WHOLE CLASS LESSON

Overview

In this three-part lesson, students investigate three-dimensional shapes by examining boxes, comparing their similarities and differences, and sorting them by various properties. Students are introduced to standard mathematical language of polyhedra as they investigate the vertices, faces, and edges of the boxes. Also, by tracing the faces of their boxes, children gain experience relating two- and three-dimensional shapes.

In Part 1, children compare boxes and record the similarities and differences they notice. In Part 2, students sort the boxes into two groups by different attributes and then guess the ways others sorted their boxes. In Part 3, children trace the faces of a box.

The menu activity Covering Boxes (see page 104) extends the lesson by having children cover the faces and edges of their boxes with construction paper and yarn. The Box Riddles assessment (see page 111) has students write descriptions of their covered boxes, creating clues for others to use to match the riddles and boxes. The menu activity Same and Different (see page 62) is a related activity, a two-dimensional version of the comparing boxes activity in Part 1 of this lesson.

Before the lesson

Gather these materials:
- 40–45 boxes of different sizes and shapes, including cylinders if possible (boxes should close or have lids)
- 15–20 sheets of 6-by-9-inch newsprint
- 15 sheets of 18-by-24-inch newsprint

For a week or two before the lesson, ask children to bring boxes to class. Tell them they should bring boxes with tops, either attached or separate. Supplement the supply so you have 10–12 more boxes than students.

Teaching directions

Part 1: Comparing Boxes

- Explain to the children that they will work with a partner to compare boxes. Have each child choose a box and put it aside for later use.

- Select two boxes from the remaining collection. Ask the class, “What do you notice about the boxes?” Have all students who are interested share their ideas. Also, introduce the geometric terminology of face, edge, and vertex, adding these words to the Geometry Words chart.

- Have students discuss in pairs what is the same and different about the boxes they chose. They should record what they notice about both boxes. Observe children as they work. If you notice students focusing only on similarities or differences, offer suggestions to help them expand their thinking.

- In a class discussion, ask pairs to read what they wrote. After each pair reports, ask the class for questions or suggestions.
Part 2: Sorting Boxes
- On another day, introduce the idea of sorting the boxes. To begin, choose six to eight boxes and sort them into two groups. For example, you can sort them into those with only rectangular faces and those with other shaped faces, or those that have attached tops and those that do not, or those that are cubes and those that are not. Ask the class to guess how you sorted the boxes. As you listen to the students, paraphrase their ideas, to model the use of correct geometric terminology.
- Have children work in small groups of three or four. Each group needs six or seven boxes. Ask groups to sort their boxes into two sets in as many ways as they can, and to record how they did so.
- After the children have recorded the ways they sorted their boxes, play a guessing game. Have groups choose one way they sorted their boxes and record each attribute they used on a 6-by-9-inch sheet of newsprint. Ask the rest of the class to guess how other groups sorted the boxes.

Part 3: Tracing Faces
- Before the lesson, choose one of the boxes you used for sorting and trace its faces onto a sheet of 18-by-24-inch newsprint. Show the children your tracings and ask them to guess which box you traced. Have them explain their reasoning.
- Tell the children that each group will choose one box and trace all the faces as you did. Ask them for ideas about how to be sure they trace each face. Also, give the instruction that groups must trace all faces onto just one sheet of newsprint, unless they can prove to you that all the faces won’t fit.
- In a later class discussion, have groups describe how they accomplished the task.

FROM THE CLASSROOM

Part 1: Comparing Boxes
I gathered the class on the rug. “In this activity,” I explained, “you and a partner each choose a box, then together examine both boxes. Your task is to notice what’s the same and what’s different about the boxes.”

Immediately, Felicia raised her hand. “Can we use the box that we brought in?” she asked, referring to the four large shopping bags that held the boxes they had collected over the previous two weeks. Several students commented that they wanted to use their own boxes. Others looked anxiously at the bags.

I decided that until students had chosen their boxes, it would be difficult to hold their attention to explain the activity. “You can pick your box or a different one,” I said. “Let’s take the time for each of you to choose a box that you like. Put it on your desk and then come back to the rug.”

A few minutes later, all the students were back on the rug, seemingly happy with their choices and better able to listen. I held up and slowly rotated two boxes for the class to see. One was a 5-by-5-by-12-inch box, a bit larger than a one-quart milk carton; the other was a 5-by-5-by-5-inch cube.
“What do you notice that’s the same or different about the two boxes?” I asked. About 10 children raised their hands.

Elena began. “One’s tall and thin and the other is short and sort of fat.”

Alex continued. “And one is like a box that a bottle might come in, and the other . . . maybe it held a coffee mug.”

Sara said, “They’re not congruent to each other.”

“Congruent?” I asked.

George blurted out, “The two boxes, if you put them next to each other they wouldn’t match exactly because they’re not the same. They just look sort of the same.” Eight or nine students nodded their heads in agreement, including Sara.

“They both have six sides,” Lisa said.

“What do you mean by sides?” I asked.

“You know, the sides are the pieces that hold the box together, and they have writing on them,” Lisa replied, leaning over to touch one of the faces of the boxes.

“Mathematicians call those pieces ‘faces,’” I said, taking the opportunity to introduce the correct mathematical vocabulary. “Let’s check the number of faces on each box.” The children counted along with me.

“What do you think these are called?” I pushed, running my finger along several edges of the boxes.

“Sides,” several students called out.

“Edges!” said Tanya.

“Yes, they’re called edges,” I confirmed.

Gena, who doesn’t often speak up in class, said softly, “I notice that each box has six faces, but they have . . . 11, no, 12 edges.”

“That’s twice as many edges as faces,” said Edward.

I called on Paul. Paul could often be counted on during discussions to share his unique logic. “There’s gotta be a special name for corners too, if sides are faces and where they meet are edges. Is there?” he asked.

“What do you think?” I asked the class.

Some children looked confused; others eagerly shouted yes; still others said maybe.

I continued, “As a matter of fact, Paul, there is a special name. Mathematicians call a corner a vertex. If they’re talking about two or more corners, they say vertices—that’s the plural. I’ll add all these words to our Geometry Words chart so you can see how they’re spelled.”

Satisfied, Paul nodded, and slowly finished his original thought. “When we did the four-triangle problem, we learned that shapes with six sides and corners are hexagons, and shapes with eight sides and corners are octagons. But the boxes have six faces and eight corners.” He demonstrated by counting the faces and edges on each box for the class to see.

“What would you call that? A hexagon? An octagon?”

“What do you think?” I asked the class. “Talk to your neighbor about this.” Paul’s question sparked enthusiastic discussion among the children. I was fascinated by the children’s interest and willingness to ponder it. After a minute or so, I asked the students for their attention.

“Who has an idea?” I asked.

Julie excitedly began, “Well, it doesn’t make sense because Jenny and I agreed that a hexagon has six sides and six corners, and an octagon has eight sides and eight corners. So you can’t really call it either because it fits both!” Several students who appreciated Julie’s argument cheered.
Teachers must decide when to offer a recording structure and when to allow students to decide for themselves how to present their work. Either way, the assignment should provide children with the challenge of expressing their ideas in their own words.

"How about a hex-a-oct?" said Grant tentatively.
"Or oct-hex?" said Mark.
"Actually, mathematicians have several different names they use for boxes like this," I said, holding up one of the boxes. "It's called a polyhedron, and it can also be called a rectangular prism. I'll write these words on our chart.

I then gave the children instructions. "With a partner," I said, "look at your two boxes. Talk about what's the same about your boxes and what's different. Record all that you notice." The students found partners and began to work. I took this opportunity to add "faces," "edges," "vertex," and "vertices," "polyhedron," and "rectangular prism" to the Geometry Words chart.

Observing the Children
I listened to the children's conversations and observed them working. The students were engaged and interested in the activity. I noticed that many of them ruled their papers into two columns, one for "Same" and one for "Different," while others just listed their observations.

As they worked, several pairs of students asked for my help. Some felt stuck for ideas, and others needed help describing a particular attribute. I also intervened with a few pairs who were having difficulty working together, either disagreeing about how to record or who was to record.

After about 20 minutes, all of the children had recorded at least a few similarities and differences. I waited a few minutes more and decided to call for the children's attention. It seemed that most of the students had run out of ideas, and some conversations had turned to social interests instead of mathematics.

Grant and Ben organized their paper as Emma and Tanya did.

<table>
<thead>
<tr>
<th>Same and Different</th>
</tr>
</thead>
<tbody>
<tr>
<td>They both have 6 faces.</td>
</tr>
<tr>
<td>They both open the same way.</td>
</tr>
<tr>
<td>They both have 8 corners.</td>
</tr>
<tr>
<td>They both have 12 edges</td>
</tr>
<tr>
<td>They are both rectangles.</td>
</tr>
<tr>
<td>They both open from the top.</td>
</tr>
<tr>
<td>They both have 3 pieces.</td>
</tr>
<tr>
<td>G's box is smaller than B's box.</td>
</tr>
<tr>
<td>G's box fits inside B's box, but B's box doesn't fit in G's box.</td>
</tr>
<tr>
<td>B's says Deluxe on it and G's says Macy's.</td>
</tr>
<tr>
<td>B's box has designs on it and G's box is plain.</td>
</tr>
<tr>
<td>G's box is smaller than B's box.</td>
</tr>
<tr>
<td>G's box fits inside B's box, but B's box doesn't fit in G's box.</td>
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<td>B's says Deluxe on it and G's says Macy's.</td>
</tr>
<tr>
<td>B's box has designs on it and G's box is plain.</td>
</tr>
</tbody>
</table>
Emma and Tanya organized their paper into two columns. Emma recorded in the “Same” column, and Tanya wrote in the “Different” column.

**SAME**
- Both have 6 faces
- Both have 12 edges
- Both have 8 corners
- Both are boxes
- Both have rips
- They both can be taken apart
- They both open-up
- They both have 2 triangles and 2 trapezoid shapes on the bottom

**DIFFERENT**
- Ones white and gray
- and ones maroon
- Ones a rectangle, and ones a square
- One, has writing, and the other does not
- One is taller than the other
- One opens like a shoe box and one like a clam
- One has numbers the other does not
- One is recyclables
- One has tape

### A Class Discussion

To begin the class discussion, I explained the procedure we would use to share our findings. My goal was for students to listen to and think about one another’s ideas. “Each pair will report three or four things you found. Use your boxes to show us what you mean,” I said. “Take a few moments to decide how you will make your presentation.”

I called on Emma and Tanya first. “Both have 12 edges,” Emma read, while Tanya counted the edges for the class. “Both have 8 corners,” Emma continued, and again, Tanya counted.

“So did ours!” Grant called out, and his partner, Ben, nodded his agreement. Emma continued reading while Tanya demonstrated. “Both have rips. Ones a rectangle, and ones a square.”

“What do you mean?” asked Craig.

Tanya responded, “Well, my box looks like a square, and Emma’s looks like a rectangle.”

I took this opportunity to reinforce the use of correct mathematical language. “Mathematicians call both of your boxes rectangular prisms,” I said, “but one is also a called a cube.” I got up and wrote “cube” on the Geometry Words chart.

Grant and Ben went next. Grant read while Ben held the boxes. “They are both rectangles.”


“Let’s all say ‘rectangular prism’,” I said, and we all said it together.
Grant then continued reading: “Grant’s box fits inside Ben’s box, but Ben’s box doesn’t fit in Grant’s box. They both open the same way. They both open from the top.”

David and Gena reported next. David read shyly, while Gena showed their boxes: “They are from different store’s. You can smush both of them. They both have 16 teen corner’s.”

Here are some of their findings:

1. One is gray and one is red.
2. You can smush both of them.
3. They both have a stores name on them.
4. One has a clear top and the other doesn’t.
5. They both have 16 teen corners.
6. They are both boxes.
7. They both have 20 faces.
8. One is bigger than the other.
9. They both are rectangles.
10. They are from different stores.

Next Kendra read while Noah held the boxes: “There both made of cardboard. Their both feel the same inside. Ones bumpy ones smooth. Their both create static if you rub it on your head.”

The reporting continued in this way until it was time for lunch. Students had noticed many things about their boxes and enjoyed sharing them with the class. The variety of ideas shared, the range of language, and the students’ enthusiasm for the activity made the discussion an exciting way to end math that day.
Part 2: Sorting the Boxes

We continued with the boxes activity the next day. For the benefit of the two children who were absent the day before, I began class by asking the children to review what we had done. Then I introduced the idea of sorting the boxes. To prepare for this, I had chosen seven boxes and sorted them into two groups—those with all rectangular faces and those with other shaped faces. In one group, I put five boxes with rectangular faces—a shoe box, a shirt box, and boxes that had held a tie, thank-you cards, and tissues. Into the other group I put a cylindrical oatmeal box and a hexagonal tube that had held fireplace matches.

“How do you think I chose to sort these boxes?” I asked. The students began to talk with one another. After a few minutes, I called for their attention. “I’d like to hear all of your ideas,” I said.

Courtney began, pointing to the cylinder. “Those have circles or funny shapes and those are regular boxes?”

Rather than respond to Courtney’s idea, I asked, “Does anyone have a different idea?”

Noah guessed next. “The faces of all those are rectangles and the others aren’t,” he said.

I called on Kendra. “Those five all have 12 edges and the other two are boxes that have . . . well, they don’t have 12 edges,” she confidently said.

George waved his hand back and forth. “I know!” he boomed. “Those five have square corners and the other two don’t!”

Lisa continued. “Some held gifts and some didn’t,” she said.

“I’m going to show how you can record your ideas,” I said, moving to the overhead projector. “Courtney’s idea could be written as ‘has circular faces’ and ‘doesn’t have circular faces.’ Noah’s idea could be written as ‘has rectangular faces’ and ‘doesn’t have rectangular faces,’” I recorded these ideas on the overhead.

“For Kendra’s idea,” I said as I continued recording, “I could write ‘has 12 edges’ and ‘doesn’t have 12 edges.’ What about George’s idea?”

“Square corners and no square corners,” George said. I recorded his suggestion.

I then explained to the students that each table group should add two more boxes to its collection so that each group had six boxes to sort. The group was then to sort the boxes in as many different ways as possible, recording all the ways, as I had done on the overhead.

Observing the Children

The students were busy at work as I circulated among the groups, answering questions and listening to the children’s ideas.

George, Felicia, Paul, and Mark were supposed to work together since they sat at the same table, but Paul had left to go to an appointment and Mark was absent. George and Felicia decided not to work with anyone else. In retrospect, I wish I had asked them to work with another small group of three children. The two argued over which boxes to add to make a collection of six, how to sort the boxes, and who had to record. I found myself spending more time than I would have liked trying to help these two children solve their problems.
Sara, Emma, and Drew found 17 ways to sort their boxes.

When it seemed as if George and Felicia had finally found a way to share their thinking and the work, I left them, only to find out later that they had compared only their two individual boxes and ignored the rest. They recorded their results as they had in Part 1 of the lesson: Same: My box has six sides and so does hers. They each have sides. Different: Felicia's box is shiny. George's box is dull. George has 12 and I have 28. (I didn't know what they were referring to here.) I have flaps and she does not.

Later I talked with George and Felicia to determine if they had misunderstood the assignment. Felicia said, “I know. We were supposed to write things like . . . like ‘has six sides’ and ‘doesn’t have six sides.’ I guess we just got carried away and forgot.”

The other groups recorded a variety of ways to sort the boxes. For example, Cal, Nicole, and Gena wrote: 1. boxes with big letters on them and the others that don't. 2. square corners and not. 3. Those that are rougher and those that aren't. 4. same shape and not same shape. 5. boxes with six faces and boxes without six faces. 6. boxes from a department store and those that aren't.

Sara, Emma, and Drew listed 17 ways to sort their boxes, focusing on texture, color, number of faces, shapes of the faces, and more.
Courtney, Elena, and Craig included how many boxes belonged in each set.

A Class Discussion

Before class the next day, I took two sheets of 6-by-9-inch newsprint and wrote "All Rectangular Faces" on one and "Not All Rectangular Faces" on the other. I placed the seven boxes I had used in the previous day's lesson into two groups, one on either side of me on a bookshelf, then posted the correct description over each group. I turned the newsprint labels over, however, so the children couldn't read what I had written.

"I've sorted the boxes we used yesterday and written how I sorted them on the other side of these papers," I told the class, seated on the rug around me. "What do you think I've written on them? Talk to your neighbor."

Gordon offered his idea first. "Lids that come off and lids that don't," he said.

"Boxes with blue on them and boxes without," Julie contributed.

"Keep guessing," I said. "Your answers show that a lot of ideas work. Let's see how many ways you can think of before I show you what I wrote."

Emma said, "Boxes with square corners and boxes without."

"Rectangular faces and not rectangular faces," Craig offered.

Justin pointed out, "But the box with the hexagons has some rectangles." Craig shrugged.

Kendra raised her hand. "Like I said yesterday, 12 edges or not 12 edges."

After everyone who wanted to contribute an idea had done so, I turned over the papers. I deliberately hadn't turned them over when Craig guessed correctly. I wanted to encourage the children to pursue their thinking.

I then told the children, "Your group is to choose one of the ways you sorted your boxes yesterday. Record the attributes on two sheets of newsprint, as I did. Then we'll come back to the rug and try to guess how each group sorted its boxes."

Although some groups initially had trouble agreeing on which attribute to choose, after about five minutes the students had returned to the rug.

NOTE Giving answers often results in stopping students' thinking. Children need to learn to be persistent, even when an answer is not immediately obvious. When teachers don't tell answers, students get the message that it's important for them to continue thinking about a problem until they make sense of it.

| 1. Are used for carrying food and 3 aren't
| 2. 5 are card board one is tin.
| 3. 5 are rectangular's one's a cube.
| 4. 2 have gold and 4 don't.
| 5. They all have white in them or on them.
| 6. One steel had Ceal the rest do not.
| 7. They all have six faces.
| 8. You can take off there lids and tub you can't.
| 9. 5 have words on them and 2 does not.
| 10. 2 have silver and 4 don't.
| 11. 4 have strips and 2 don't.
| 12. One is all white and five don't.
| 13. 2 carry, carry, and 4 don't.
| 14. One has people on it.

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I explained what we would do. "When it's your group's turn, bring your boxes to the bookshelf and sort them. Pin the label sheets above the boxes, with the writing facing the wall. Then the class will guess how you sorted the boxes. When someone guesses, either say that the guess was correct and show the cards or ask the person to try again. You can tell students if they're close, but ask them to explain a different way."

I asked Noah, Paul, and Kendra to begin. They put a small, white hexagonal-shaped box on one side of the bookshelf, and four rectangular-faced boxes and one cylinder on the other side.

Courtney began the guessing. "That one is small and those aren't?"

"Nope," said Noah.

Courtney tried again. "One's a hexagon and those aren't?"

"No," Noah said again.

Paul called on Maurice, who said, "The single box has 12 edges and the others don't."

Kendra replied, "No."

Craig guessed next. "The white box doesn't have words on it and the others do."

Kendra looked carefully at the boxes and smiled. "That's true," she said, "but it's not how we sorted them."

Justin offered, "The single box has more faces?"

Noah shook his head.

The class was stymied. Then Courtney spoke up again, saying, "The single box can fit triangles in it and the others can't." I was interested in how Courtney knew this, but I didn't interrupt.

Kendra shook her head. "Not it," she responded. "Do you need a hint?"

"YES!" the class shouted. Kendra, Paul, and Noah put their heads together and whispered. Then Paul said, "One word starts with an S."

Courtney tried again. "The single box has 18 edges?"

Justin replied, "That doesn't start with an S, Courtney."

"She's right," Noah said, "but it's not how we sorted them."

"It had earrings in it?" Courtney asked.

"Close," said Paul.

The guesses came fast and furiously.

"Jewelry?" offered Elena.

"Something to wear?" from Justin.

"Gold?" asked George.

"Silver?"

"No, no, no!" Kendra, Noah, and Paul replied. They were laughing at the determined guessing. "Do you need another hint?"

"Yes!" cried the class again.

Finally the group said, "It has nothing to do with faces, edges, or corners."

A few minutes later, the class still hadn't guessed. I finally asked, "Is there any way for us to guess from just looking at the boxes?"

"Well . . . ," Noah replied, "not really. It's heck of hard!"

It was time for lunch, so we decided to leave the boxes where they were and try again later.

After lunch, Courtney burst into the classroom. "Kendra told me at recess how they sorted the boxes," she cried. "There's no way we can figure it out! You absolutely cannot tell from looking at them."
NOTE Children often think and work in ways teachers may not expect, so teachers should always be interested in and curious about students’ ideas. It’s important not to look for specific responses but to be open to new directions.

NOTE It’s important to ask children to explain their answers. Requiring children to elaborate on their answers helps reveal their reasoning processes and gives them the message that their thinking, not just their answers, is important.

Kendra grinned sheepishly. “Well . . . I guess you’re right. Do you want to know or want to keep guessing?” she asked the class, who had settled down on the rug.

“Tell!” most of the class replied.

Paul turned over the label cards. On them were written, “Had something in them,” and “Didn’t have anything in it.”

This was not what I had expected. Yet it was a good reminder to me that children do things in ways adults may not expect.

We continued the group sharing over the next few days. Attributes students came up with were: boxes with gold print on them and those without, six faces and not six faces, boxes made in the U.S. and boxes made elsewhere, and circular faces and no circular faces.

Part 3: Tracing Faces

I showed the class a piece of 18-by-24-inch drawing paper on which I had traced the six faces of the shirt box I used when I sorted boxes. “I’ve traced all the faces of one of the boxes I sorted the other day,” I explained.

“I wonder if you can tell from the tracing which box I used. Talk to your neighbor about it.” There was an immediate murmur of conversation and much pointing at the boxes.

“Does anyone have an idea to share?” I asked. I called on Julie.

“I think you traced this one,” she said, coming up to pick up the shirt box. More than half the class nodded in agreement.

“How do you know?” I asked, wanting to hear her explanation.

Holding the box against my drawing, Julie said, “I knew it couldn’t be the tissue box because it’s a lot smaller than the big rectangle. I knew it couldn’t be the oatmeal can because . . . ” she faltered momentarily, searching for words to express her thought. “Because you didn’t draw a circle. I also knew it couldn’t be the hexagon poster box because then the rectangles would be long and skinny and probably wouldn’t fit on the paper.”

Craig raised his hand and said, “It couldn’t be the tie box because the tie box is long and skinny. The thank-you cards are too small; that’s obvious. So it had to be the shirt box.”

“How could you find out for sure?” I asked.

“Hold the box up to your paper and see,” said Justin, exasperated.

“Like Craig said, it’s obvious.” He took the shirt box from Jessie and held it against my paper, rotating it so that everyone could see that the faces of the box match my drawings.

“I’m curious about what my tracing will look like if I trace the cylinder,” I said, as I held up the oatmeal box. “What do you think? Discuss your ideas with someone sitting nearby.”

After a few minutes I asked, “Is anyone willing to venture a guess?”

Edward volunteered, “I think you’ll get two small circles for the ends and one big circle for the middle.”

Jenny raised her hand. “I think you’ll get two small circles, but I don’t think you’ll get a big circle. I think you’ll get a rectangle instead.”

“Huh?” replied Edward.

“Look,” said Jenny, “imagine you cut the oatmeal box straight down the side and lay it flat. You’d get a rectangle, not a circle.”
Edward looked at Jenny dubiously. Other children looked confused. I decided not to resolve the children's confusion and instead discuss it again after they had finished the activity.

"With your group," I instructed, "choose one of your boxes and trace the faces onto a sheet of 18-by-24-inch newsprint." I showed them the paper they were to use.

"Make sure that you trace each face," I continued. "How can you be sure you've done that?"

Grant quickly said, "You could write a number on each face and then once you've traced it, write the same number on the paper."

"Does someone have a different idea?" I asked.

"You could use letters instead of numbers," Tanya offered.

"Or mark each face with your pencil after you trace it," Ben suggested.

"One last instruction," I told the children. "Make sure you can fit your faces onto one sheet of paper. If you think you need another sheet, you'll have to prove to me first that all the faces of your box won't fit on one sheet."

Observing the Children

The children eagerly got to work. They seemed to enjoy the tracing and cooperated well with one another. Some children traced, some measured, some cut out the pieces, and others held a box while someone else traced around it.

"I can't believe they all fit on one piece of paper!" was one comment I heard frequently, as well as "Look! This shape is exactly the same as that shape!"

Most groups chose to trace their faces onto the paper without first planning how to arrange them. Justin and his group, however, measured the dimensions of their box and cut out templates. Then they arranged and rearranged the templates on their paper until they found a way to fit all of the faces of their box on one sheet of paper.

A Class Discussion

In a class discussion, all the groups had a chance to explain how they had accomplished the task. Several groups reported how they had saved space by tracing faces next to one another. Edward commented that his group had thought that the paper wouldn't be big enough for all the shapes. "But it was," he said, "because we were careful." Justin explained his group's system for making templates for all the faces; other students seemed impressed with this method.

Two groups had traced cylindrical boxes and were eager to explain their methods to the others. Emma spoke for her group. "We chose the oatmeal box because it looked . . . weird. Anyway, I made a little line starting at the top and going down the side of the can about an inch. Then we laid the box on our paper and Jessie got down close to the desk top to see if the line was right on the paper. When we got it right, we traced along the lid as we rolled the box until the line got back to where it started from." Some of the children were in awe; others looked confused.

"How did you end up with a rectangle?" Paul wanted to know.

Emma answered, "I just knew it would be a rectangle. I closed my eyes and imagined what it would look like."
Kendra interrupted and said, “Our group had the potato chip can and we didn’t know what shape we were going to get. So Alex decided to cut the can open, and we got a rectangle. See?” Kendra held up the drawing while Alex showed the cut-open can to the class.

Julie added, “I’m with you, Kendra and Alex. I didn’t know what we’d get either, even though Emma said it’d be a rectangle. I guess I had to see it to believe it!”

I knew that Emma loved to sew and draw and that she was quite competent at both for a third grader. The children’s conversation reminded me that the development of spatial visualization requires a variety of experiences over time with two-dimensional and three-dimensional objects.