DON'T BOX ME IN

PREPARATION

Grade Levels: 4 – 6

Time: 45 minutes – 1 hour

Prerequisites:
Group leaders will need to have access to the Video on Demand service, available to New York state educators at http://www.thirteen.org/edonline/itv. If you do not live in New York state, get a password by calling 1-800-323-9084. Group leaders should also:
- Preview the video
- Make copies of the handout (see below).
- Copy the questions from the handout onto large poster paper, making sure to leave ample space between the questions for the answers.

Materials:
Students will need:
- Large graph paper – the bigger the squares, the better
- Paper cutouts of squares, approximately 2" x 2"
- Tape
- Ruler, pencil, and paper for each child

Group leader will need:
- Poster paper or blackboard
- World map on the wall
- The Thirteen/Ed Online Video on Demand (VOD) program "Mathematical Eye: Paper Engineering" Segments: 1 – Exploring Box Shapes (time: 1:19) and 3 - Examining and Building 3D Shapes (3:53). To access Thirteen's Video on Demand service and download this video, visit http://www.thirteen.org/edonline/itv/.
- Boxes of various shapes and sizes to use as examples of 3D shapes that are made from flat shapes (recommended but not required)

Academic Goals:
- Students will learn the relationship between flat and 3D shapes

- Students will learn the names of 3D shapes and how to construct a cube from squares (time permitting, they can construct additional 3D shapes)
- Students will have an opportunity for self-discovery and problem solving through hands-on manipulation of mathematical concepts

Social Goals:
- Students will collaborate as they help one another to construct successful 3D shapes

STEPS

Introductory Activity (20 minutes)**:**

Ask the children for examples of polygons. (If necessary, first discuss what a polygon is: a shape with many sides.) Write the examples on the board: square, triangle, pentagon, etc. Then have each student give an example of polygons they see in the room (e.g. window, table). Write each example on the board, and count how many different examples of these shapes they find.
- Put a slash between and the prefix and suffix of the words: tri/angle, penta/gon. Review of the definition of prefix and suffix. Ask them for the meaning of 'tri' (3) and 'penta' (5). See if they know the meaning of 'gon' (many angles). Make sure they connect the meaning of the word to the number of angles of these shapes.
- Tell them the lesson will focus on exploring 3D shapes that are made from polygons.

Learning Activities (45 minutes):

1. Distribute the handout for students to complete while watching the video. Go over the questions to make sure all students understand the language and tasks.

2. Tell the students that first they will see how different shaped boxes are made in a factory, and then they will watch students making 3D shapes. Then, start the video. Watch the first segment, then continue on to the third segment. Pause the video at the end of the part where the students are constructing 3D shapes.

3. Show students examples of 3D boxes and their flat shapes (pizza boxes or bakery boxes work well for this). Ask the students to work in pairs to answer the first question on their handout. Then have students volunteer information out loud to see if any can identify the 3D shapes made by flat shapes. Write their answers on the board. If they do not know any, continue with video.

4. Continue the video from where you left off. Stop after the cartoon illustrations of 3D shapes. Have students work in pairs to answer questions 2 –7 on the handout. Go over

the answers as a group and write them on the poster paper you prepared with the questions. The answers are:

- #2: Plato, Greece. Ask if students have any idea when Plato lived. Tell them he was born in 427 BC and died in 347 BC. Have students figure out how old he was when he died. Have a student locate Greece on a map as well as identify the continent.
- #3: 6 squares makes a cube
- #4: 12 pentagons make a dodecahedron
- #5: 4 triangles make a pyramid or tetrahedron
- #6: 8 triangles make a octahedron
- #7: 20 triangles make a icosahedron

Have students put a slash between the prefix and suffix of the polygons and 3D shapes listed in questions 3 - 7. Have them identify and define the prefixes: 'tetra' (4), 'octa' (8), 'dodeca' (12), 'icosa' (20) and the suffix: 'hedron' (geometrical figure having a number of surfaces). If they are unable to answer any of these terms, explain them.

5. Continue with the video. Stop when the clip is over. Have them write the answer to question 8 and then solicit the answer from the group and write on the poster paper (a net). Pass out graph paper and rulers and have students work individually to make various ways of putting 6 squares together. See how many ways they can do it out of a possible (9) and predict which designs will fold up to make a cube. Have them write their answers on the worksheet as they work through the problems. Students can also work in small groups to try to come up with as many variations as possible; they can then share these solutions with other groups.

6. Pass out paper squares and tape. Have students construct a cube based on their drawings. Were their predictions correct?

Extension (time varies):
Have the children write the numbers 1 – 10 on each face of their cube and use them as dice. Working in pairs, children can take turns rolling two cubes and multiplying the two numbers that come up.

Follow up:
Ask the children to choose one of the other shapes on the handout to construct. Have them work individually or in groups of two to successfully complete the more difficult shapes. (You will need to have cutout shapes of triangles and pentagons, and tape.)

CREDITS

This AFTERSCHOOL EXCHANGE activity was developed by Julie Spiegel Ph.D., Educational Specialist at The Point CDC, based on the Thirteen/Ed Online Video on

Demand (VOD) program "Mathematical Eye: Paper Engineering." To access Thirteen's Video on Demand service and download this video, visit http://www.thirteen.org/edonline/itv/. (Note: If you are not a New York state educator, you must first call 1-800-323-9084.)

Student Handout: Don't Box Me In
From Mathematical Eye: Paper Engineering (VOD)

<u>Watch the video and answer:</u>

1. What 3D shapes can you get by sticking flat shapes together? Any ideas?

2. Who was one of the first people to think about making 3D shapes from regular polygons? _____

Where was he from? _____

3. _____   squares make a _____

4. _____   pentagons make a _____

5. _____   triangles make a _____ or a _____

6. _____   triangles make a _____

7. _____   triangles make a _____

8. Putting flat shapes together to fold into a solid is called a _____

<u>Now work it out yourself!</u>

9. How many ways are there to stick 6 squares together? _____

10. How many will fold up to make a cube? _____