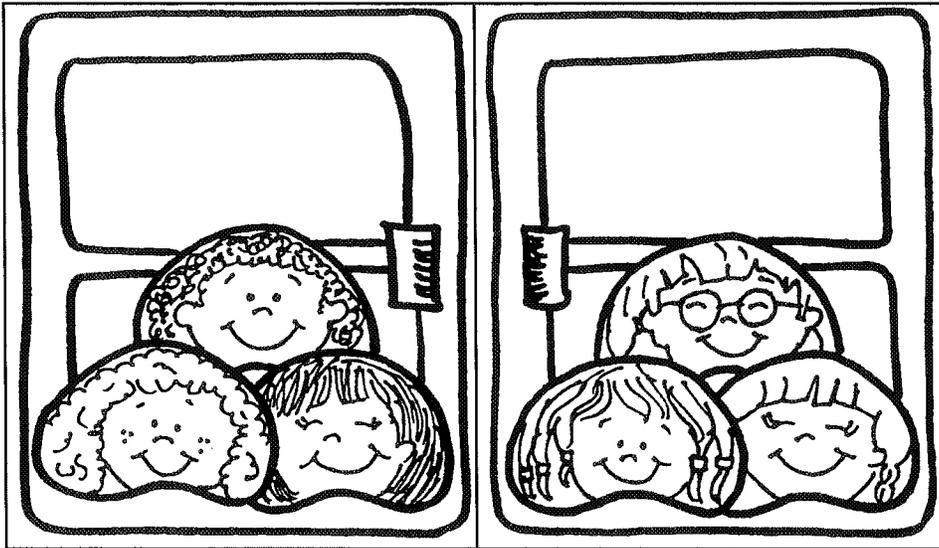




How many eyes?
? 

Flap 3

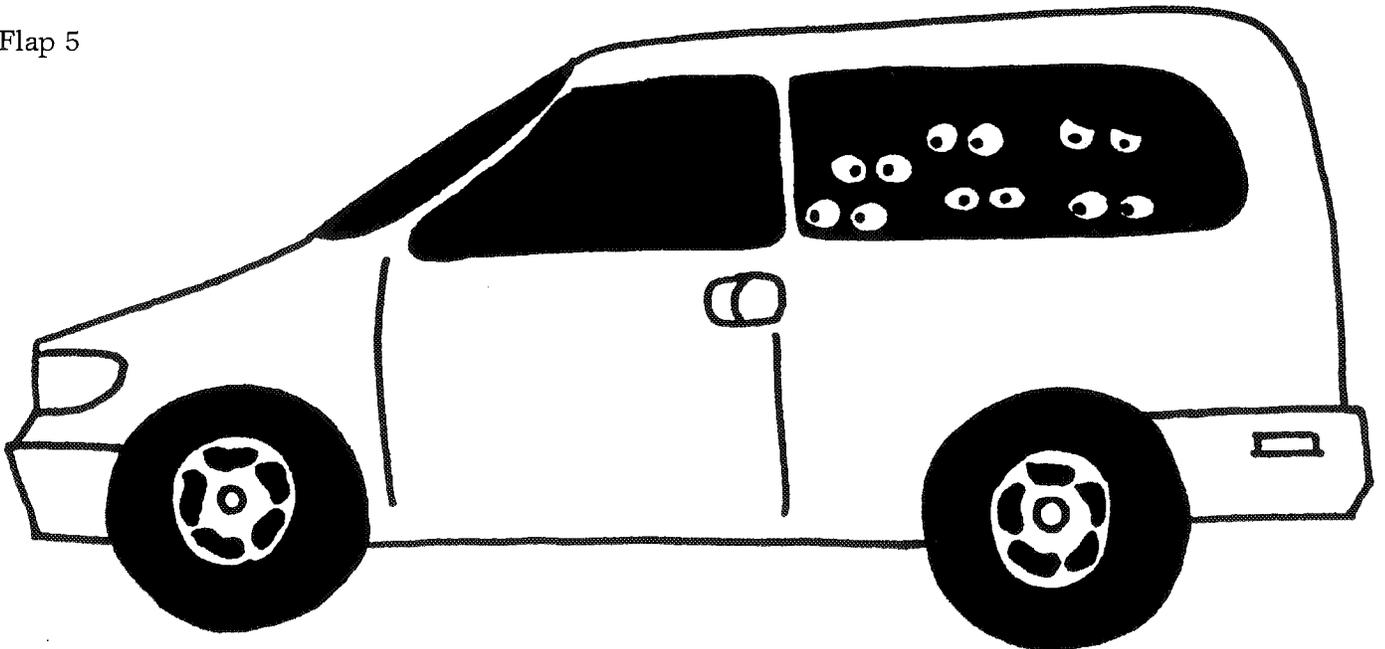
Cut this flap in half to separate the two doors.
Glue the right-hand door onto the Burger Hut.
Tape the left-hand flap with a hinge of scotch
tape, so it will swing away to the left.

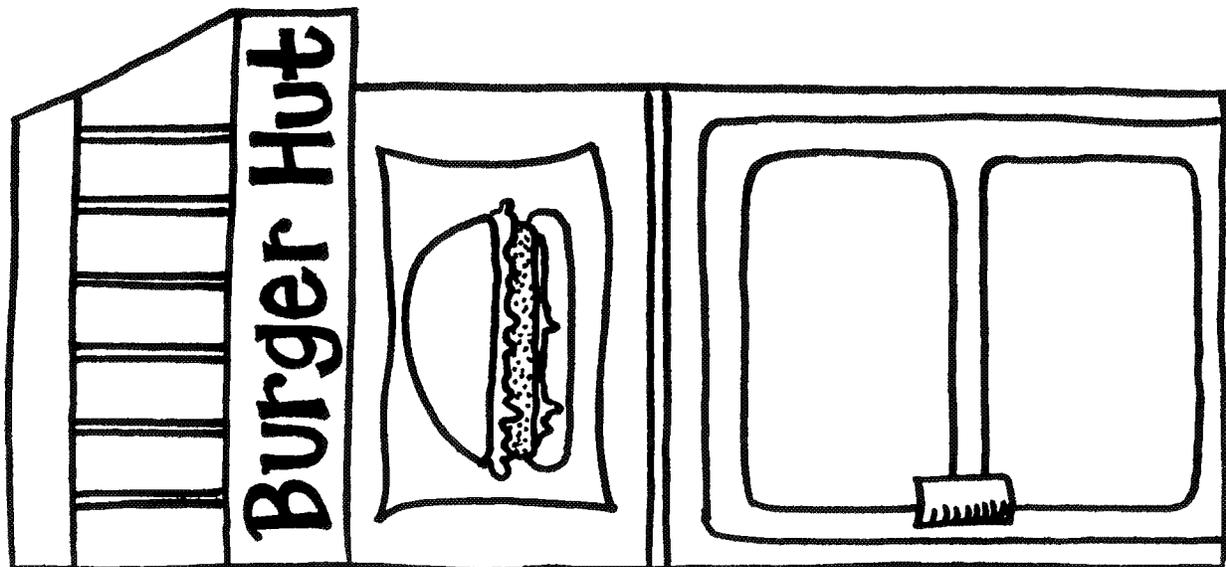
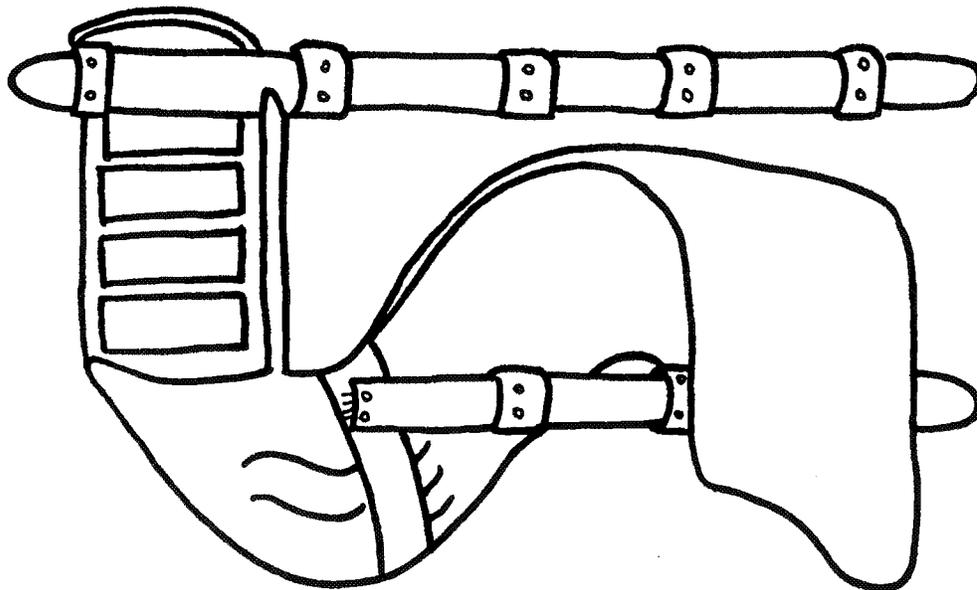
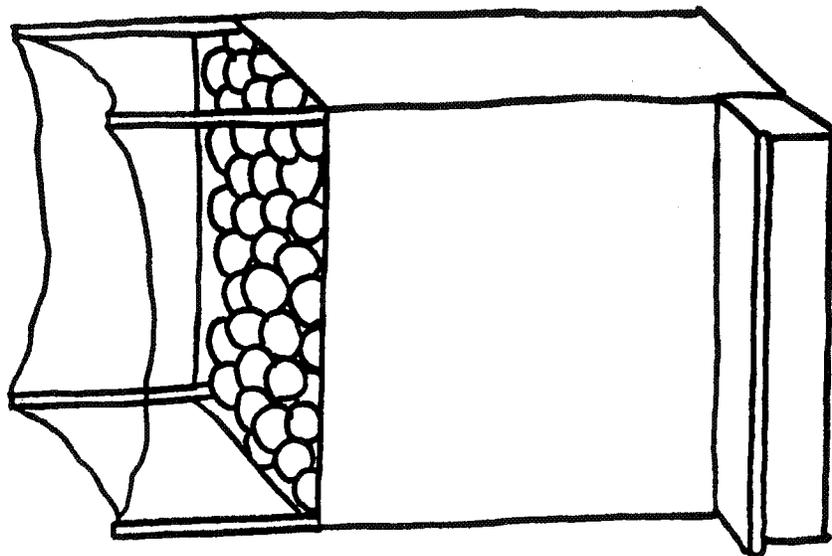


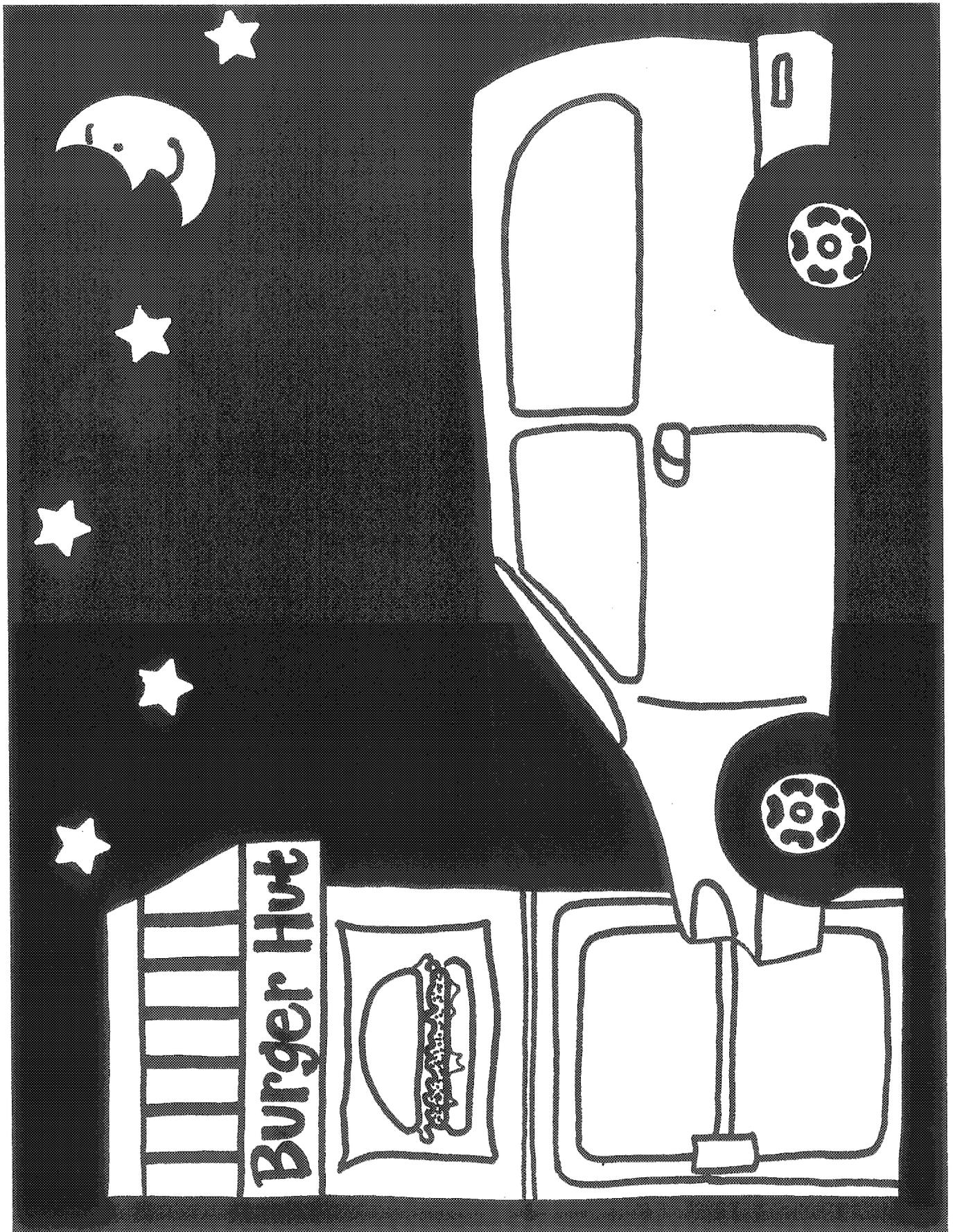
Flap 4

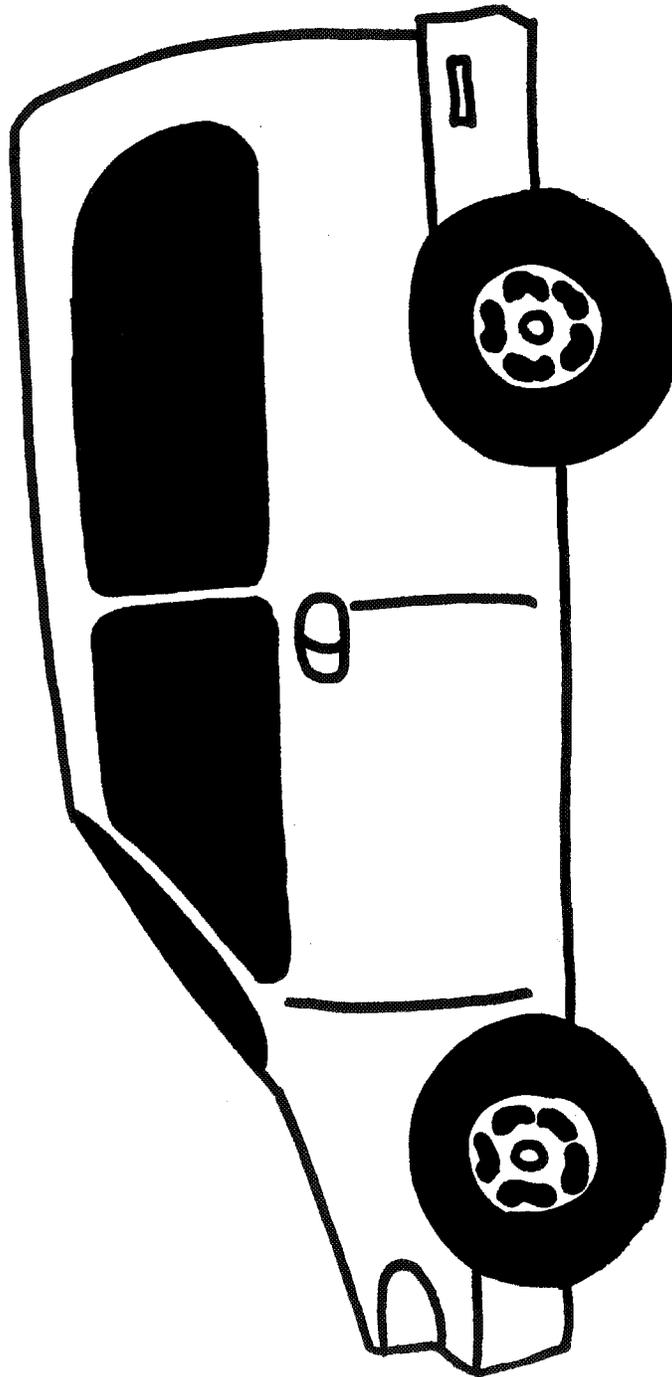


Flap 5









(Glue problem text to the back of each picture problem as teacher tips for having students figure out what is being asked by the picture problem.)

Picture Problem 1

One thoughtful child is waiting by the Burger Hut doors to help carry out the food. Four grinning kids are playing in the ball cage and four cheerful kids are taking turns on the slide. How many kids are visiting the Burger Hut altogether?

Picture Problem 2

There are five silly kids playing on the slide. Two bouncing kids are playing in the ball cage. Which play area has more children? How many more?

Picture Problem 3

There are six happy kids by the doors of the Burger Hut. Three of them have to go home. How many children will be left?

Picture Problem 4

Seven kids are playing in the play area of the Burger Hut. Oh dear, some must be under the balls. How many are hiding?

(Glue problem text to the back of each picture problem as teacher tips for having students figure out what is being asked by the picture problem.)

Picture Problem 5

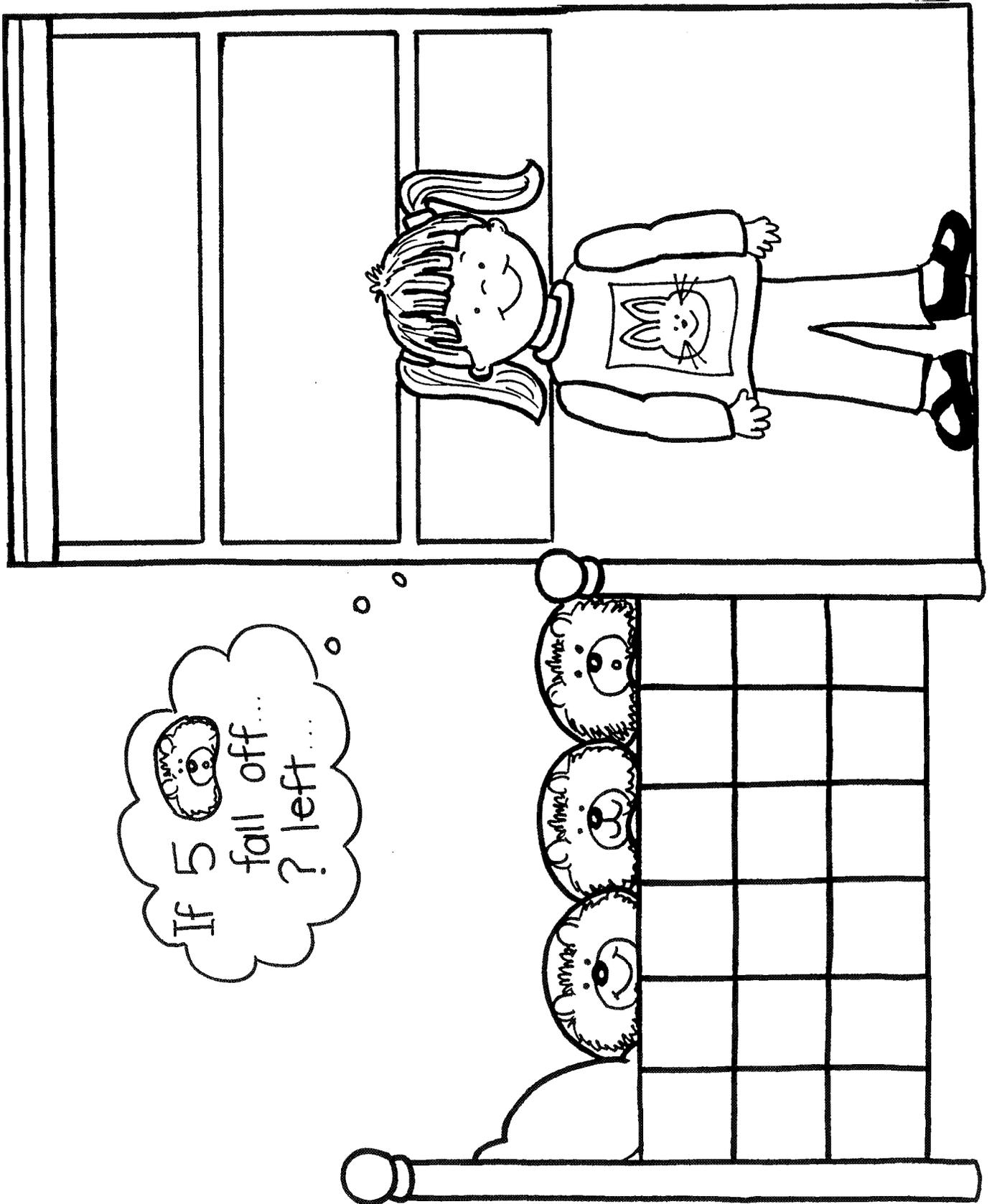
There are twelve beaming eyes looking for their dads who will bring them food from the Burger Hut. How many hungry kids are in the van?

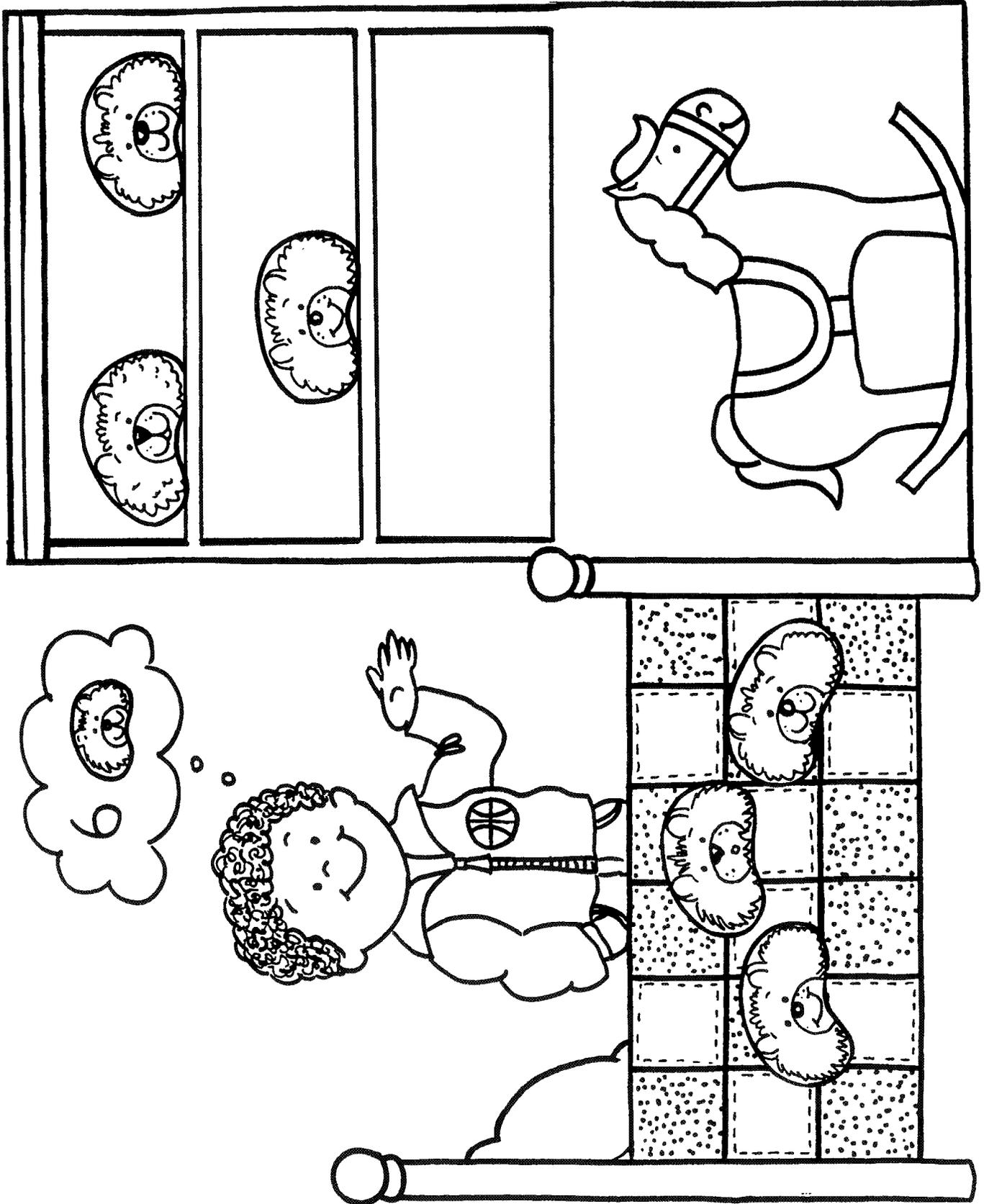
Picture Problem 6

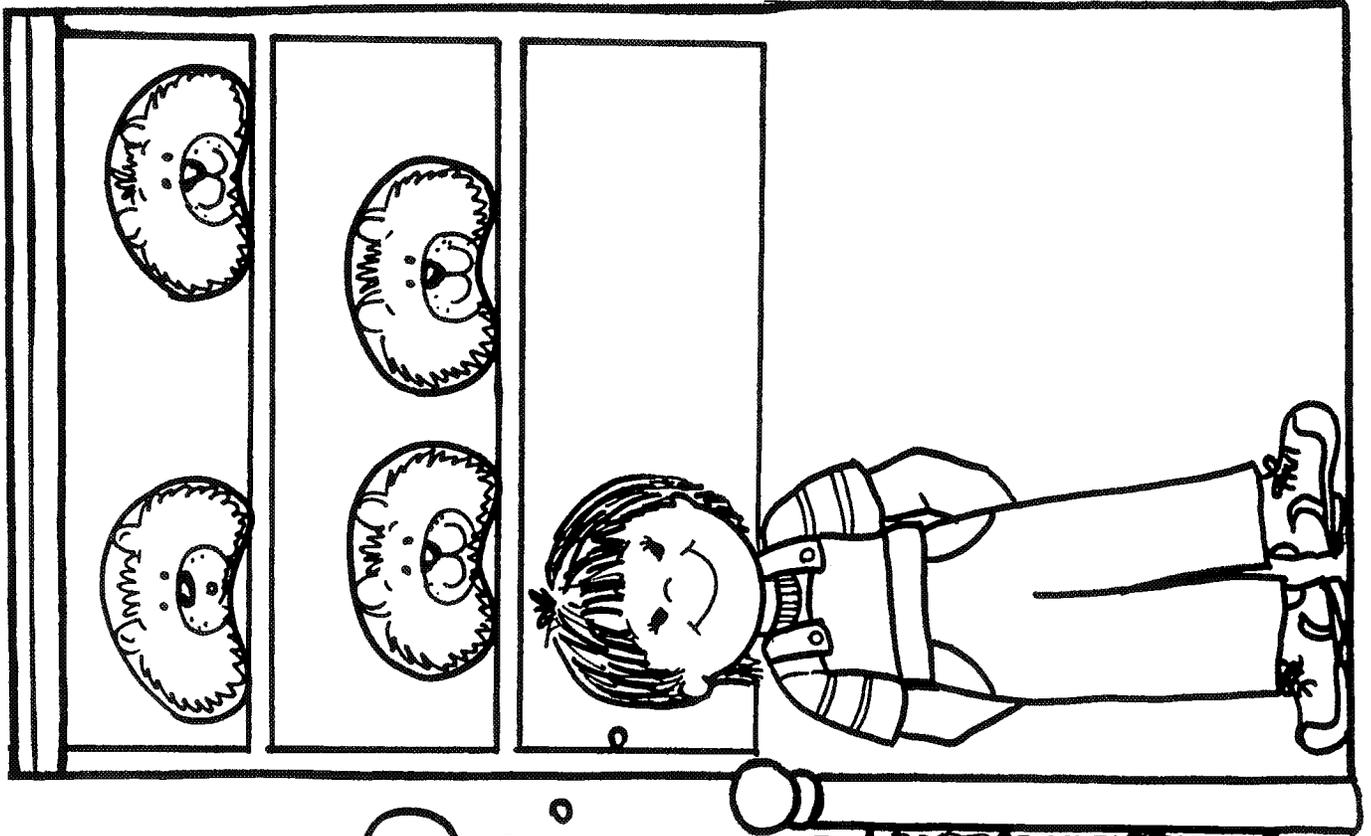
Four happy kids are gazing at their lucky meals. They can hardly wait to see the prizes inside their boxes. How many eyes are waiting for a peek?

Picture Problem 1
Tape Flap 1 over quilt.

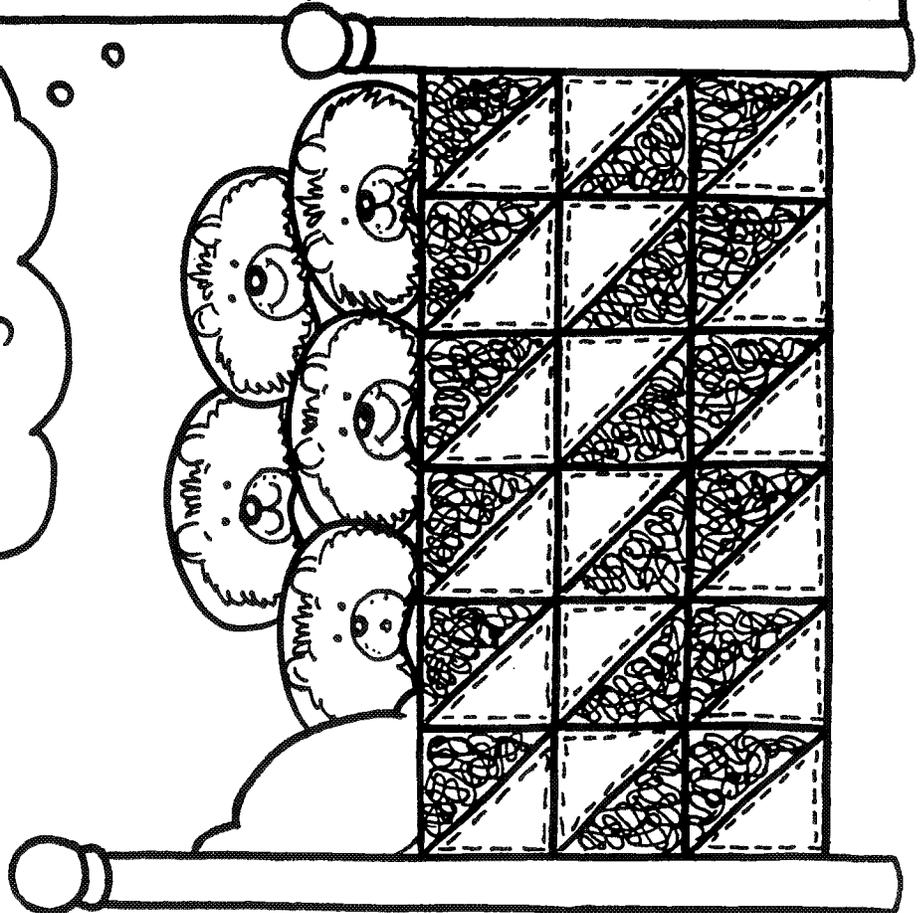
Rainbow Bears B67

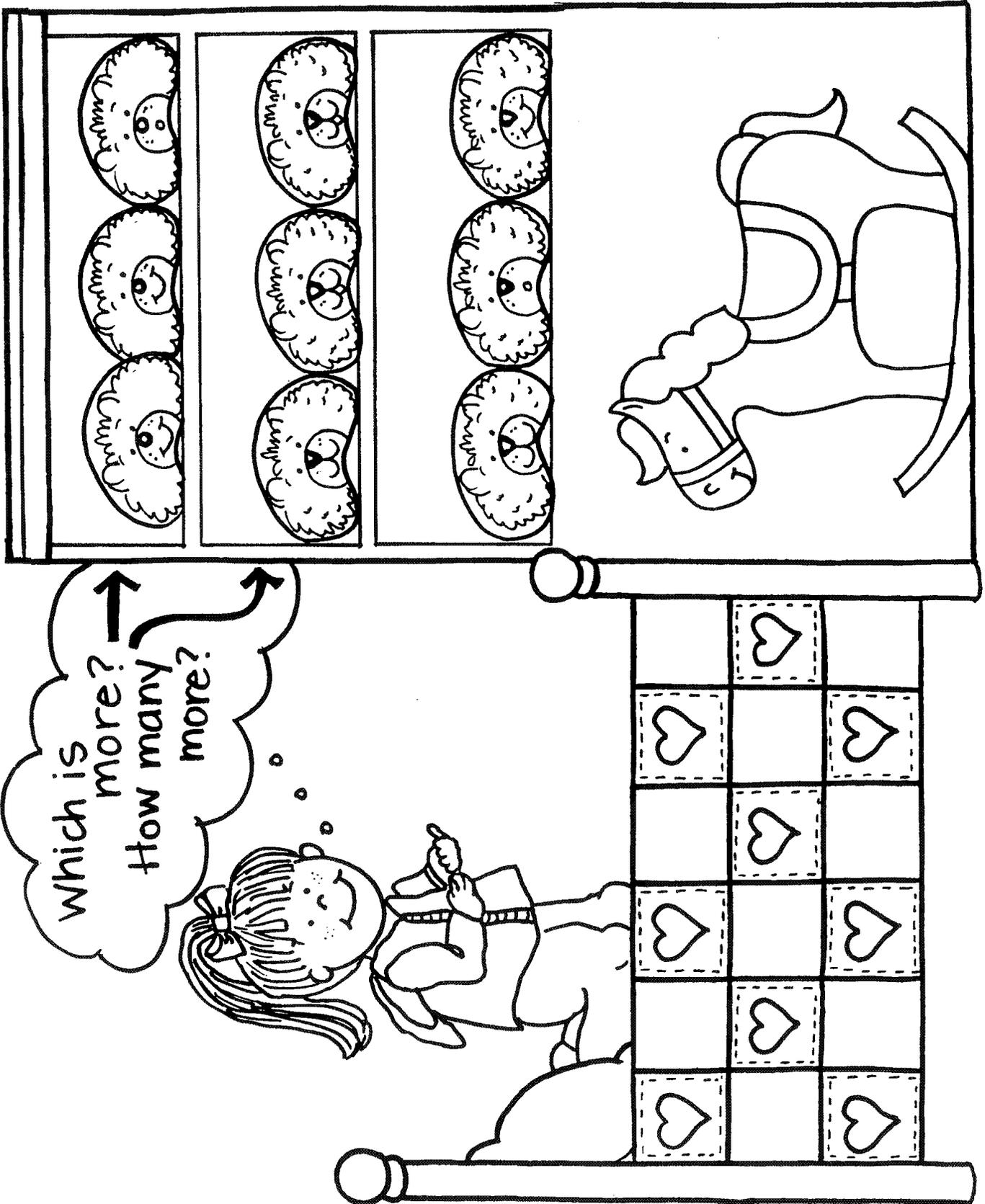






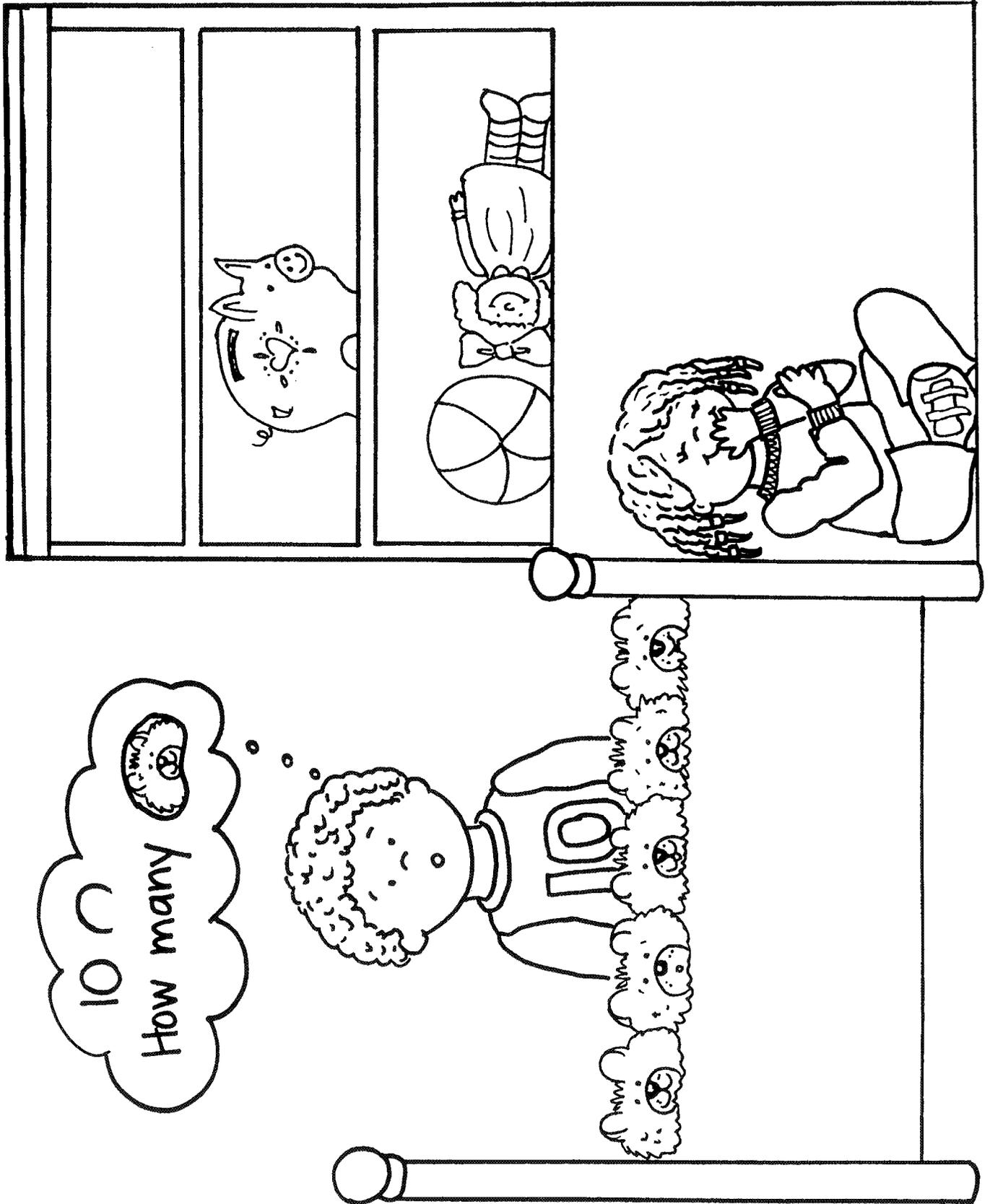
! altogether

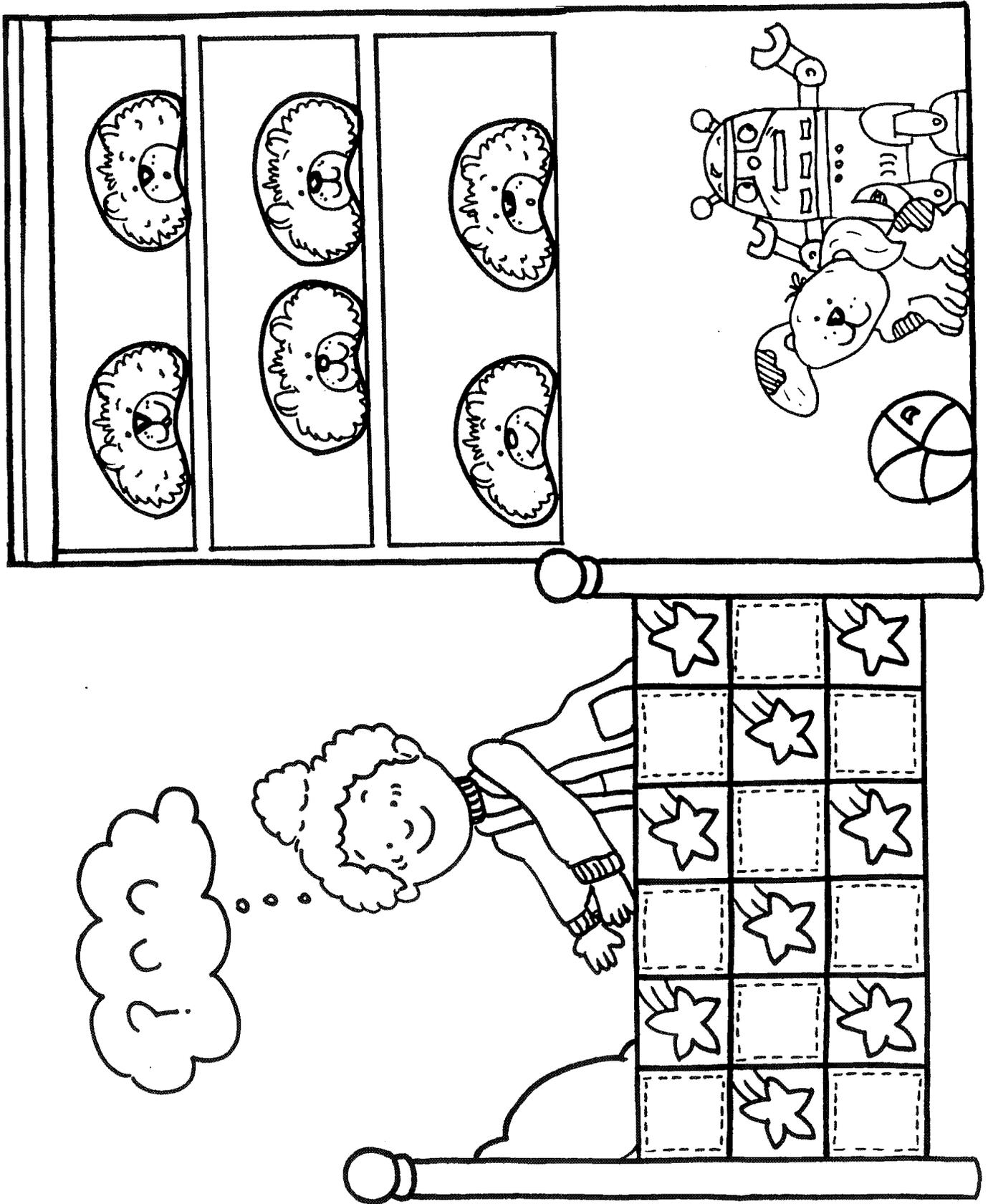




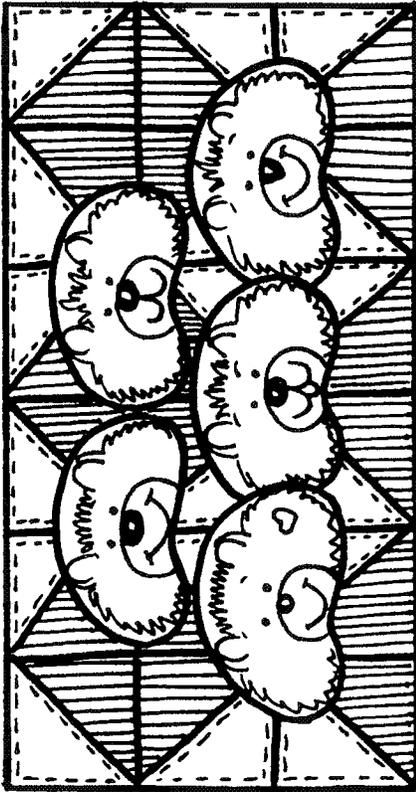
Picture Problem 5

Tape Flap 5 over bed so only the bears' ears show.

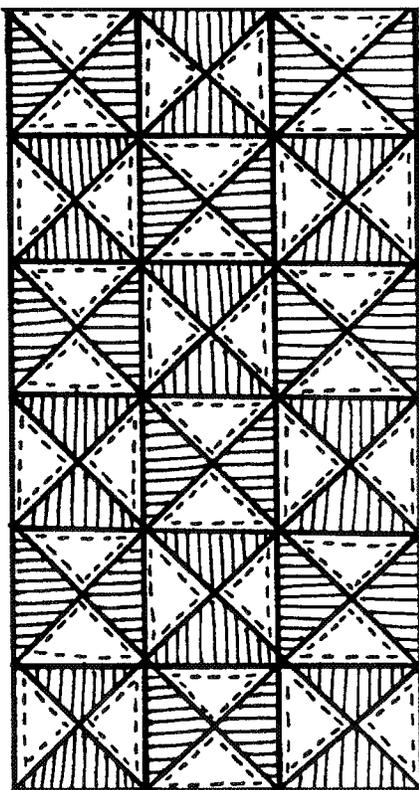
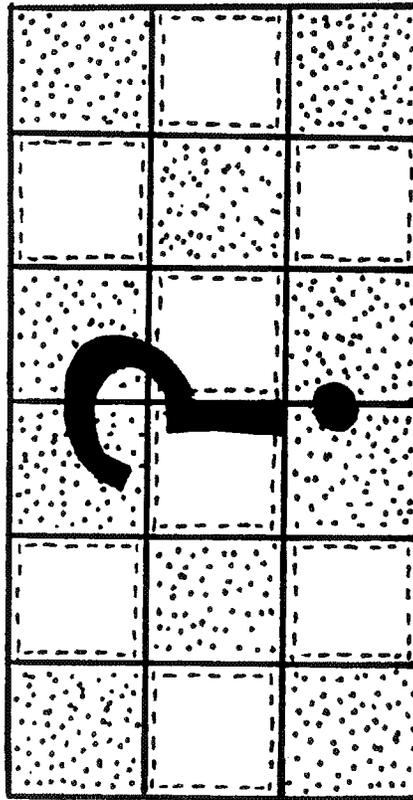




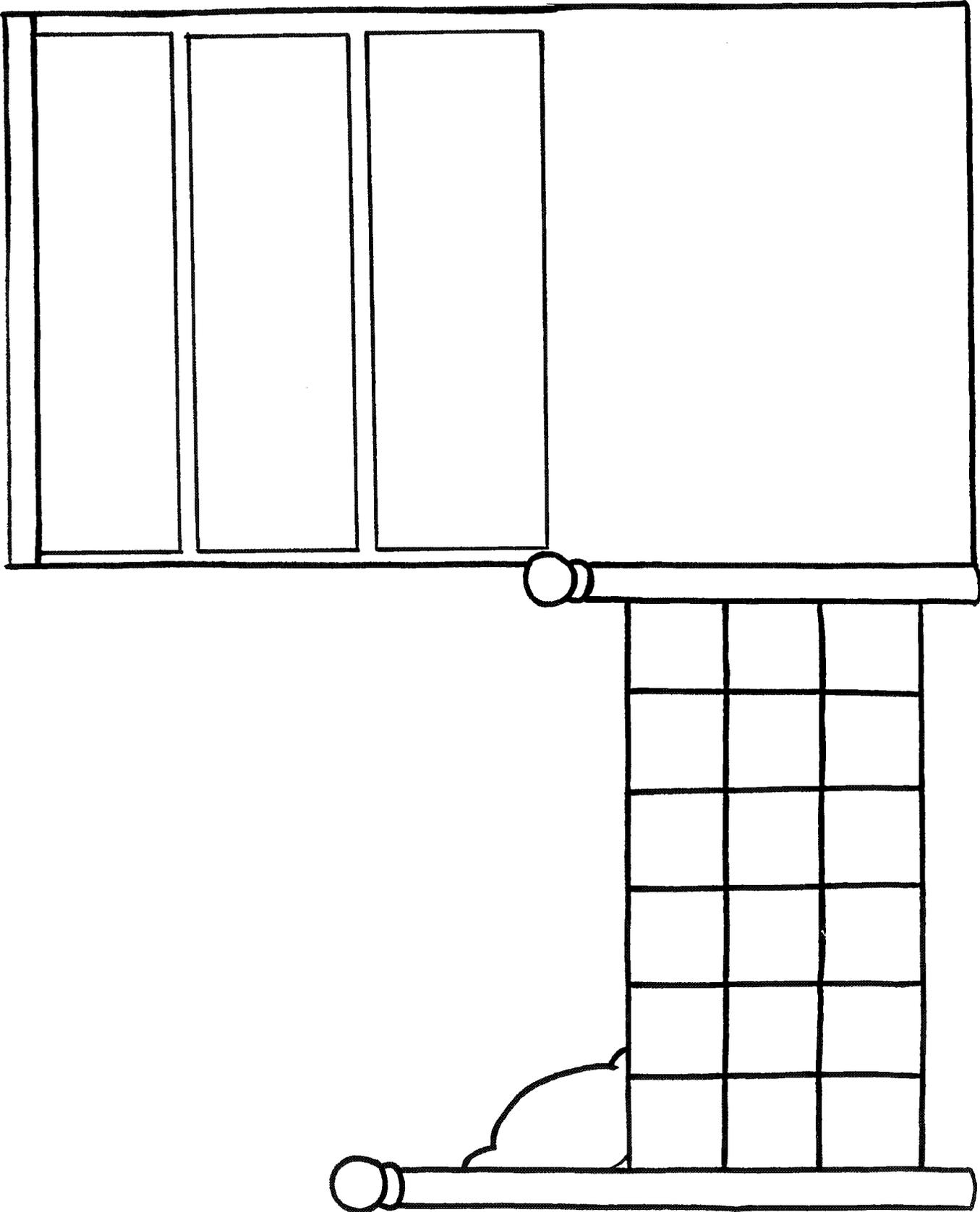
Flap 1

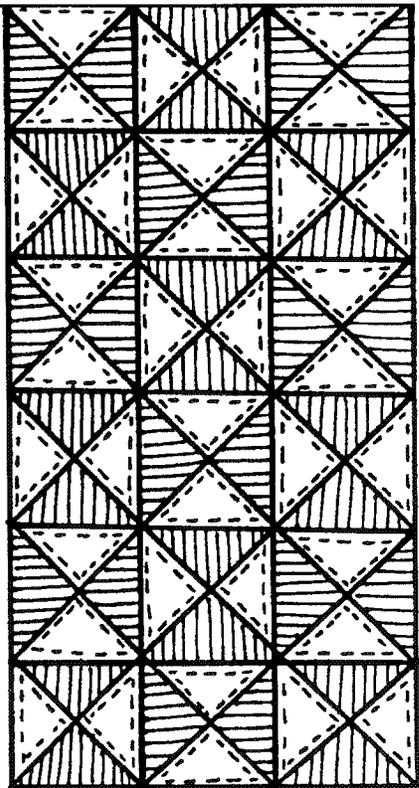
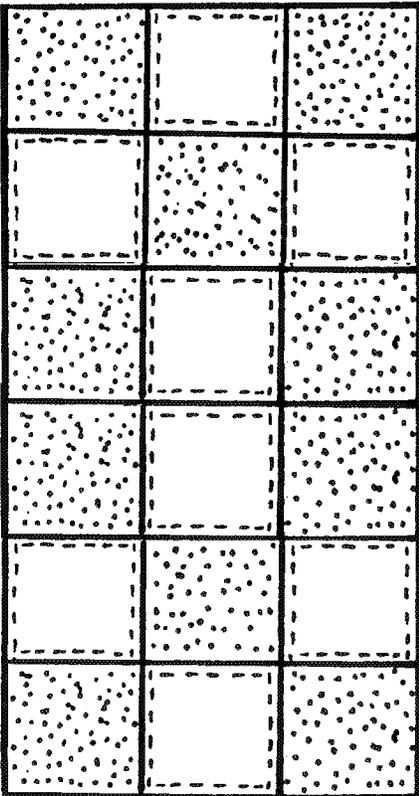
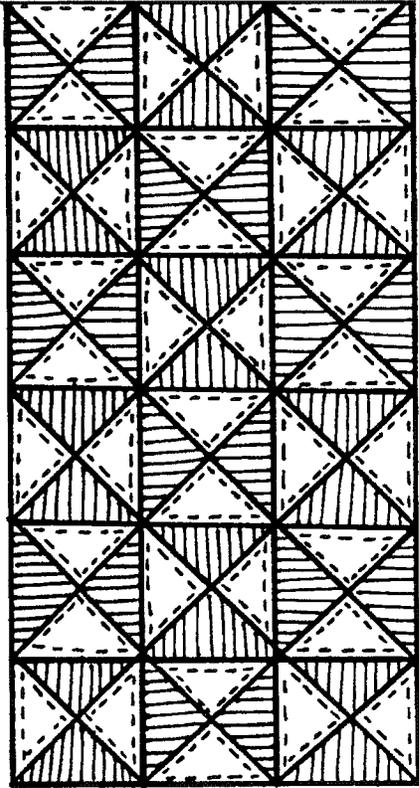
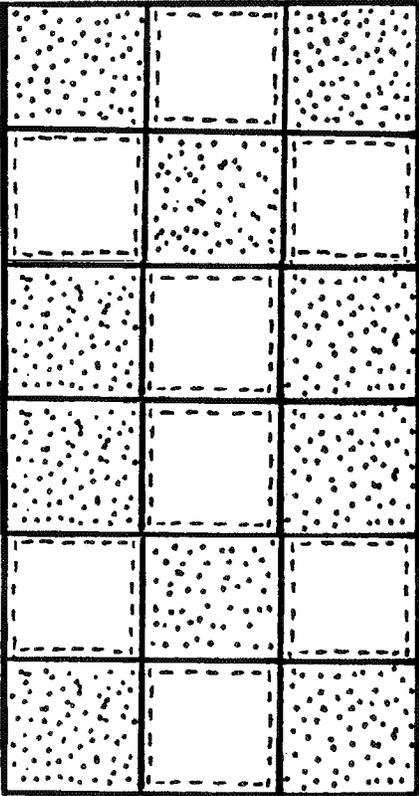


Flap 2



Flaps 5





(Glue problem text to the back of each picture problem as teacher tips for having students figure out what is being asked by the picture problem.)

Picture Problem 1

There are eight rainbow bears on the young girl's bed. She will have to take the quilt off to change her sheets. Five of those bears will fall off under the quilt. How many will be left?

Picture Problem 2

The teen age boy was sure his little brother had six rainbow bears altogether. He could see three bears on the shelves. Perhaps some of the bears were hiding under the quilt. How many bears will he find under the quilt?

Picture Problem 3

The young boy had four rainbow bears on his shelves and five bears on his bed. How many rainbow bears did he have altogether?

Picture Problem 4

There were three pink bears on the top shelf and six yellow bears on the lower shelves. Did the young girl have more pink bears or more yellow bears? How many more?

(Glue problem text to the back of each picture problem as teacher tips for having students figure out what is being asked by the picture problem.)

Picture Problem 5

His little sister loved hiding her bears under her quilt. Her big brother could see ten ears sticking out. How many bears are hiding under the quilt?

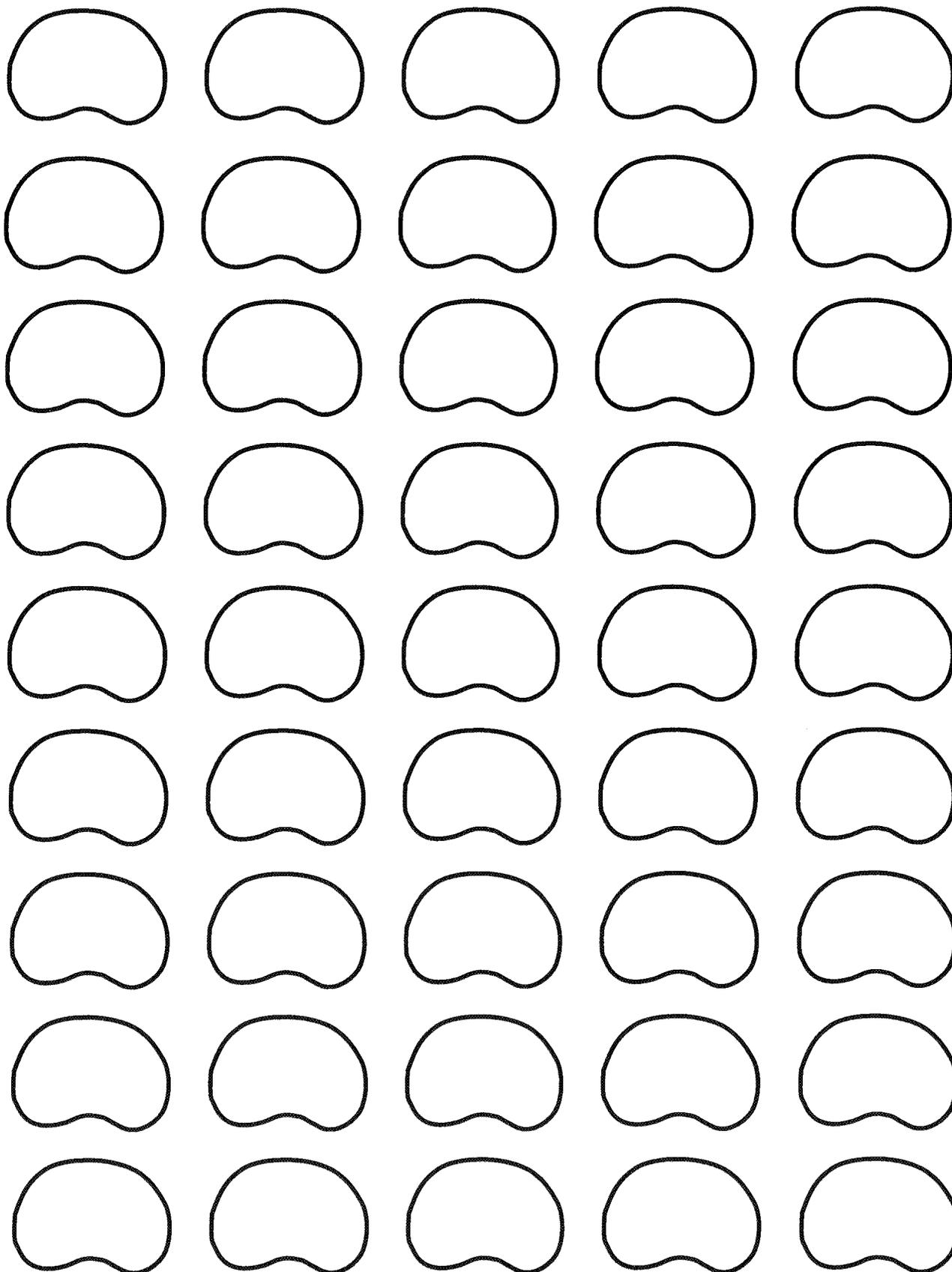
Picture Problem 6

There were six rainbow bears on the grandmother's shelves. She loved collecting bears for her grandchildren. How many ears are on her shelves?

NOTES

Run a copy on one sheet of colored construction paper and then staple on three more blank sheets of the same color to match the colors of

the bean counters. (Children use these paper lima beans in crafting their own story problems.) Send out to parent volunteers to cut.



The Spooky House

(beans,
picture problems &
pocket chart scenery)



The Spooky House

(beans,
picture problems &
pocket chart scenery)



The Cat Cottage

(beans,
picture problems &
pocket chart scenery)



The Cat Cottage

(beans,
picture problems &
pocket chart scenery)



Penguins

(beans,
picture problems &
pocket chart scenery)



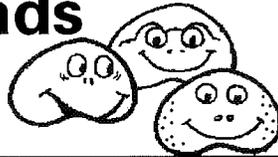
Penguins

(beans,
picture problems &
pocket chart scenery)



Frogs & Toads

(beans,
picture problems &
pocket chart scenery)



Frogs & Toads

(beans,
picture problems &
pocket chart scenery)



The Burger Hut

(beans,
picture problems &
pocket chart scenery)



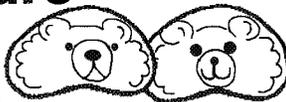
The Burger Hut

(beans,
picture problems &
pocket chart scenery)



Rainbow Bears

(beans,
picture problems &
pocket chart scenery)

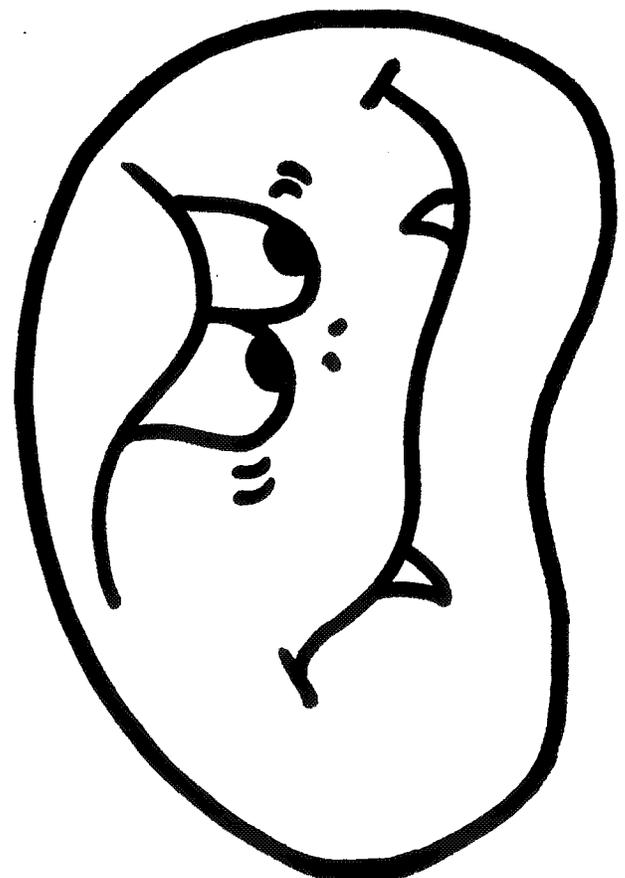
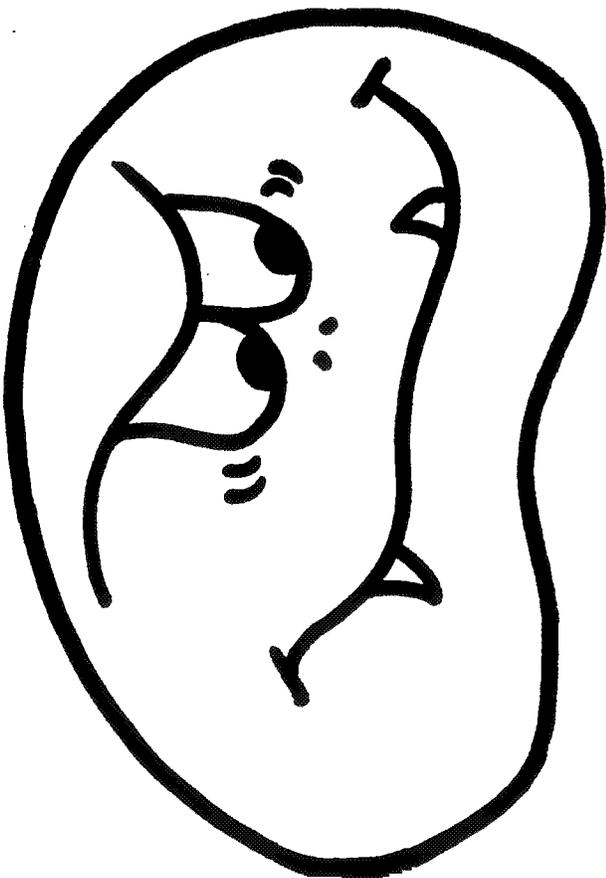
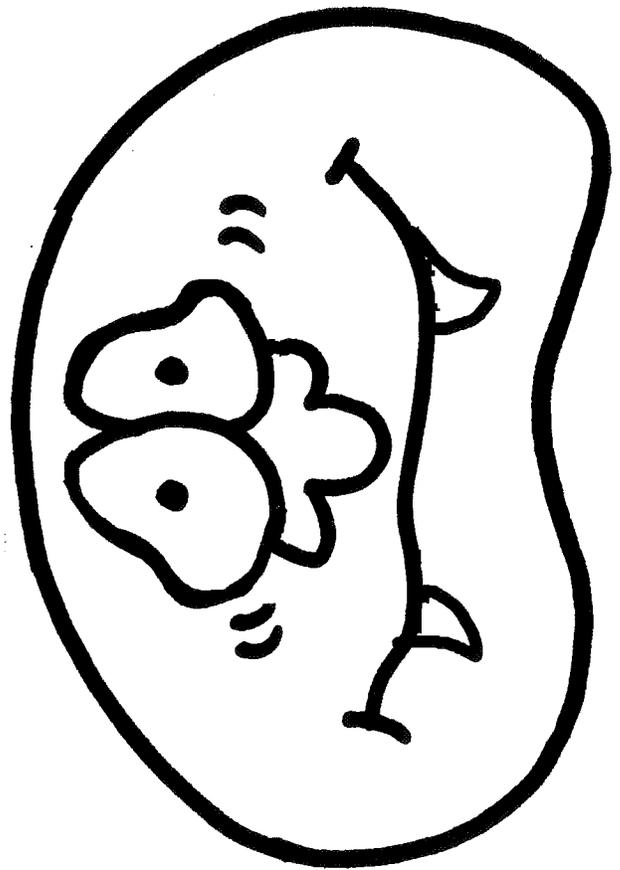
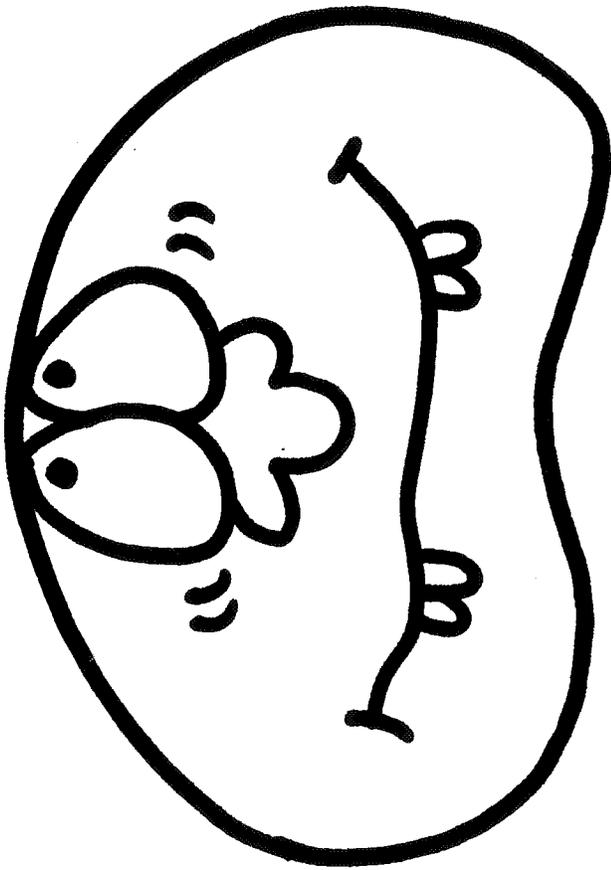


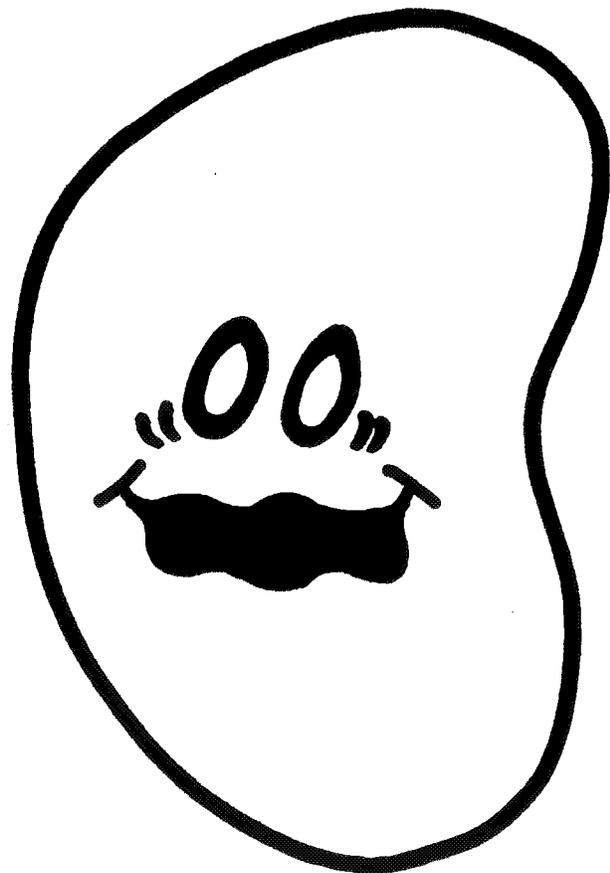
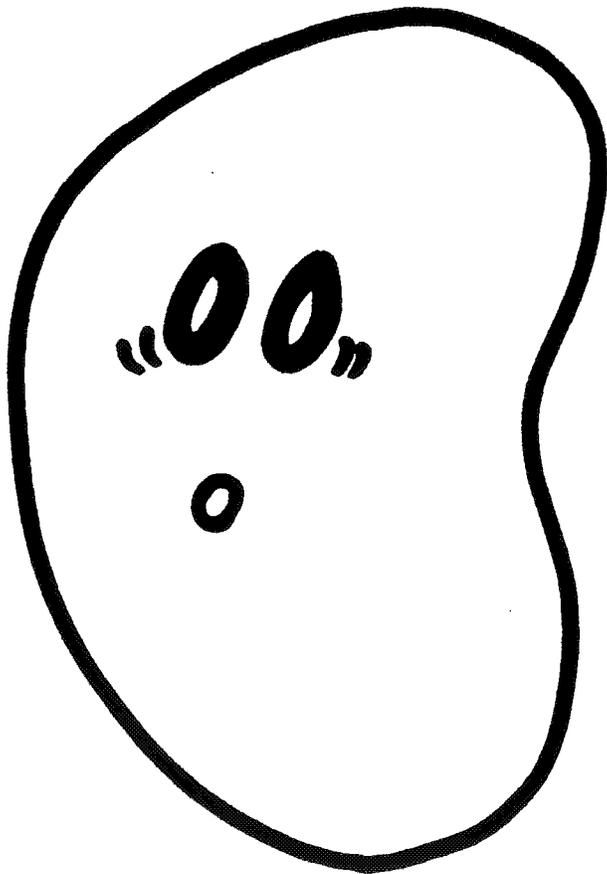
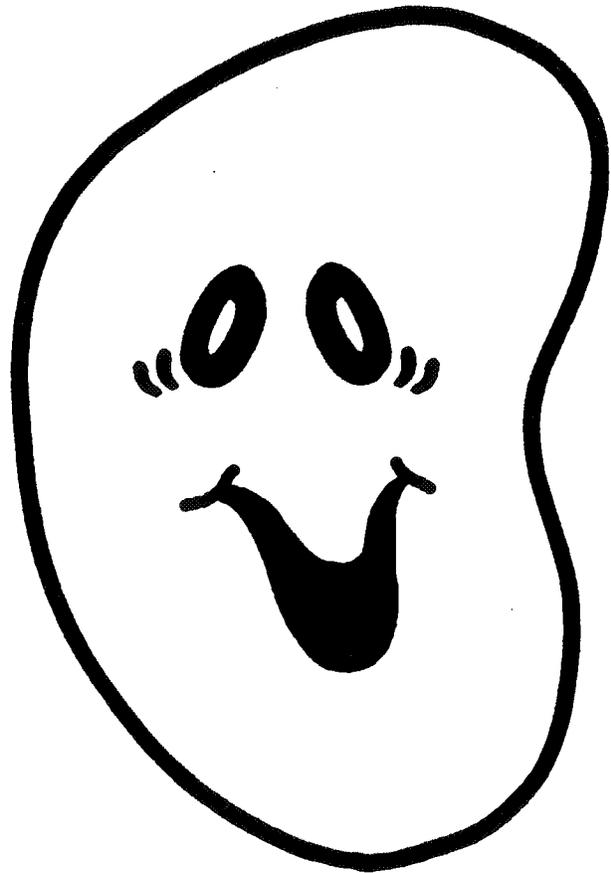
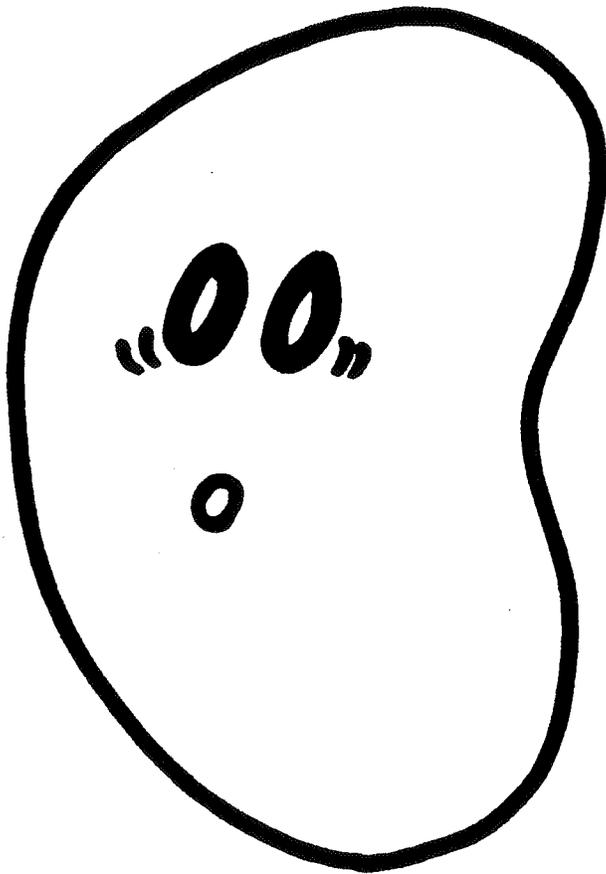
Rainbow Bears

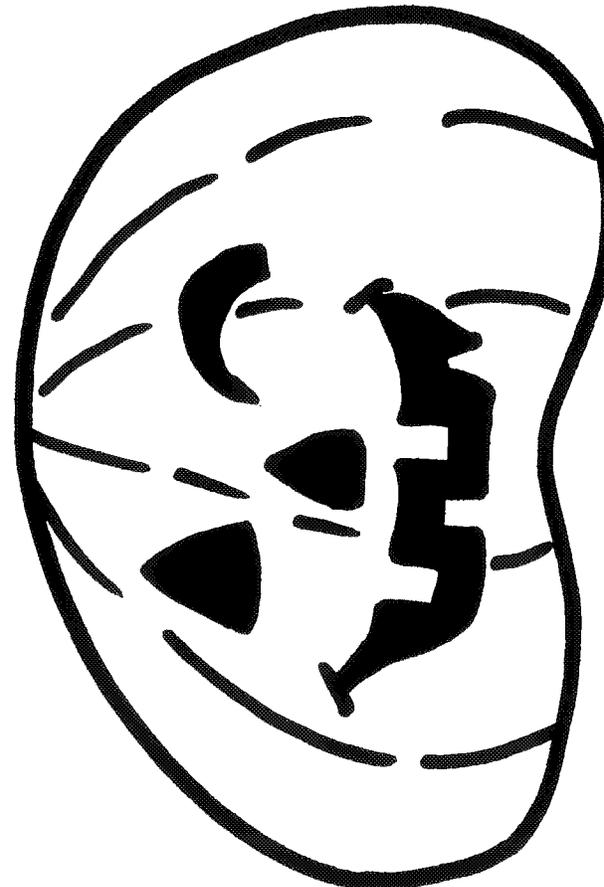
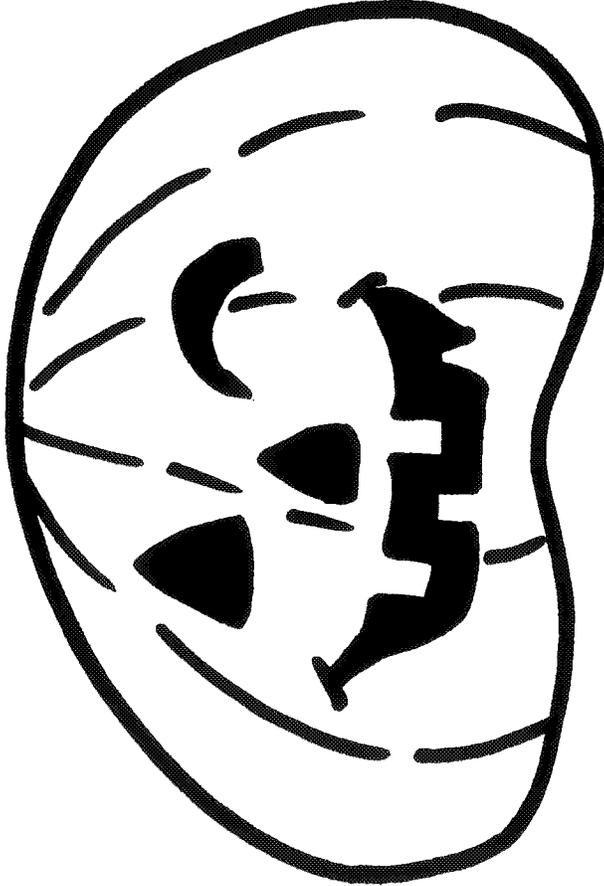
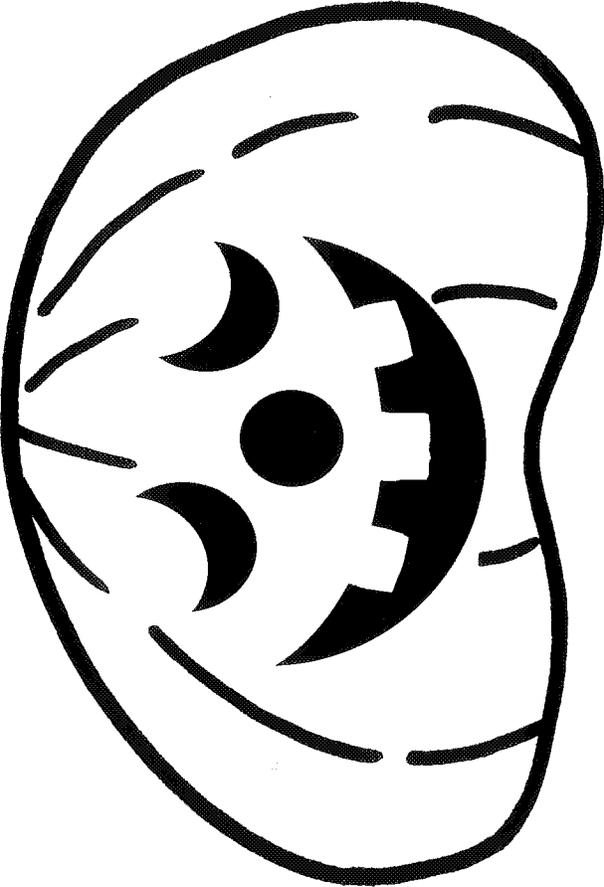
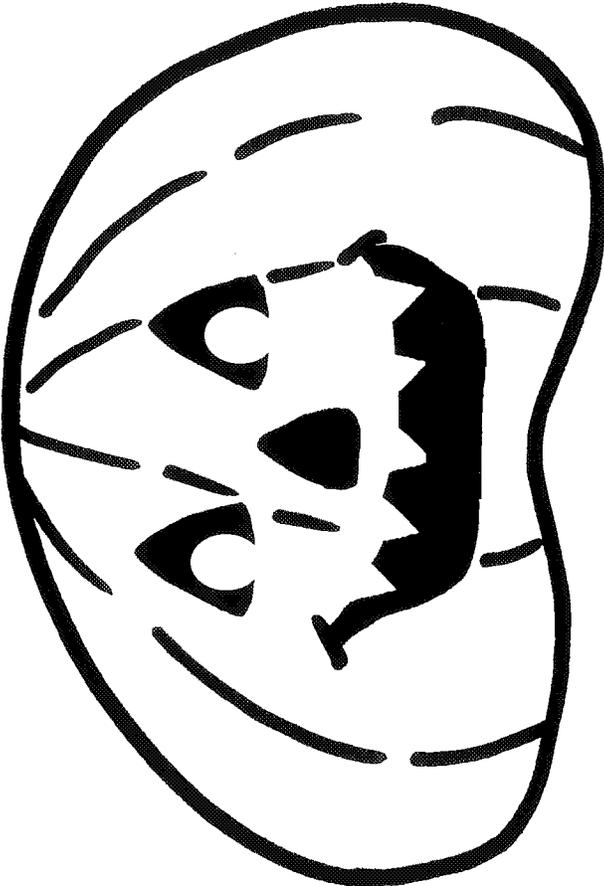
(beans,
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pocket chart scenery)

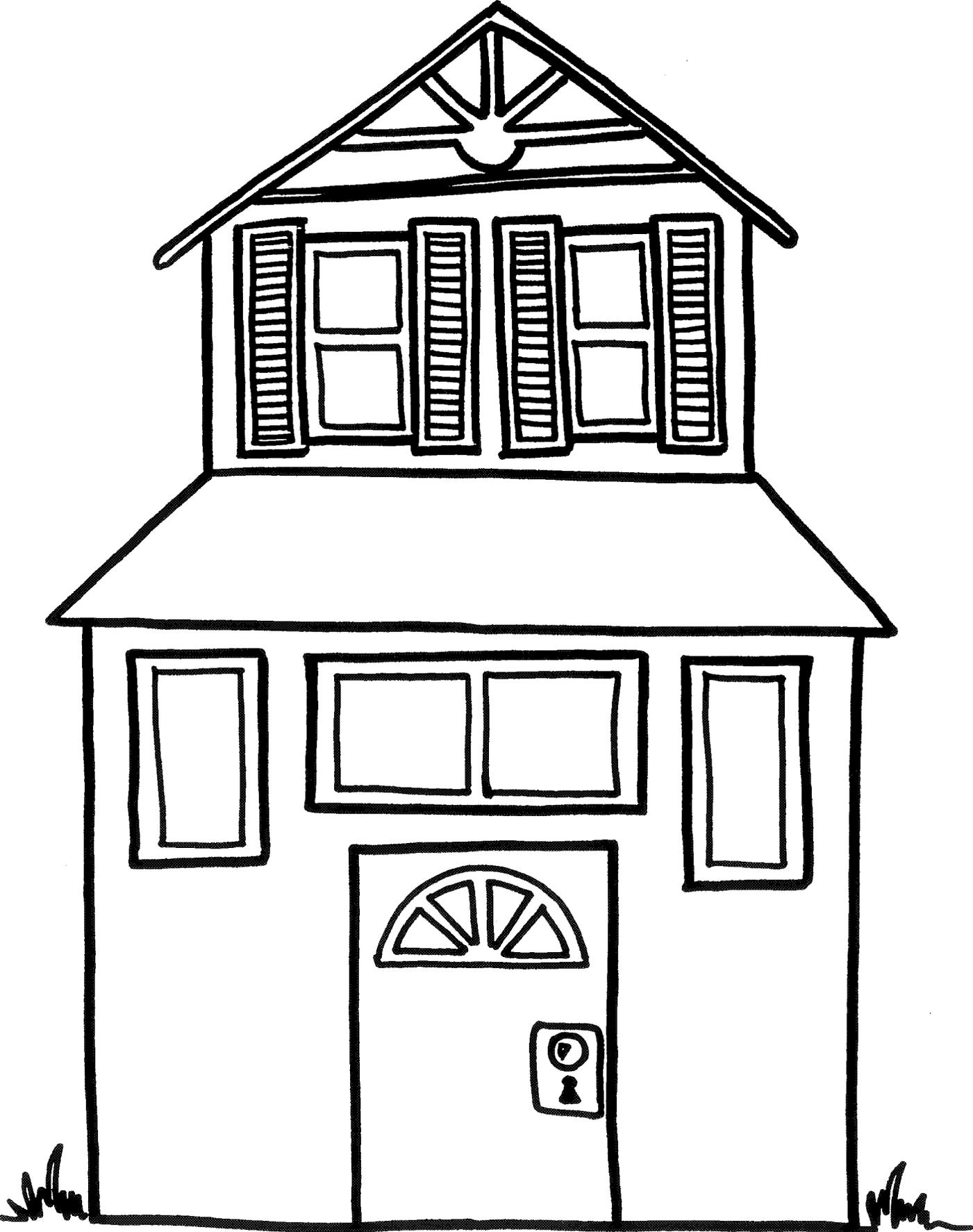


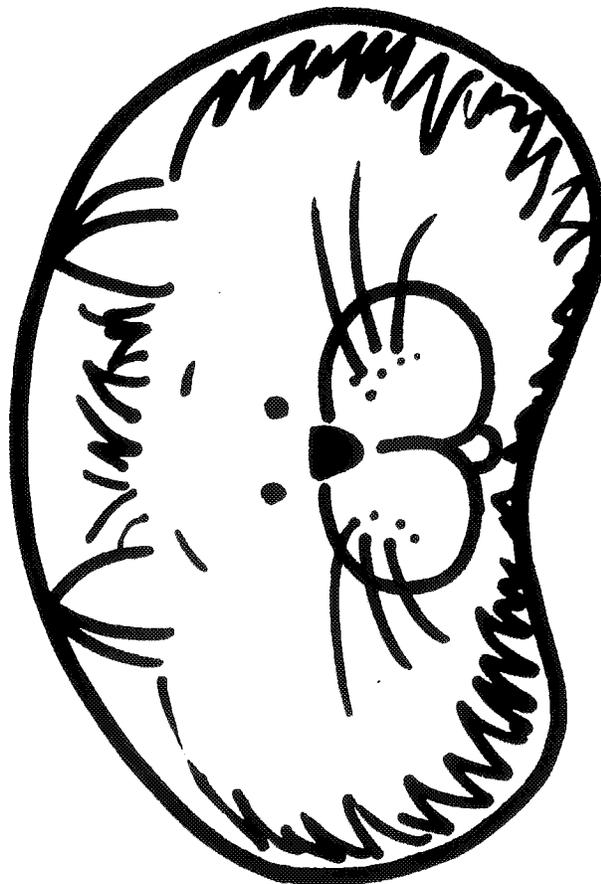
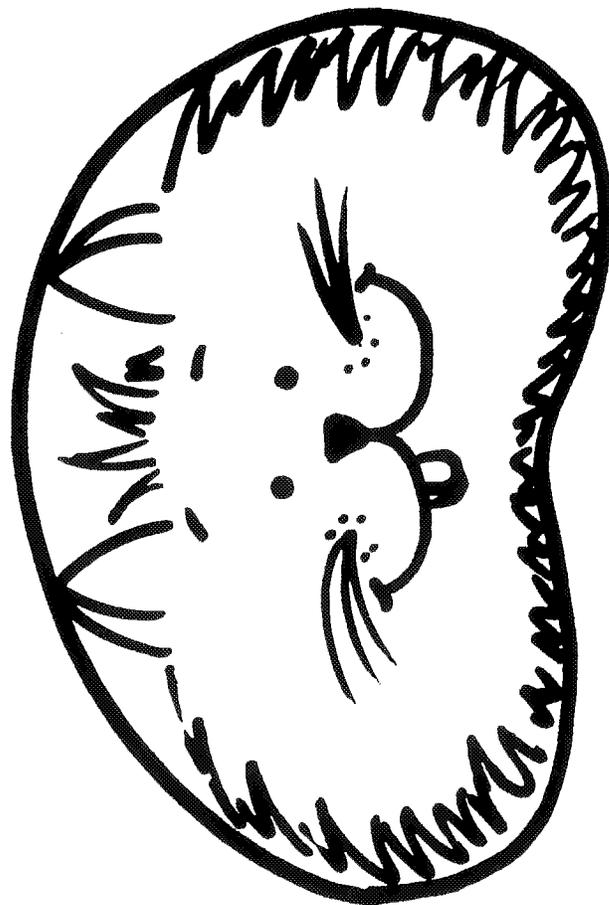
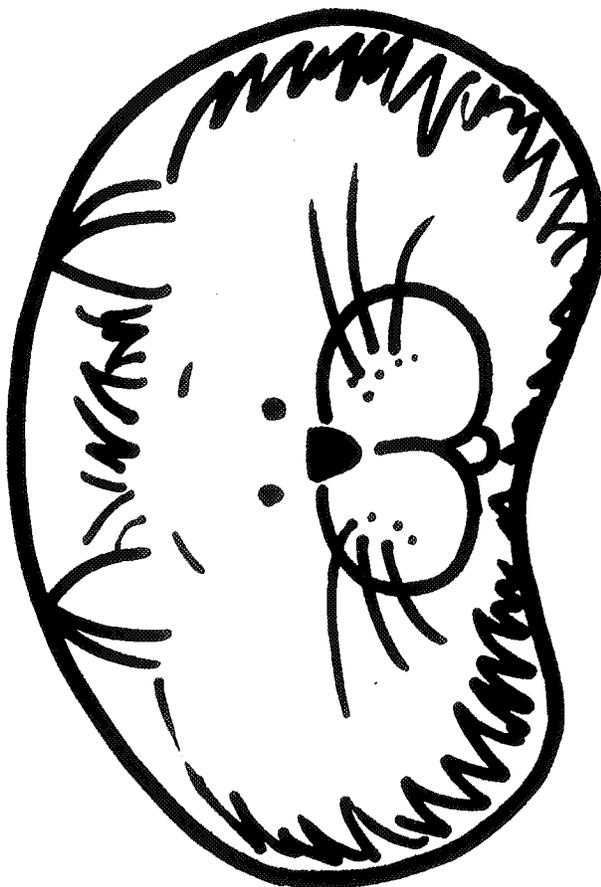
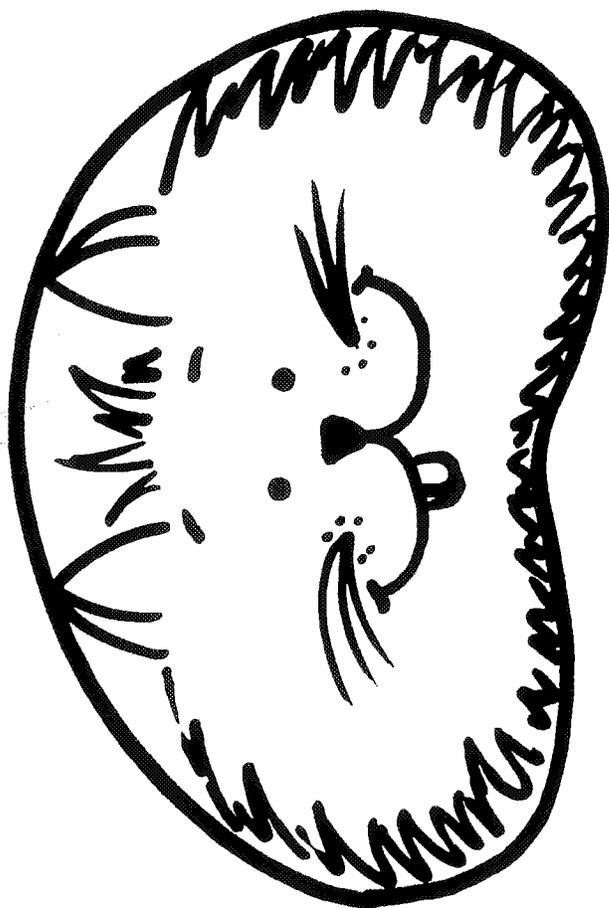




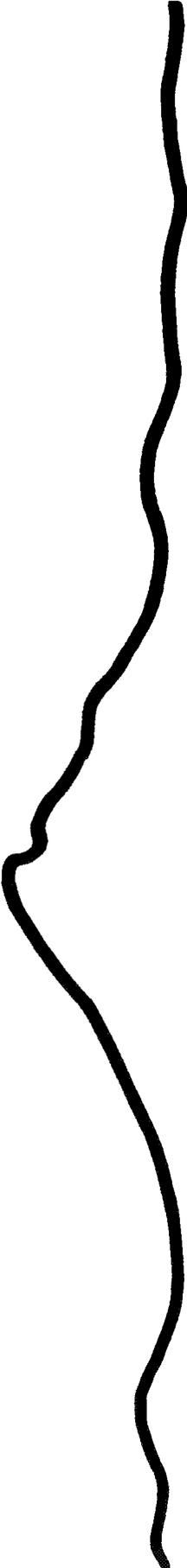


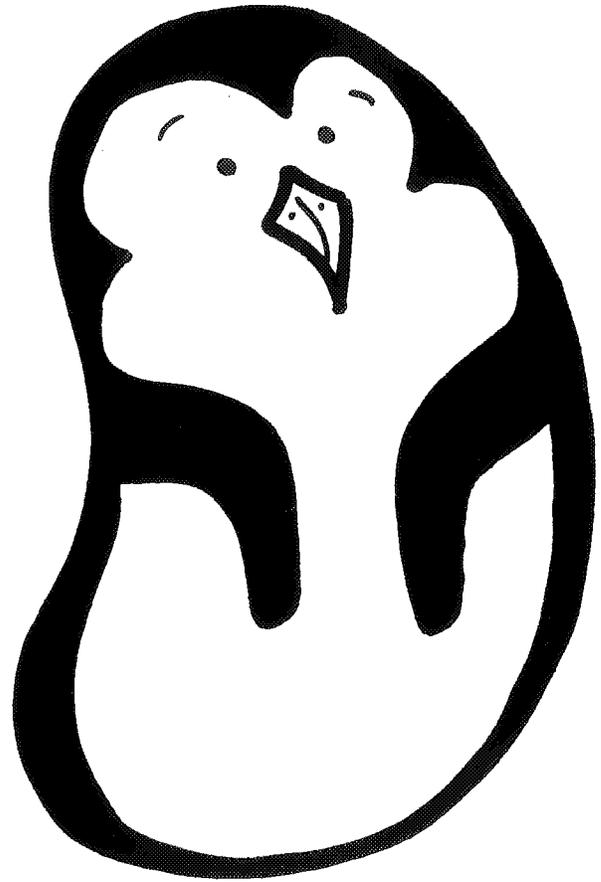
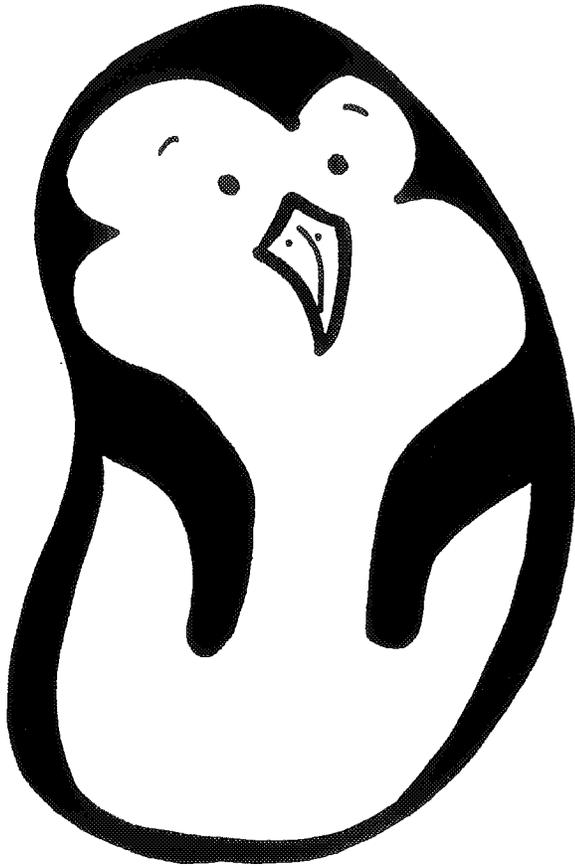


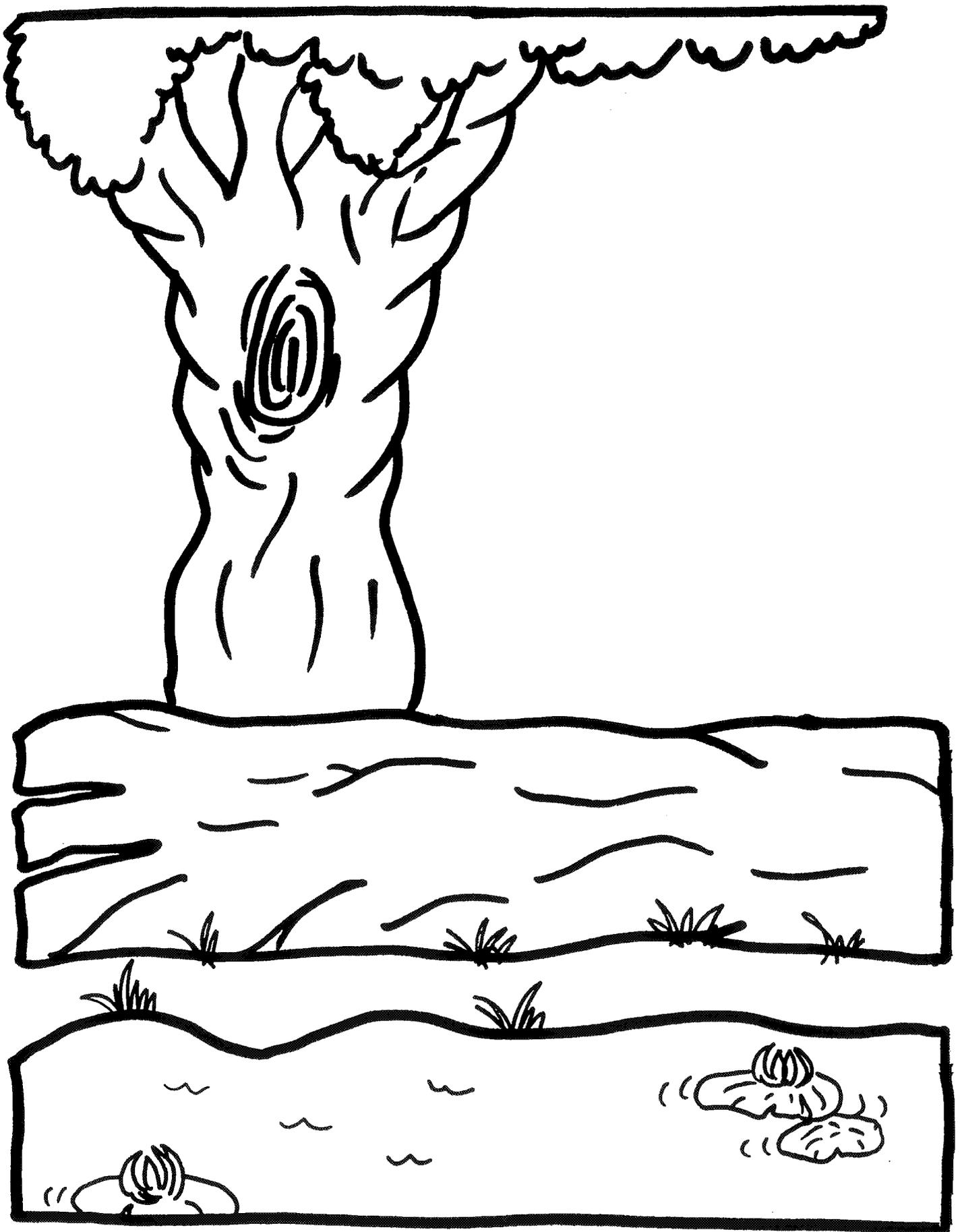


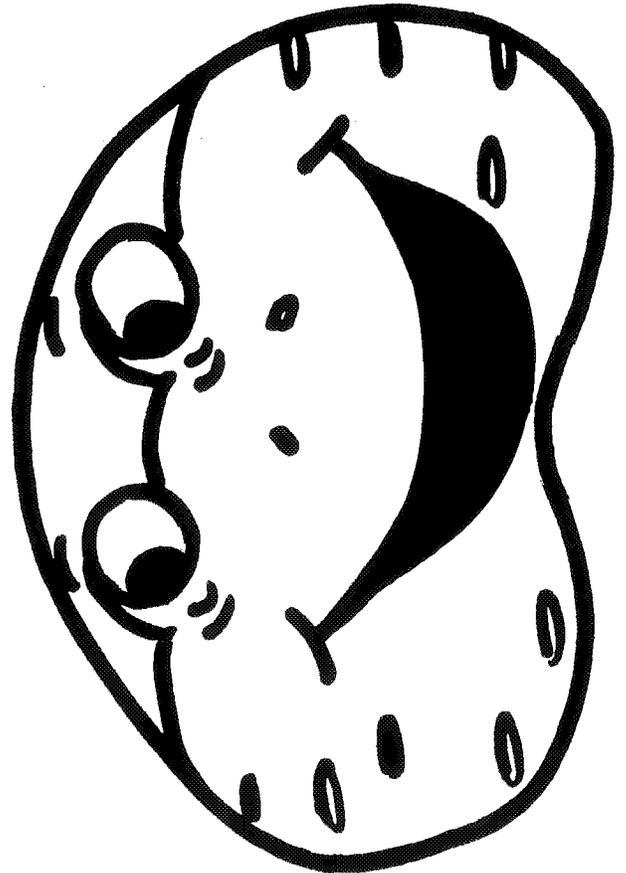
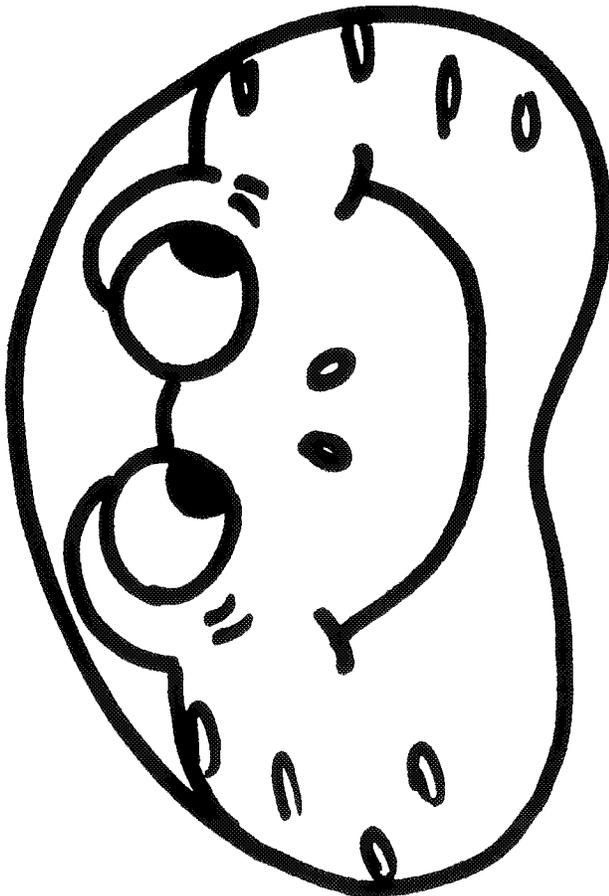
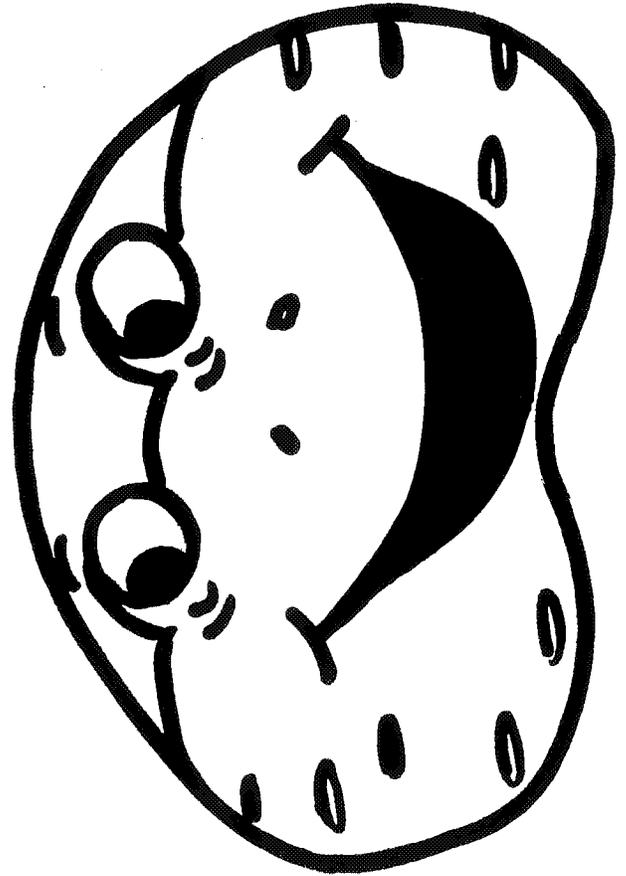
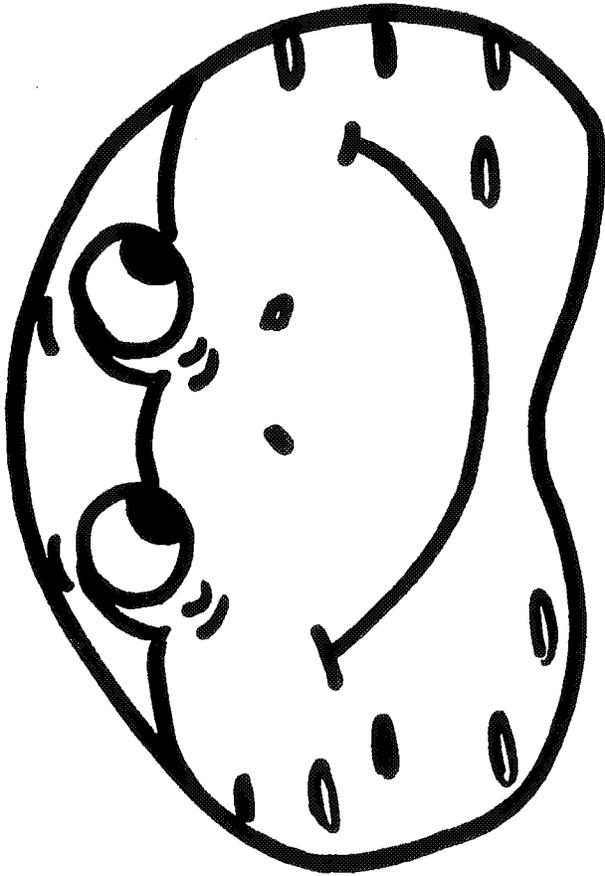


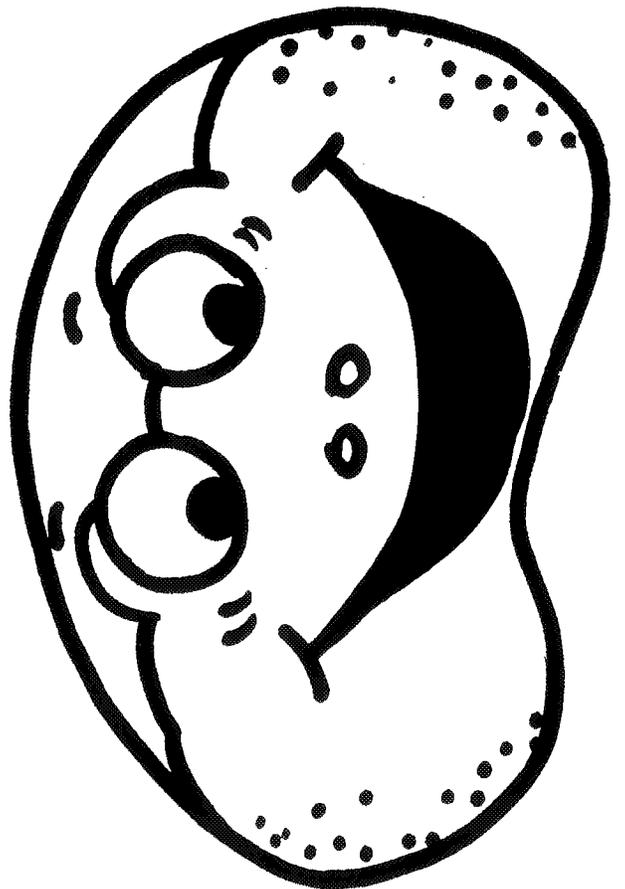
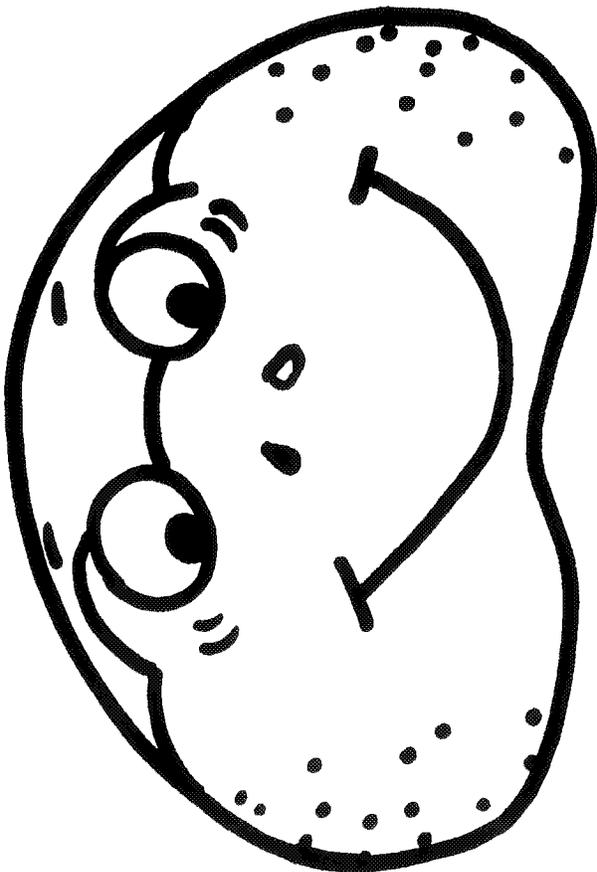
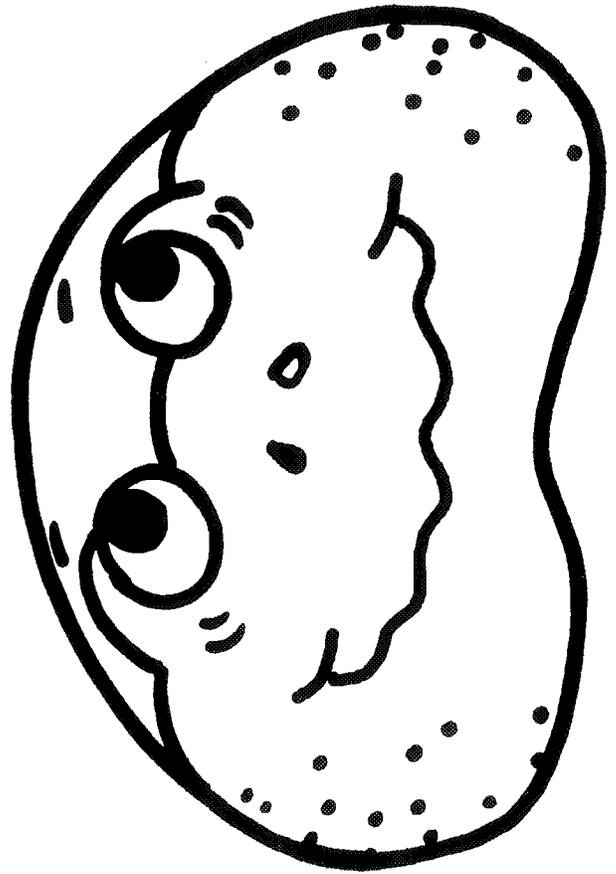
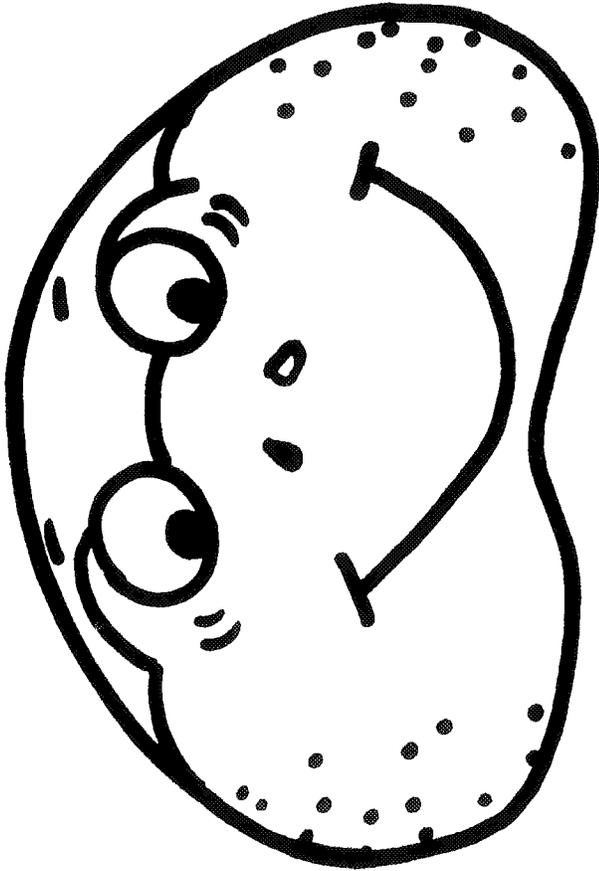


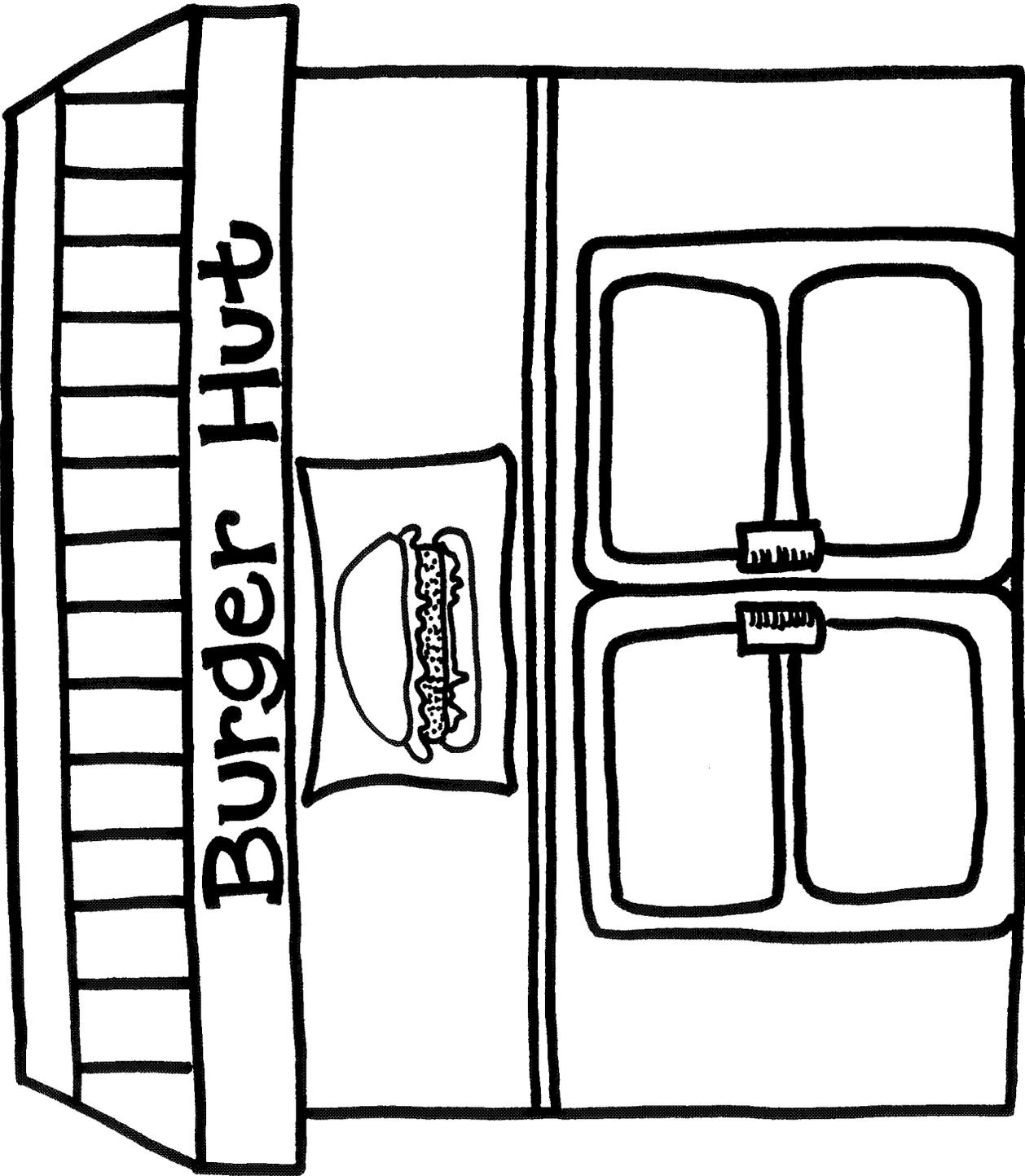


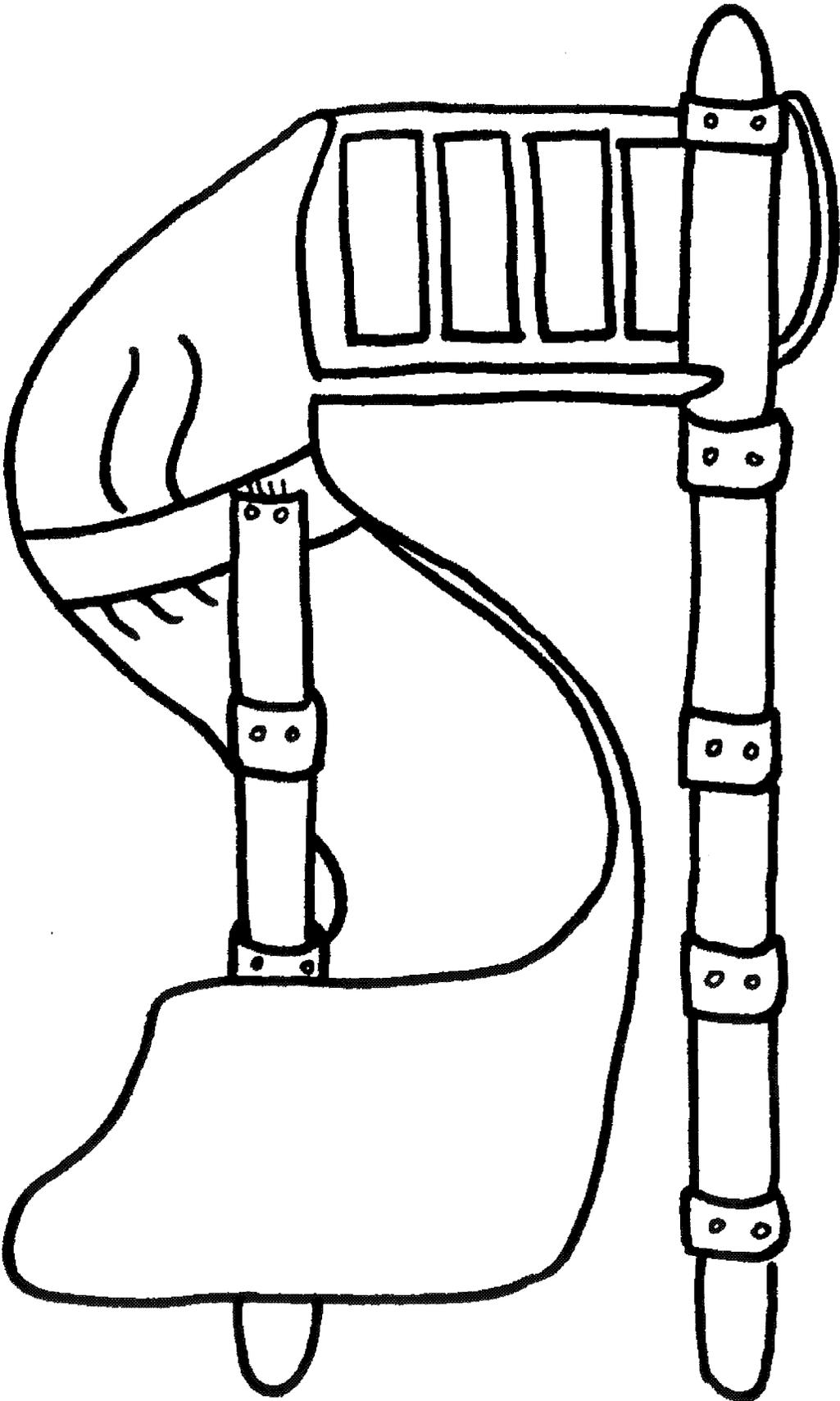


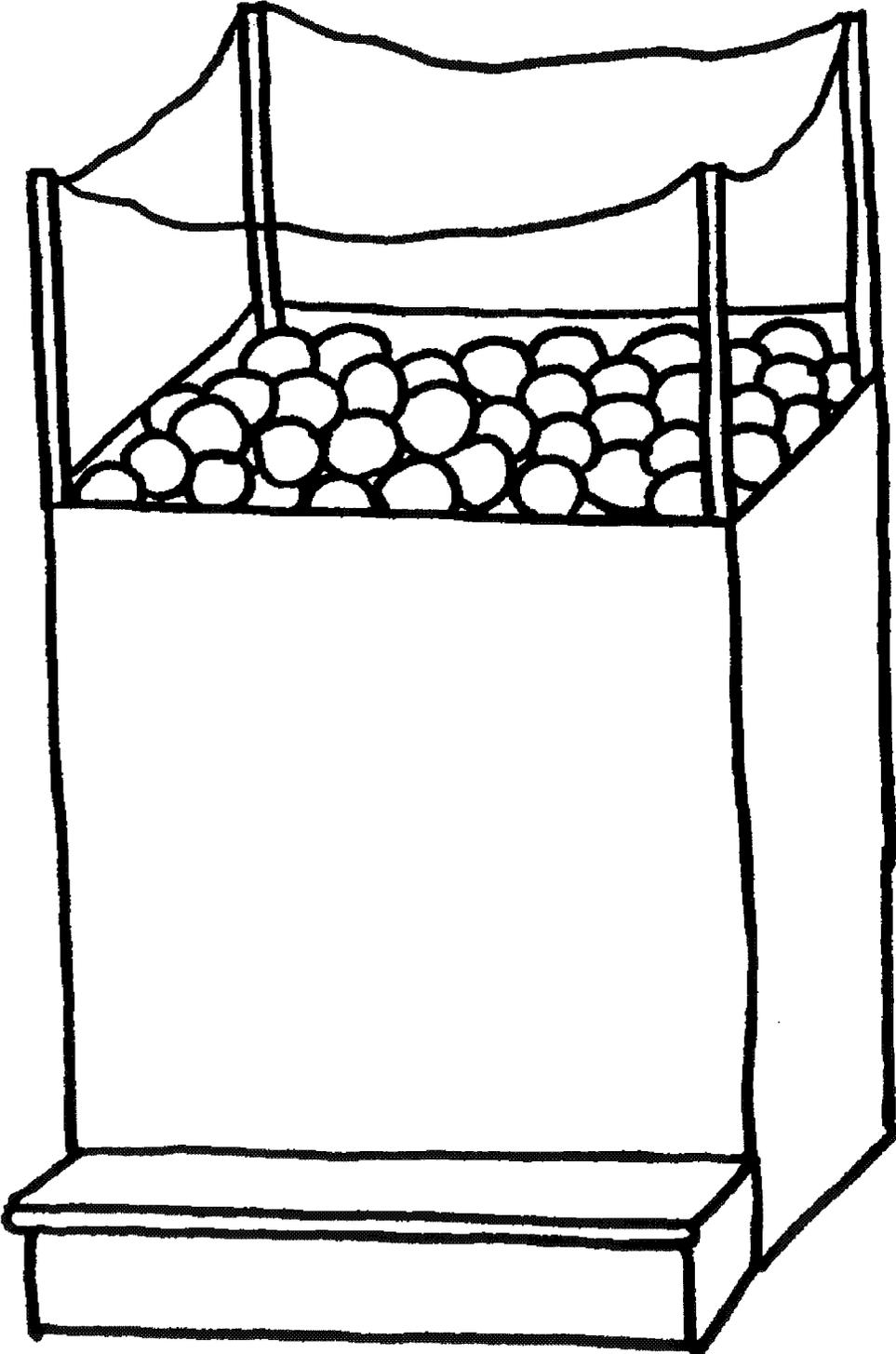


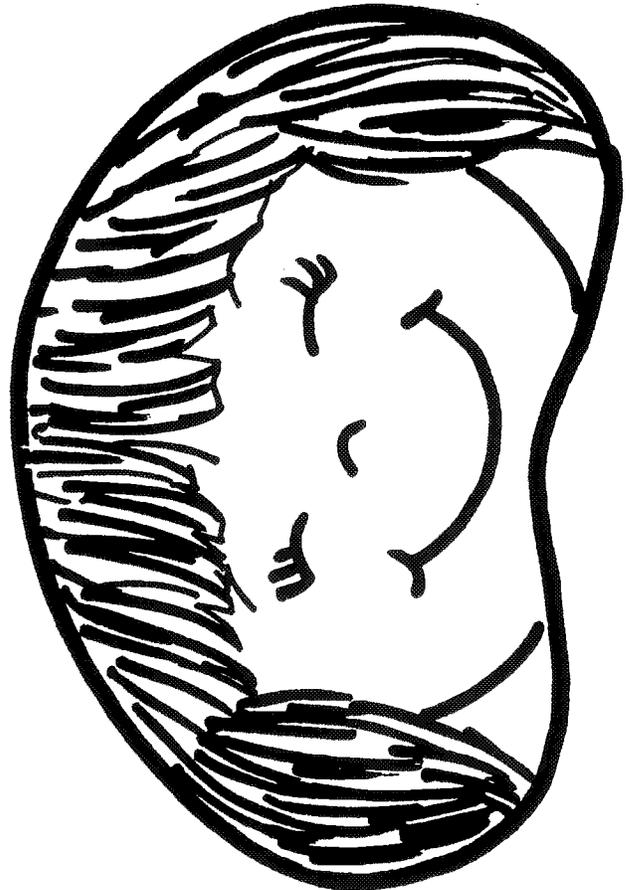
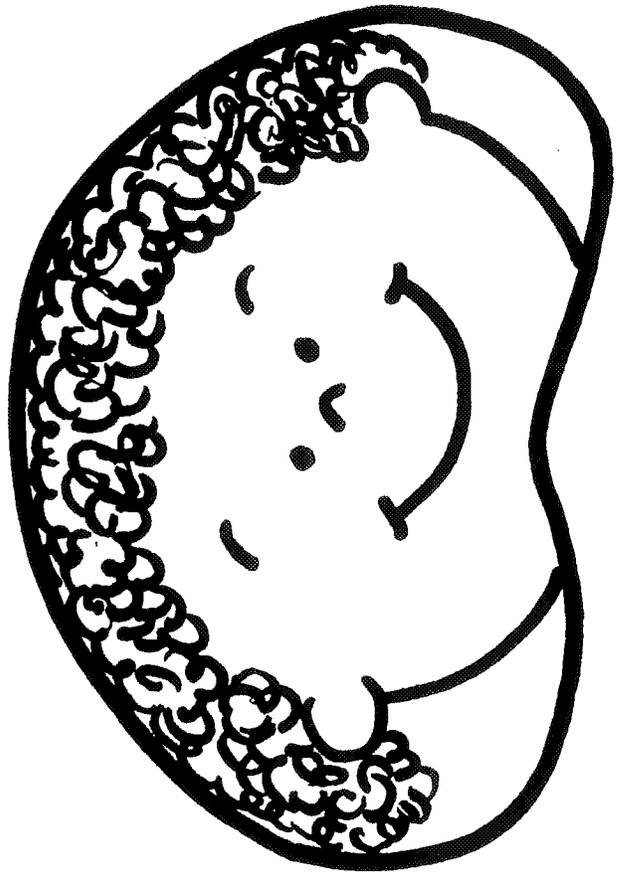
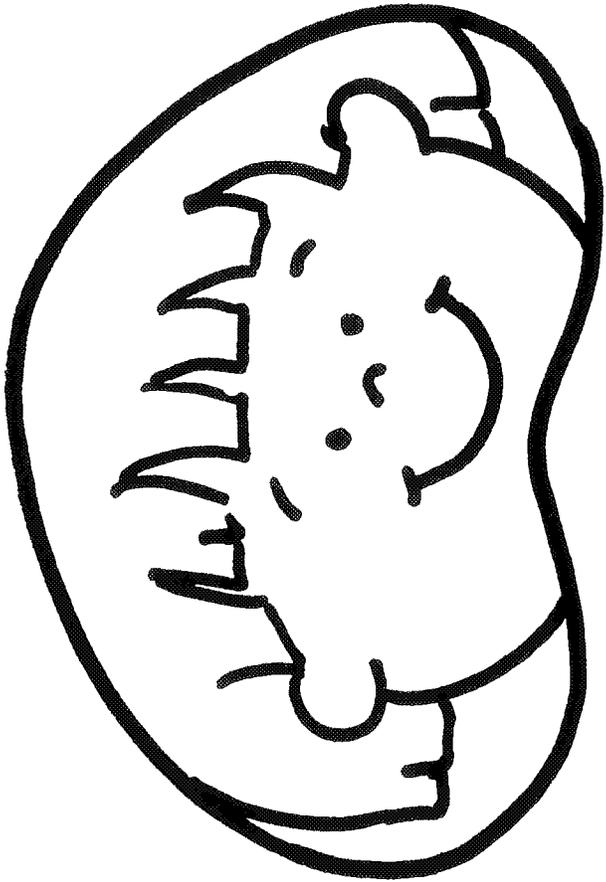


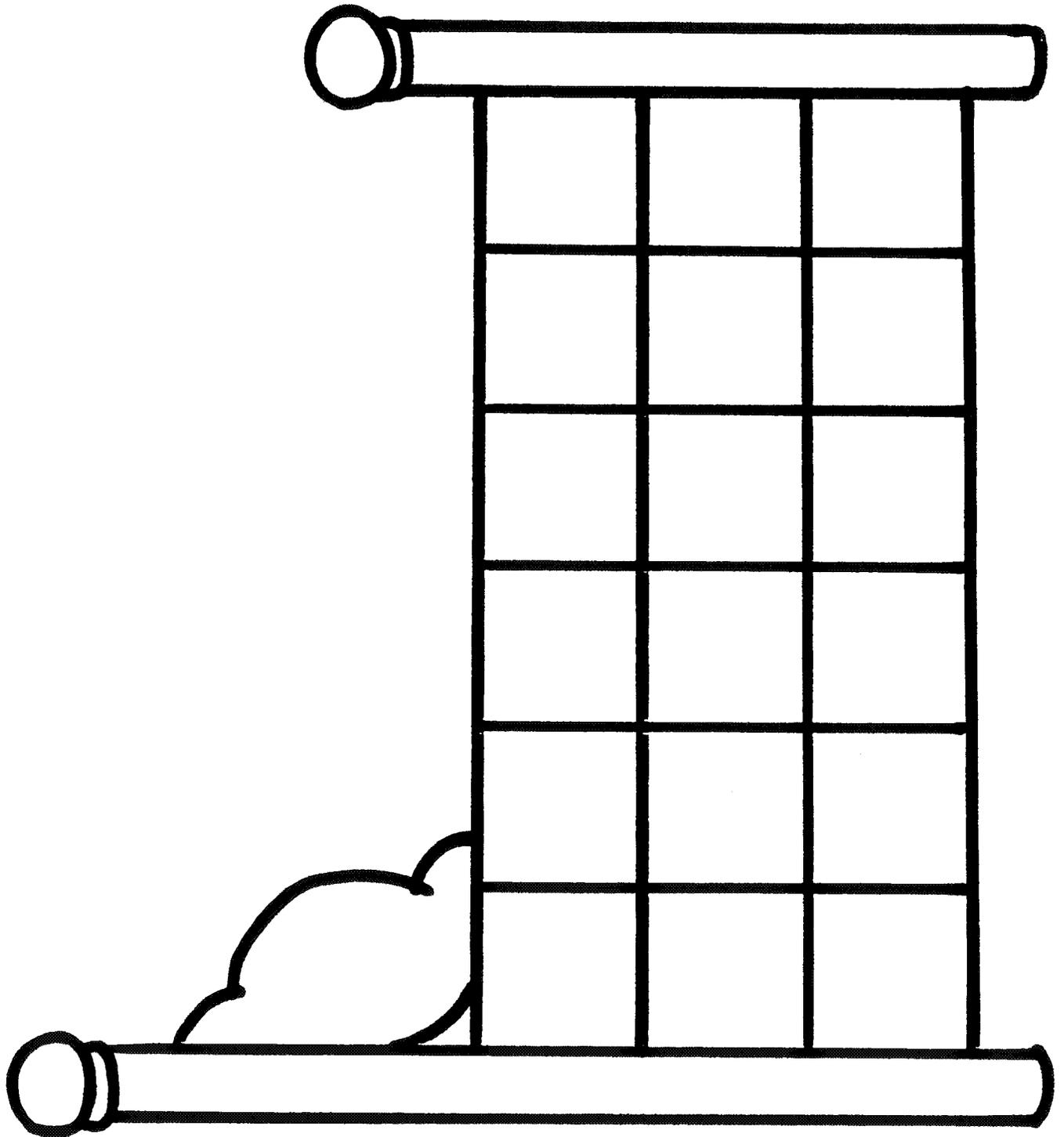


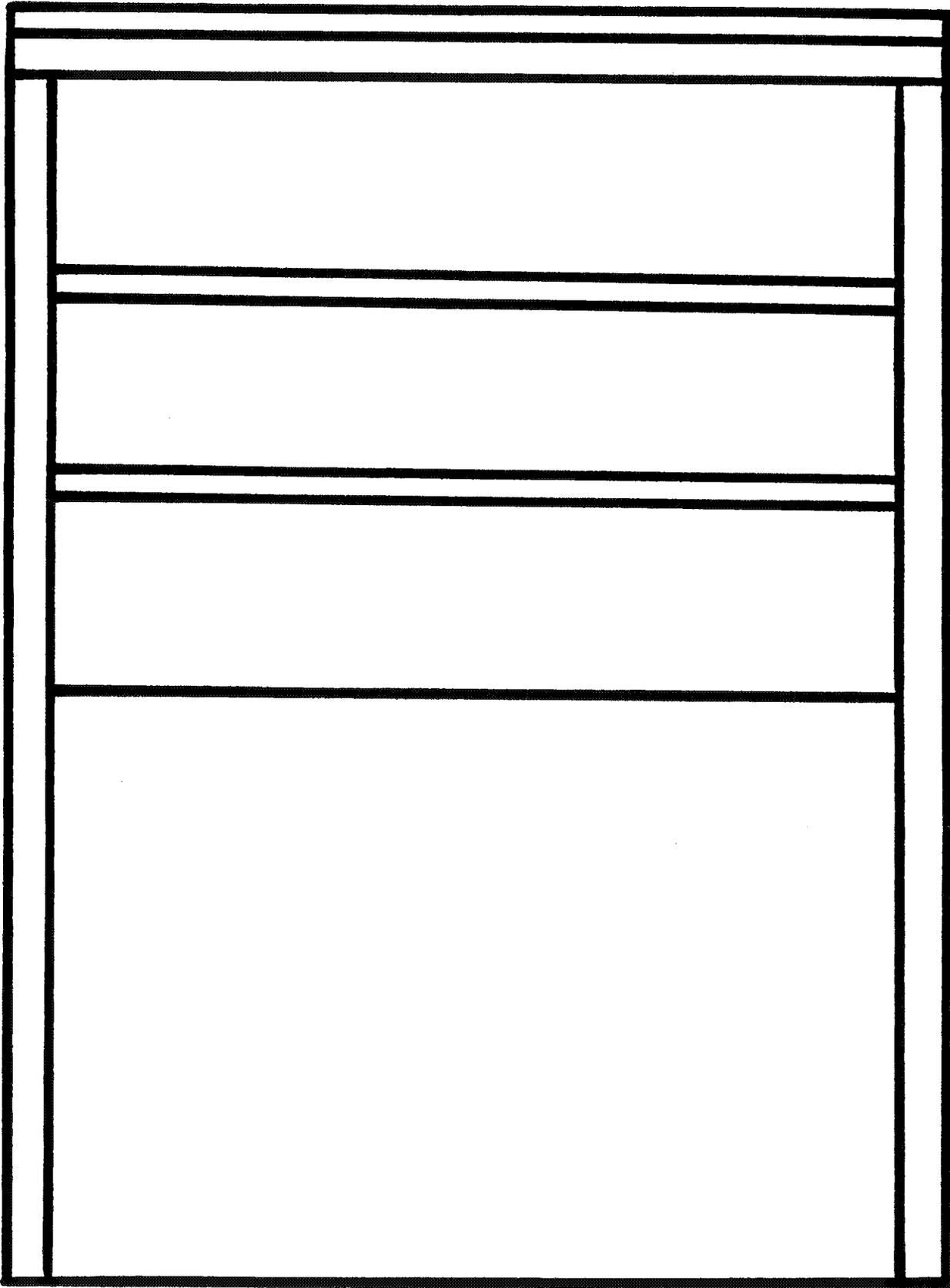


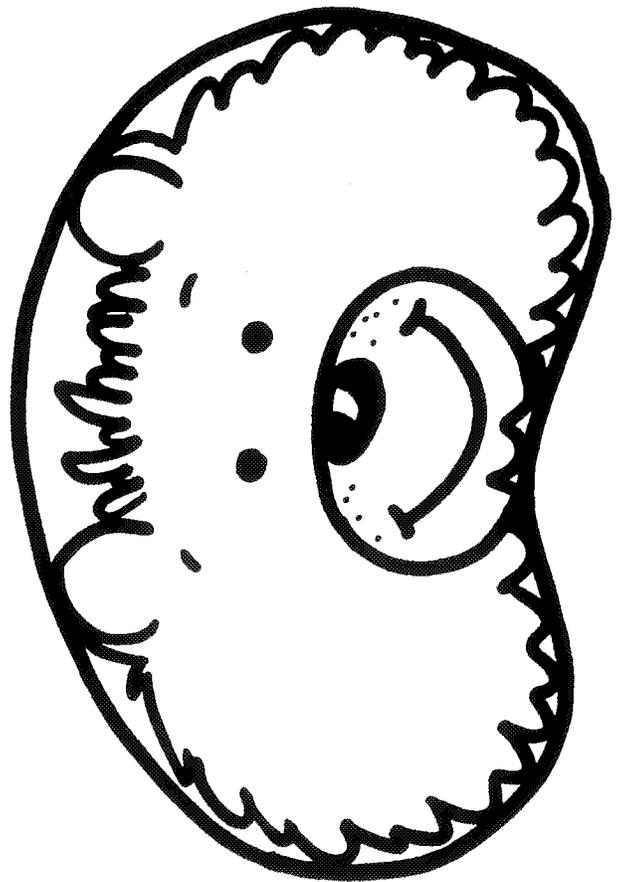
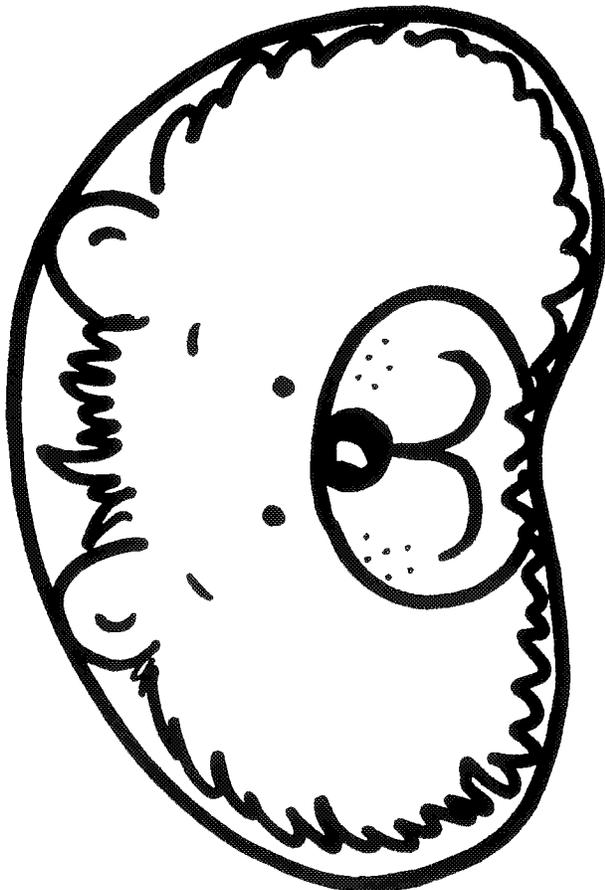
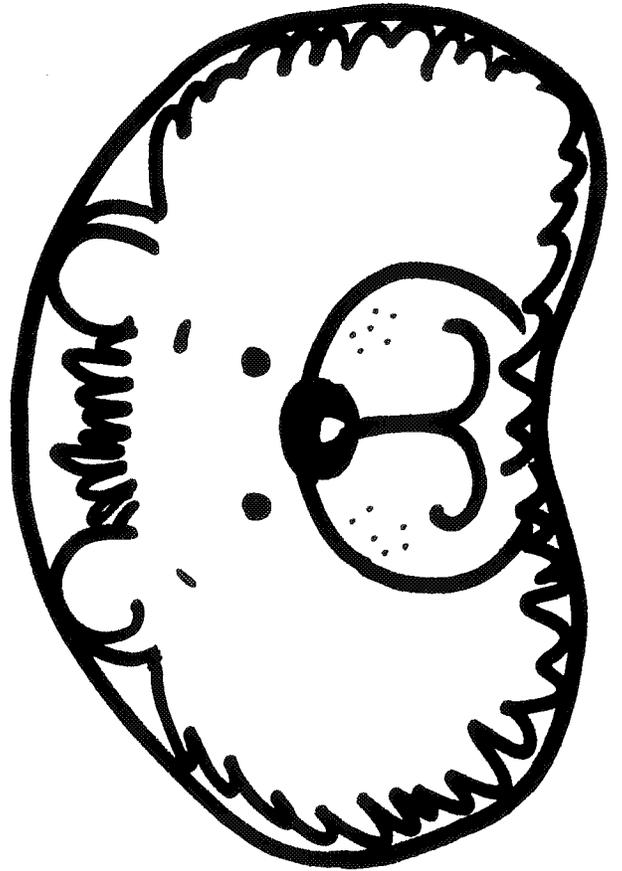
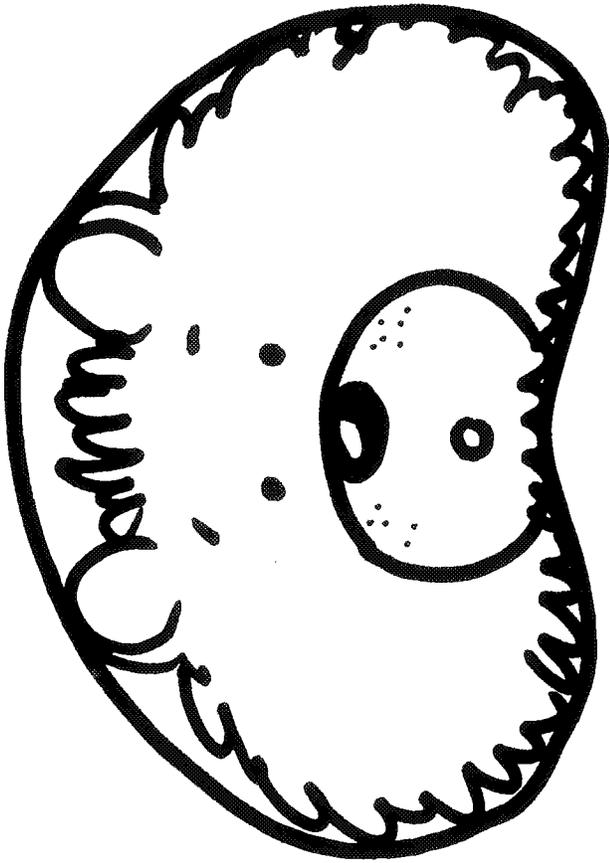












NOTES
