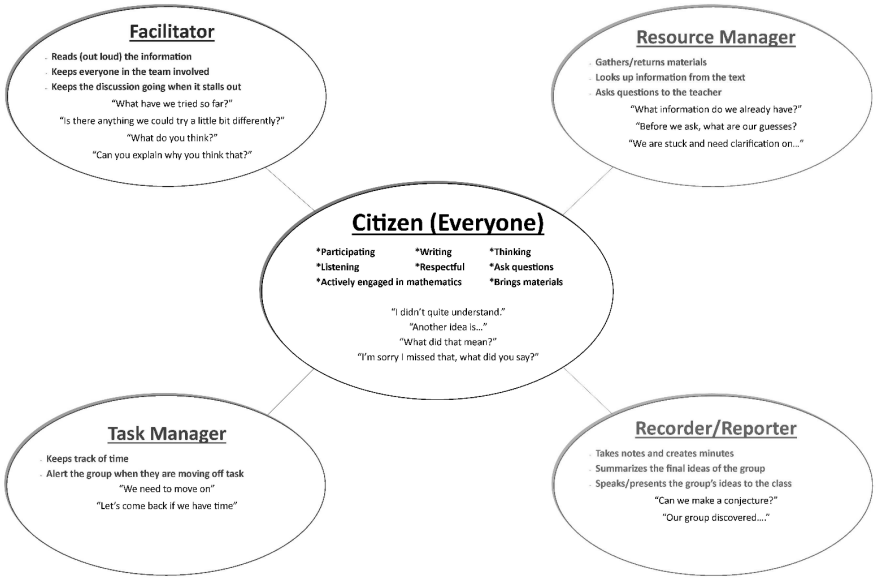
1.0 Habits of Mind

Objectives:

- Warm up to the ideas behind the CME Project.

- Work experientially to begin developing mathematical habits of mind.



Page: 5 Materials: Basic Shapes Worksheet, Ruler

In-Class Experiment

Look for Patterns

1. Since this is early in the class year, it is time for introductions. If everyone in a class shakes hands with everyone else, how many handshakes will there be? 19 students → (19·18) ÷ 2 = 171 handshakes
2. How many diagonals are in a square? In a pentagon? In a hexagon? In a heptagon? In an octagon? Write a formula that relates the number of diagonals of *any* regular polygon to the number of sides.

Vocab: $\frac{n(n-3)}{2}$

If *penta-*, *hexa-*, *hepta-*, and *octa-* mean 5, 6, 7, and 8, and *poly-* means "many," what does *-gon* mean?

Definitions

A **regular polygon** is a closed figure with sides all equal in length and angles all equal in measure. A **diagonal** of a polygon is a segment that joins two nonconsecutive vertices.

#sides	#diag.
3	0 +2
4	2 +3
5	5 +4
6	9 +5
7	14 +6
8	20

3. How is counting handshakes similar to counting diagonals? Explain.

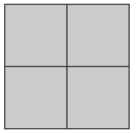
The vertices are similar to people & the diagonals & edges are like handshakes.

Page: 5 Materials: Dot paper, Ruler

In-Class Experiment

Build Mental Agility

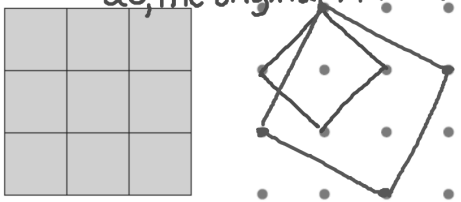
Consider the question "How many squares are in the figure at the right?"



Many people would quickly answer "four," but, in fact, there are five squares in the figure, four small squares and one large square.

4. How many squares are in the figure at the left below? Explain how you got your answer. 14; 9 small, 4 medium (2 by 2) & 1 big
5. Copy the dot pattern at the right below. How many squares can you make using the dots for vertices? Draw diagrams to support your answer.

20, the original 14 from above, plus:
4 small tilted
2 large tilted



15 minutes

Page: 6 (Just questions 6, 7, 9)
Materials: Nets page, Scissors

In-Class Experiment

Plan Strategies

Think about unfolding a cube and laying out its faces as a set of squares attached at their edges. The figure that results from unfolding a three-dimensional solid is called a **net**. There are many nets for a cube.

vocab:

6. Which of the following are nets for cubes? How do you know?

a. needs a top/bottom

b. only has 5 faces

c.

d.

Habits of Mind

Visualize. Continue to unfold the cube in your mind.

7. How many *different* nets for a cube can you make? What does it mean for nets to be different? 11; 2 nets are different when you can't flip or rotate one to match the other.

8. Find all the possible nets for a regular tetrahedron.

9. Draw a net for a cylinder. It should include the top and bottom circular faces. In your drawing, what lengths should be the same?

The circumference of the circle & the lengths of the rectangles should be same.

15 minutes

Page: 7 Materials: Clay, floss or index card

In-Class Experiment

Visual Relationships Vocabulary

A **cross section** is the face you get when you make one slice through an object. These questions ask you to visualize the insides of solid objects.

a square	an equilateral triangle
a rectangle that is not a square	a triangle that is not equilateral
a pentagon	a hexagon
an octagon	a trapezoid
a parallelogram that is not a rectangle	

11. What cross-sectional shapes can you make by slicing a cube? Record which shapes above you can make, and describe how to make them.

12. Can you produce any shapes that are not listed above? Draw and name any other cross sections you can make.

13. If you think any of the shapes on the list above are impossible to make by slicing a cube, explain what makes them impossible.

14. What cross sections can you construct from the following shapes?

a. a sphere b. a cylinder

Here is an example of a cross section of a cube, showing one possible shape.

15 minutes

Page: 7 Materials: 3 number cubes, Tracking sheet, 18 rods (or graphing calculators)

In-Class Experiment

Model the Problem

For this experiment, you need three number cubes and eighteen rods—three rods of each length, 1 unit through 6 units.

Roll the number cubes and pick three corresponding rods. For example, if you roll 5, 3, 5, pick two rods of size 5 and one of size 3. Try to make a triangle using the three rods as the sides of the triangle. Some sets of three rods will work, and others will not.

15. Repeat the experiment several times. Keep a table of your results. For the combinations that do not work, write an explanation of what went wrong when you tried to make a triangle.

16. Write About It Your experiments dealt only with side lengths from 1 to 6 and not with noninteger lengths, such as $4\frac{1}{2}$ or 3.14159. Write a rule that explains how you can tell if *any* three segments will actually fit together to make a triangle. Some sets of three lengths just do not work. Explain why they do not and how to predict which ones do not from the lengths involved.

You can create a triangle only if the sum of any 2 sides is greater than the third side.

17. Which of the following sets of three lengths will make a triangle? Explain.

a. 1 cm, 6 cm, 6 cm yes
b. 2 cm, 4 cm, 6 cm no
c. 1 cm, 1 cm, 1 cm yes
d. 2.1 cm, 4 cm, 6 cm yes
e. 0.99 cm, 0.99 cm, 2 cm no

15 minutes

Wrap-up/Exit Slip:

* Make sure that everyone that was/is in your group is on your paper. Hand your paper to the center of the room and I will collect them.

What did you learn from these experiments?