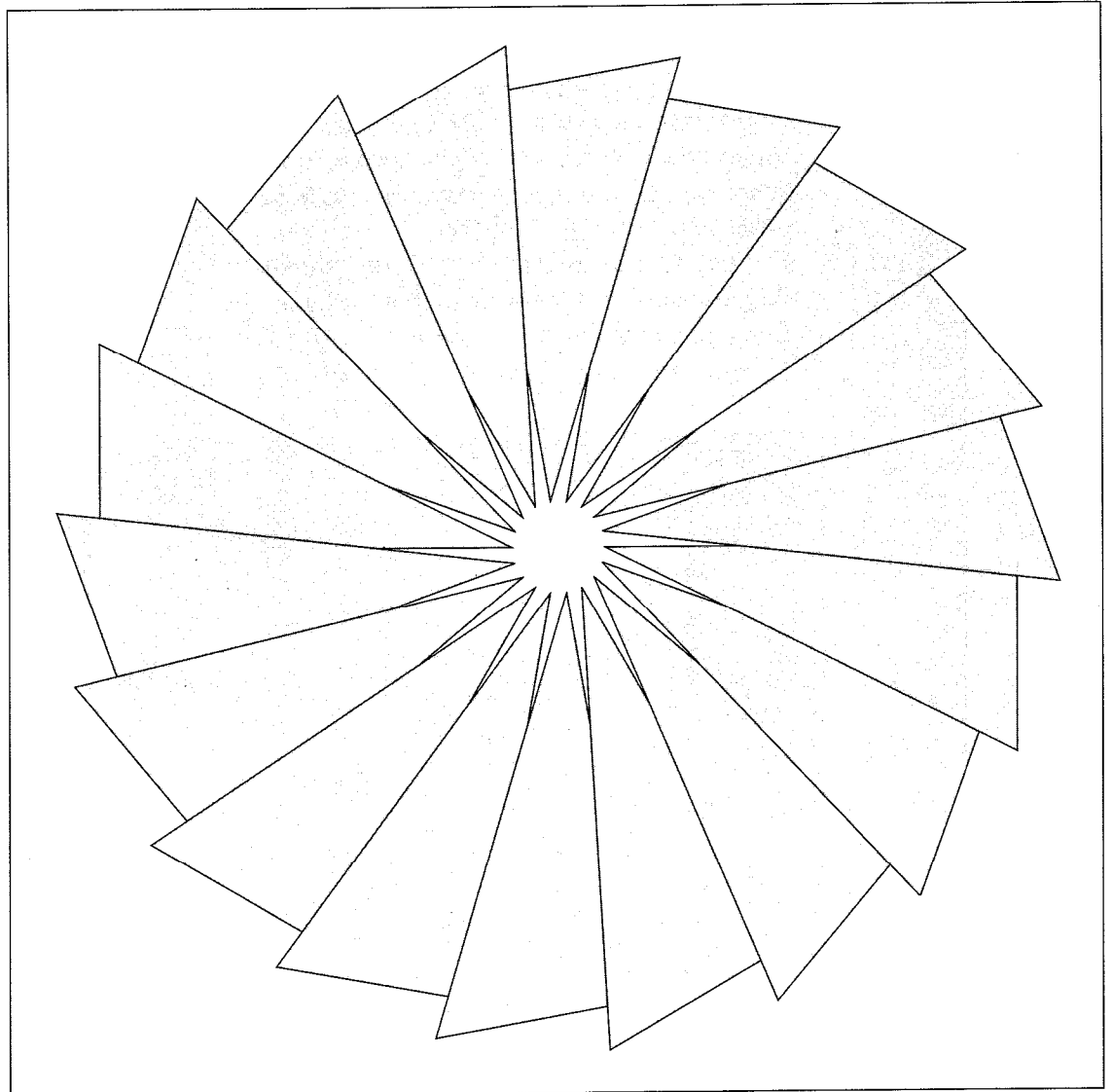


ATTRIBUTES

The activities in this chapter flow naturally from students' unstructured explorations. Students will intuitively sort and classify the blocks without direction from the teacher. The lessons that follow will direct students' attention to identifying and describing specific Power Block attributes.



SORTING AND CLASSIFYING

Materials: _____ Power Blocks (mixed colors)
Yarn loops

Purpose: _____ To sort a set of blocks in different ways

Activity: _____ **Teacher:** Can you think of a way to sort your blocks?

Student: Sure.

Teacher: How would you sort them?

Student: Sort them by color?

Teacher: Okay. Try it. Can someone suggest a different way to sort the blocks?

Student: By shape.

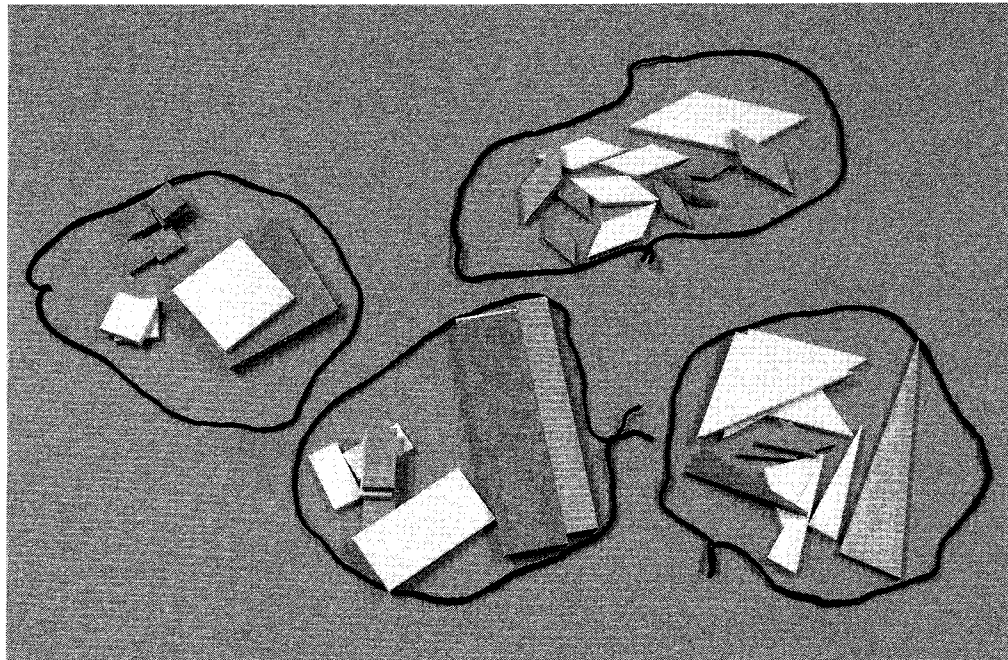
Teacher: How many different shapes are there in your set?

Student: I don't know.

Teacher: Use the loops of yarn to surround groups of blocks with the same attribute.

Questions to explore with students:

- When you sorted by shape, how did you decide what it meant to be a different shape? Is T1 the same shape as T3? If so, why?
- When you sorted by shape, how many different shapes did you find?
- When you sorted by size, how many different size triangles, squares, rectangles, and parallelograms did you find?
- Can you sort the blocks by their interior angles?
- Can you sort the blocks by their exterior angles?
- Can you sort them by perimeter?
- Can you sort them by area?



GUESS MY BLOCK

Materials: _____ Power Blocks (T2, T4, S2, S4, P2, P4, R2, and R4)

Purpose: _____ To identify a specific hidden block from a list of clues

Activity: _____ Before the lesson, divide the Power Blocks into groups so there is a large and small example of each shape. Place each group in a sock, bag, or box. Each container should have the same set of blocks.

Teacher: I am going to reach into my bag and find one block. I will describe it to you without looking at it. Reach into your bag and see if you can find the block I am talking about. Don't take it out until I have finished giving the clues.

It is small.

It has four sides.

It has four right angles.

It has two sides longer than the other two sides.

Now take out the block you think I have described.

Students: Okay.

Teacher: Did all of us take out the same block?

Students: No.

Teacher: Why not?

When students can identify blocks described by the teacher, they may describe a block and have their classmates identify it.

Questions to explore with students:

- What would happen if we added more blocks to our set?
- Which blocks shall we add?

DESCRIPTIONS

Materials: _____ Power Blocks

Purpose: _____ To generate a list of attributes that uniquely describes a given block

Activity: _____ This activity is essentially the same as the activity outlined on pages 200-202 of *Mathematics...A Way of Thinking*.¹ In the activity described in *Mathematics...A Way of Thinking*, students write descriptions that uniquely describe themselves. The teacher collects all the descriptions and selects one to read to the class. The class stands, and the teacher reads the description one attribute at a time. As each attribute is read, students for whom it is not true take their seats. The goal is to have the student who wrote the description be the only one left standing after the last attribute is read.

Teacher: Choose a block. Write statements that describe your block. Number each statement. You cannot use its code to describe a block. When you have finished writing, I will collect all the papers.

Students: How many statements do we need to write?

¹Baratta-Lorton, Robert. *Mathematics ... A Way Of Thinking*. Reading, MA: Addison-Wesley Publishing Company.

Teacher: As many as you need to describe your block.

Students: Okay.

Teacher: Pass your papers to me.

Students: Okay.

Teacher: Everyone please stand up. Now I will read one of the descriptions. If the statement I read is true for your block, stay standing. If it is not, sit down. It has four sides. Who should sit down?

Student: Anyone who described a triangle.

Teacher: It has four right angles. Who should sit down?

Student: Those who described parallelograms.

Teacher: It is not a square. Who should sit down?

Students: Anyone with a square.

Teacher: It is red. Who should sit down?

Student: People who have other colors.

Teacher: It is one-half S5. Who is left standing?

Student: Those with red R4.

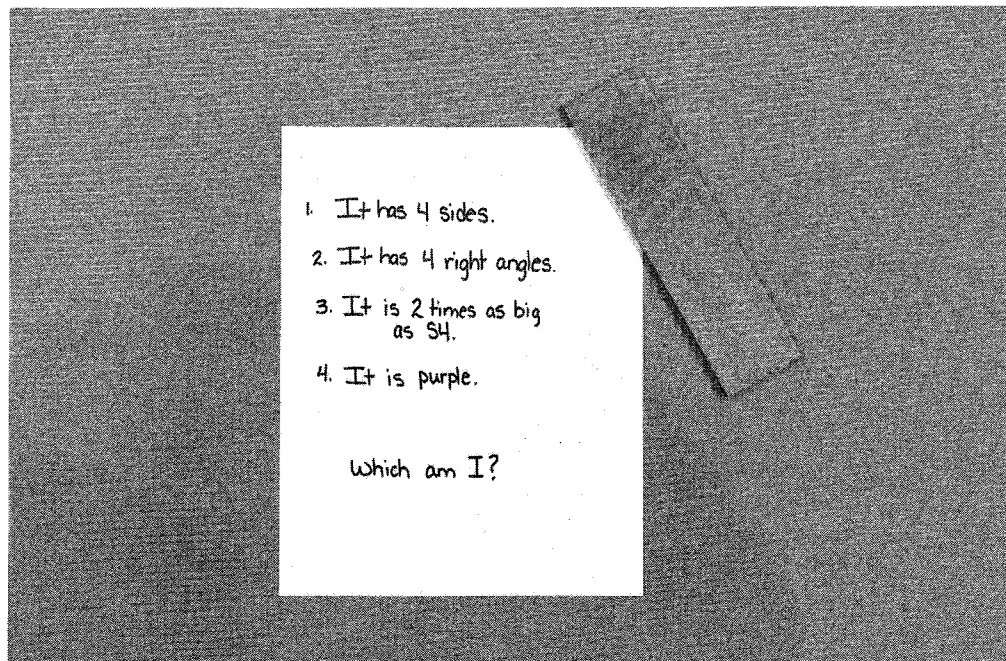
Teacher: How many people?

Student: Two.

Teacher: Only those with R4s are left. The R4s were uniquely described in terms of the group of blocks we chose to describe.

Questions to explore with students:

- What is the fewest number of statements that you can write and still uniquely describe a block?
- Is there more than one way to uniquely describe a block? If so, how many can you find?
- Do all blocks have the same number of ways?



FIND A RULE

Materials: _____ Power Blocks (at least two sets of different colors)
Yarn loops

Purpose: _____ To sort blocks by two attributes into two mutually exclusive groups

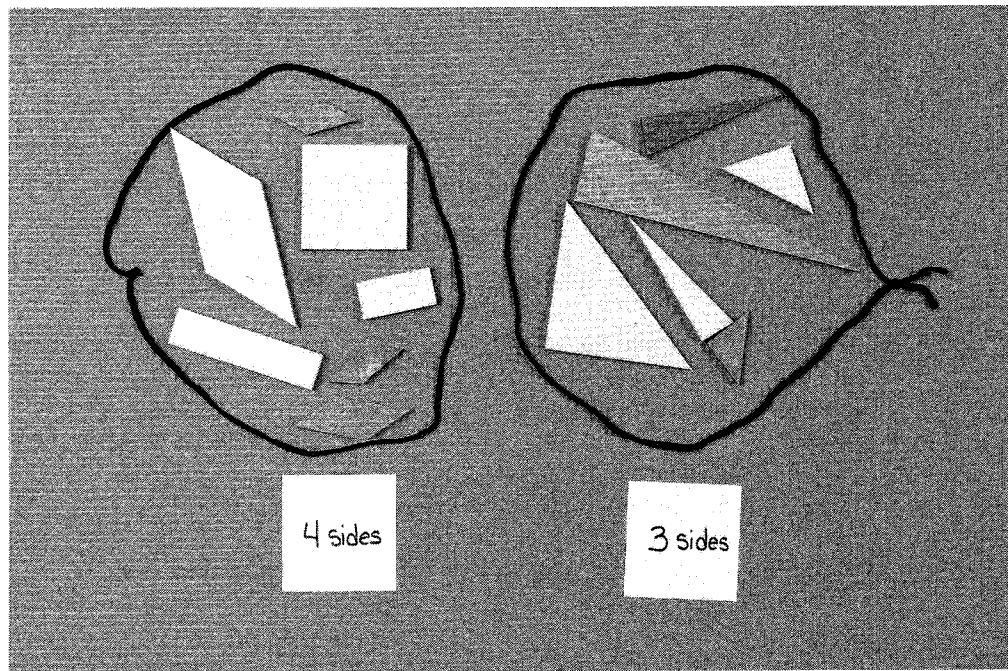
Activity: _____ **Teacher:** S4 goes in the green loop. P4 also goes in the green loop. T3 goes in the orange loop. Where do you think S1 will go?
Student: In the green loop with S4.
Teacher: Yes, by my rule it will go in the green loop. What about R2? Where will it go?
Student: In the green loop with S4 and P4.
Teacher: Where do you think I will put T7?
Student: In the orange loop with T3.
Teacher: That fits my rule. Do you know a rule that would work?
Student: Blocks with four sides go in the green loop. If it is a triangle it goes in the orange loop with T3.
Teacher: Yes, that fits what we have done. Is there another rule that would fit?
Student: Shapes with four right angles go in the green loop, and shapes with one right angle go in the orange loop.
Teacher: That works too. Can anyone think of a different rule that would work?

When students can sort objects that have a single attribute in common from the balance of the blocks, they may attempt more complex sorts.

Teacher: See if you can determine a rule that works. Yellow S4 goes in the green loop. Blue R1 goes in the orange loop. Yellow P4 goes in the green loop. Blue R5 goes in the orange loop. Where do you think blue T1 will go?
Student: In the orange loop.
Teacher: What rule did you use to place it there?
Student: Yellows in the green loop, blues in the orange loop.
Teacher: That's a good rule, but by my rule I would put blue T1 in the green loop. Where would yellow T3 go?
Student: In the green loop.
Teacher: Why?
Student: Because it is yellow and only blues are in the orange loop.
Teacher: O.K. Where would blue P4 go?
Student: I don't know.
Teacher: By my rule it would go in the green loop. Where would blue R5 go?
Student: I don't know.
Teacher: By my rule it would go in the orange loop.
Student: I know a rule that works. All blue rectangles go in the orange loop and the rest of the blocks go in the green loop.
Teacher: That seems to work. Where would blue R4 go?
Student: In the orange loop.
Teacher: Yes, that's where I would put it by my rule. Is there another rule that would fit this situation?

Questions to explore with students:

- How many different ways can you sort the blocks when one group has one attribute in common?
- How many ways can you sort the blocks when one group has two attributes in common?



VENN DIAGRAMS

Materials: _____ Power Blocks (two sets of different colors)
 Small cards or pieces of paper (3 x 5)
 Yarn loops

Purpose: _____ To sort and classify blocks using a Venn diagram

Activity: _____ This activity is essentially the same as that outlined in *Mathematics Their Way*² on pages 84 through 87. Students create a set of cards, each of which lists an attribute of a set of objects contained in a sorting box. They take two cards at random from the stack and sort as many of the objects as they can into two groups. They must deal with the problem that occurs when an object has both attributes listed on the cards. Before the lesson, the teacher sorts the blocks into smaller groups composed of two or three large triangles in each color, two or three medium size triangles in each color, and two or three small triangles in each color. Do the same thing for each of the other square, rectangle, and parallelogram shapes.

Teacher: Think of ways to sort the blocks in your set. I will write the ways on the overhead. Does anyone have an idea of one way to sort the blocks?

Student: By color.

Teacher: Okay. Does anyone have a different idea?

Student: We can sort by size.

Teacher: Okay. Can anyone think of another way?

Student: By number of sides.

Student: By shape.

Student: By those that have right angles and those that do not.

Student: By...

²Baratta-Lorton, Mary. *Mathematics Their Way*. Reading, MA: Addison-Wesley Publishing Company.

Teacher: Now that our list is complete, write each suggestion on a different card.

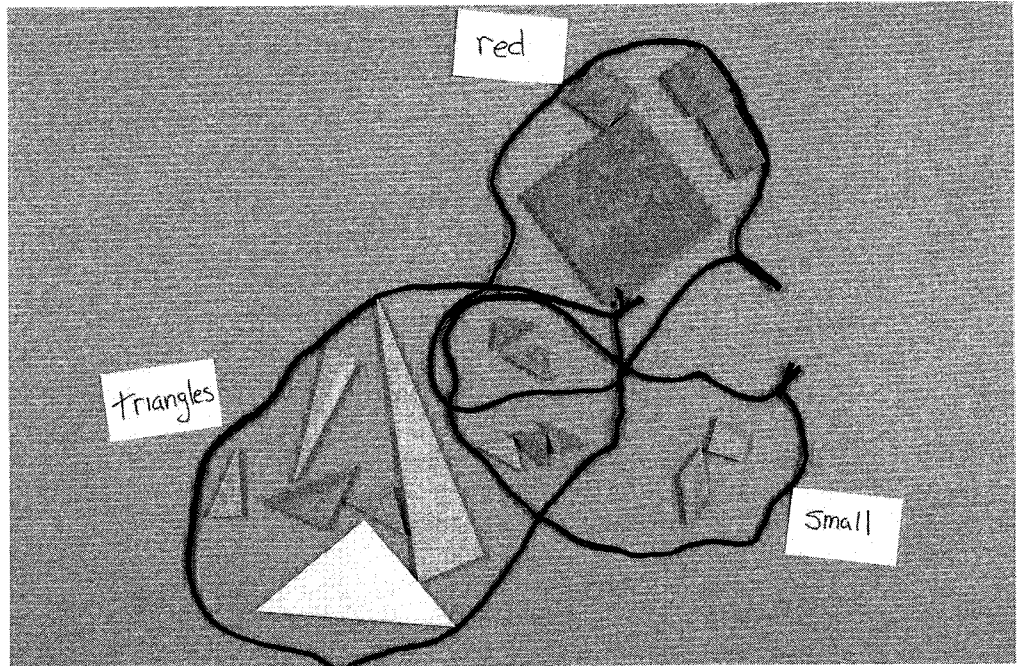
Student: Finished.

Teacher: Shuffle your cards, and then pick two. Put all the blocks with the same attribute listed on the card inside a loop of yarn. Then pick another card and put all the blocks that have that attribute in the second loop.

Student: Some of the blocks could go in both loops. Which loop should I put them in?

Teacher: Is there a way to arrange them so that they are in both loops?

When students have sorted by two attributes, have them sort by three. They may leave the cards with the attributes listed on them face down close to the loops of yarn. Other students may look at the sorts and try to predict the attributes used to sort the blocks. Students turn over the cards to check their predictions.



QUESTIONS

Materials: _____ Power Blocks

Purpose: _____ To identify a specific block from student generated questions

Activity: _____ **Teacher:** We are going to play a game that requires asking good questions. One half of the class is on one team, and the other half of the class is the other team. I have chosen one Power Block for you to identify. The first team to identify the mystery block is the winner. You can only ask me questions that can be answered with a yes or no. If I answer your question with a yes, the next person on your team gets to ask a question. If I answer the question with a no, the other team gets to ask a question. You cannot give helpful hints to your teammates. If you ask me if it is a specific block and it is not the correct block, the other team gets a point. If you guess the block, your team gets a point.

Student on first team: Is it green?

Teacher: No.

Student on second team: Is it a square?

Teacher: No.

Student on first team: Is it red?

Teacher: Yes.

Student on first team: Is it P4?

Teacher: No. That's one point for the other team.

Student on second team: Is it a triangle?

Teacher: Yes.

Student on second team: Is it smaller than T4?

Teacher: Yes.

Student on second team: Is it smaller than T3?

Teacher: No.

Student on first team: Is it T3?

Teacher: No. That's one for the other team.

Student on second team: Is it T7?

Teacher: Yes. One more point for your team.

Questions to explore with students:

- What strategy did you use to help you decide what question to ask?
- Is one strategy of asking questions more helpful than other strategies?

ATTRIBUTE TRAINS

Materials: _____ Power Blocks (at least two sets of different colors)
Lined paper

Purpose: _____ To build a train of blocks where each succeeding block is one attribute different from the previous block

Activity: _____ For this activity, it is useful for students to have completed the activities that enable them to create a table of relative areas because they need to know which shapes have the same areas.

Teacher: I want you to work in teams of two. Fold your paper so that it has three columns. Write the word “color” at the top of one column, and the words “shape” and “size” at the top of each of the other columns. Pick one block to start your train.

Student: Any block?

Teacher: Yes. Record its color, size, and shape in the columns on your paper.

Student : Okay.

Teacher: Now choose another block that is the same color and shape, but a different size. Record the information about this block.

Student: Done.

Teacher: This time, pick a block that is the same size and same shape, but a different color than the block I just put down.

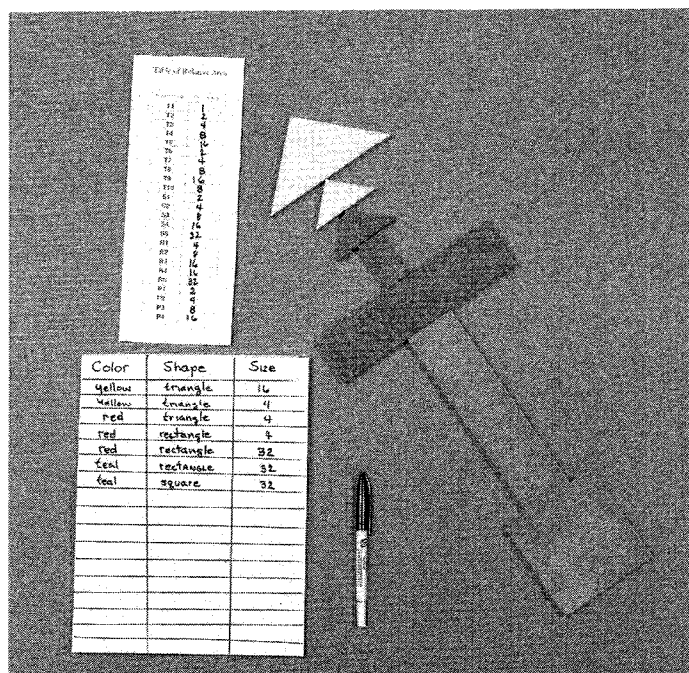
Student: Okay.

Teacher: Record its color, size, and shape. Take turns adding pieces to your train. I want you to make your train of blocks as long as you can. Be sure that each new piece follows the pattern “same, same, different”. That is, two attributes are the same and one attribute is different from the previous block.

When students understand how to make trains with one different attribute between each step, ask them to make trains that have two differences between each step.

Questions to explore with students:

- If you stack blocks on top of one another, for example two T4s, so you had blocks of different thicknesses, could you make trains that followed the pattern “same, same, same, different”?
- If you can make trains of blocks with four attributes, can you make one with the pattern “different, different, different, same”?



ATTRIBUTES ON A MATRIX

Materials: _____ Power Blocks (at least three sets of different colors)
 Large piece of paper (12 x 18 inches)

Purpose: _____ To place blocks in a three by three array so that each block has two attributes different from those immediately next to it

Activity: _____ For this activity, it is useful for students to have completed the activities that enable them to create a table of relative area because they need to know which shapes have the same area.

Teacher: Fold your paper so that you have a matrix with three columns and three rows.

Student: Okay.

Teacher: Choose one block and place it in the upper left hand corner of your matrix.

Student: Any block?

Teacher: Yes. Now I want you to find another block that has two attributes that are different from the attributes of the first block. Put that block in the space immediately to the right of the first block. For example, your block might be a “different color” and “different shape”.

Student : Okay.

Teacher: Now find a block that has two attributes that are different from the first block and place it in the space below the first block.

Student: This takes thinking.

Teacher: Now for the final step, see if you can find a block to put in the space that is below and to the right of the last two blocks you put down. This block must be two attributes different from the block above it and two attributes different from the block to the left of it.

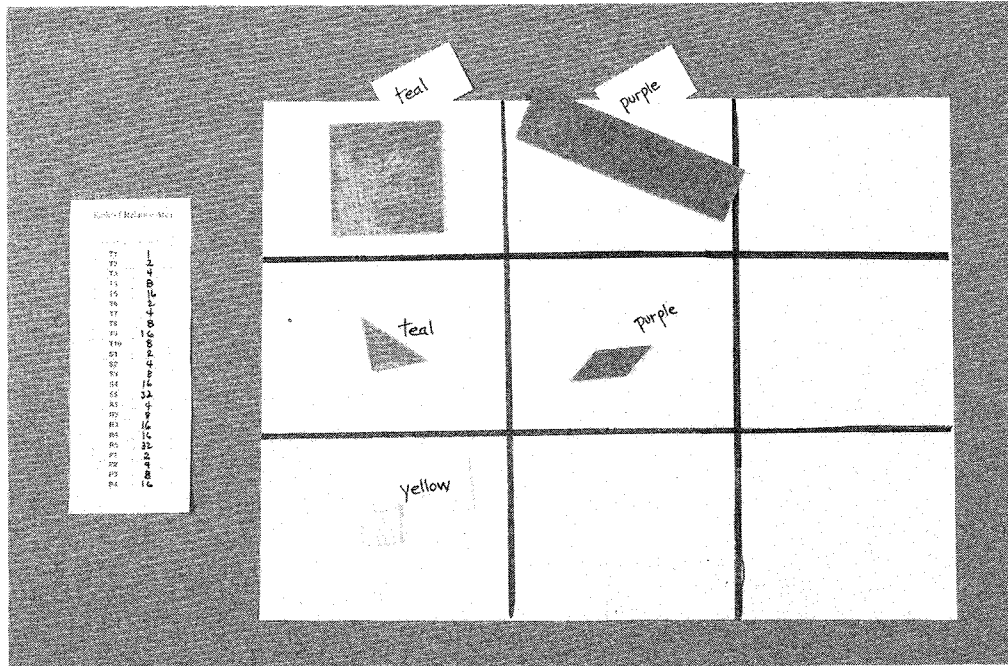
Student: Can we go back and change one of the other blocks if we can't find a block to work?

Teacher: Yes. The idea is to fill in the matrix. Sometimes you have to move things around to make it work. When you have finished one matrix, get another piece of paper and try it again with a different block.

Students may take small pieces of paper or sticky labels to record the attributes that are the same or different between two blocks. They place these between the two blocks on the matrix. When students can do a three by three matrix, they may try a four by four matrix.

Questions to explore with students:

- Can you make an array in which each block is one different?
- What would happen if you stack blocks so that you added the attribute of thickness to the attributes you are working with?
- What would happen if you were to add another set of blocks of a different color? Would the task be more difficult?
- What would happen if you tried to make an array in which each block was three different?



BUILDING BEHIND A SHIELD

Materials: _____ Power Blocks
Shields (file folders work nicely)

Purpose: _____ To build a shape from verbal directions given by another person

Activity: _____ The level of difficulty of this activity may be controlled by limiting the number of block students use in their designs?

Teacher: I am going to make a shape behind this shield so that you cannot see what I am building. I want you to build what I describe. Build your shape behind your shield so that other students cannot see what you are building. When I have finished giving directions, everyone will lift their shields at the same time and we will see what has been built. You cannot ask questions. If you do, I will not answer them.

Place the S4 so one edge is parallel to the edge of your desk.

Student: Okay.

Teacher: Next, find a triangle that has two sides that are equal to the length of the side of the square. Put the top of the triangle against the top edge of the square. The right angle of the triangle must be against the top left hand corner of the square.

Student: Can I stand the triangle up?

Teacher: Remember no questions may be asked. Find a parallelogram that has its longest side equal to the length of the side of the square.

Student: Found it.

Teacher: Place the parallelogram against the left side of the square. Match the side of the parallelogram and square that are touching so they are the same length. The pointed end of the parallelogram must extend below the bottom to the square.

Student: Okay.

Teacher: Continue giving directions until the shape is completely described. Then tell everyone to “Lift your shields”. Did everyone make the same shape?

Student: No.

Teacher: What could I have done to make my directions clearer?

When students understand how to build a shape described by the teacher, they may work in groups. One student takes a turn playing the teacher’s role, the others build. When the directions are finished, all the students lift their shields to see the results.

Questions to explore with students:

- What would happen if we played the game and let students ask the teacher questions that can be answered with a yes or no?
- Was the game easier?
- What are the important things for those who are giving the directions to do?
- What are the important things for those who are following the directions to do?

