List of Materials Needed:

- 1 set of JENZAC™ pieces per group of students
- Ruler (1 per group of students)
- Paper (1 per student)
- Pens/Pencils (if needed)

Activity Time Frame:

- Two one hour time blocks.

Environmental Setting:

- A classroom with semi-large tables with space enough to build small cubes.

PASS Objectives:

The student will:

- Select the most logical conclusion for given experimental data.
- Communicate scientific procedures and explanations.
- The student will engage in investigations that lead to the discovery of the following concepts:
  - The volume of an object is not altered due to changes in shape.
  - The mass of an object is not altered due to changes in shape.
  - The surface area of an object is altered due to changes in shape.

Project Objectives:

The students will:

- Determine the volume of various shapes to lead to the conclusion that volume does not change if all of the JENZAC™ blocks are used.
- Evaluate the surface area of various shapes to lead to the conclusion that surface area does change with different shapes if all of the JENZAC™ blocks are used.

Vocabulary Terms

- Volume
- Surface Area
- Cube
- Prism
- Box

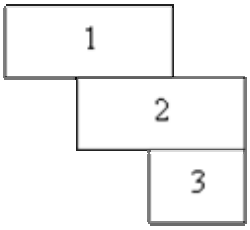
Background Knowledge:

Volume - The volume of a box is given by the equation:

$V=l*w*h$

- V = the volume of the box
- l = the length of the box
- w = the width of the box
- h = the height of the box

Since several of the JENZAC™ pieces are not perfect boxes, the volume of these individual pieces must be evaluated in parts. For example, with a piece such the one shown below, it can be divided into three separate boxes as shown.



Shape Volumes - The volumes of these three boxes are then added together to get the entire volume of the puzzle piece. Each puzzle piece volume is calculated in the same manner. The volumes of the pieces are then added together to get the entire volume of the shape.

Surface Area - The surface area of box (or rectangular prism) is found by adding the areas of each of the six sides of the box together:

$SA = A_1+A_2+A_3+A_4+A_5+A_6$

Area - The area of a square or rectangular is found the following equation:

$A=a*b$

- A = the area
- a = the length of one side
- b = the length of the other side

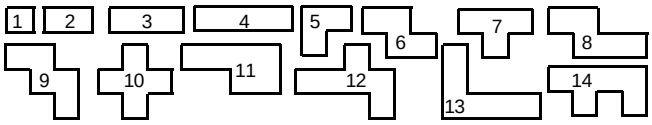
Surface area for shapes as shown above can be determined in the same method as determining volume, i.e. breaking the shape into several boxes.

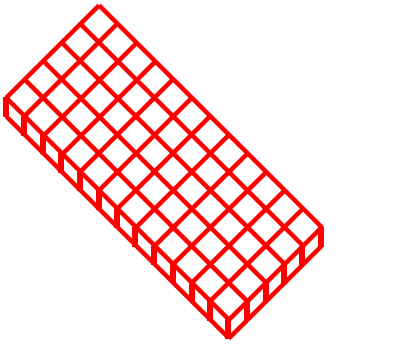
Activity Procedures

Day 1: Give each group of students a JENZAC™ set. Teach the students the equation for volume. Then have students determine the volumes of each shape in the JENZAC™ set (fifteen minutes). Give each group of students a box to assemble using their JENZAC™ sets (1 half hour). Have students determine the volume of their box. Write the volumes of each box on the board and compare. Then ask students if the volume of the individual blocks will be the same as the boxes (fifteen minutes).

Day 2: Give each group of students a JENZAC™ set. Repeat the procedures for Day 1 but have the students determine surface area rather than volume.

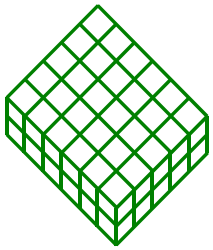
Note for Teachers: the solutions to selected sample shapes can be found below, as well as a key for the JENZAC™ pieces. Refer to your JENZAC™ Instruction Sheet for an explanation on reading the solutions. For older students, more complex shapes are encouraged for both Days 1 and 2 or as an extension on Day 3. A description of the easer and harder shapes is provided on the Education page of our web site.





6	4	4	4	4	7	13	13	13	13	14	14
6	6	12	2	7	7	13	11	11	11	11	14
1	6	12	2	10	7	13	11	11	9	14	14
5	12	12	10	10	10	8	8	8	9	9	14
5	5	12	12	10	3	3	3	8	8	9	9

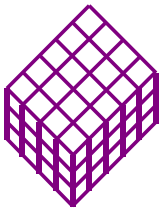
1x5x12



14	14	14	14	6	6
14	12	14	6	6	5
12	12	12	12	5	5
12	8	8	8	2	2
8	8	4	4	4	4

7	7	7	3	3	3
13	7	9	9	11	11
13	9	9	10	11	11
13	9	10	10	10	11
13	13	13	10	1	11

2x5x6



9	9	2	3	5	9	9	3	5	12	9	3
6	6	2	11	10	8	14	4	5	12	14	13
10	6	6	11	10	8	14	4	10	12	12	13
1	8	11	11	10	8	14	4	12	12	14	13
7	8	11	11	7	7	14	4	7	13	13	13

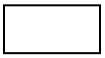
3x5x4

Volume Worksheet

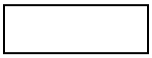
Divide the shapes shown below into smaller boxes if needed. Draw lines to show how you divided them. Then fill in the blank with the volume of each shape.

1. 

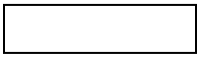
V=_____

2. 

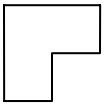
V=_____

3. 

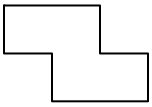
V=_____

4. 

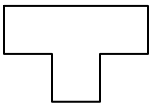
V=_____

5. 

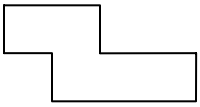
V=_____

6. 

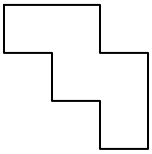
V=_____

7. 

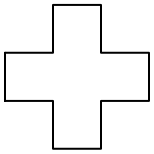
V=_____

8. 

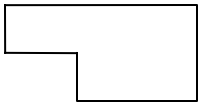
V=_____

9. 

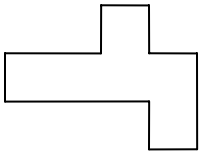
V=_____

10. 

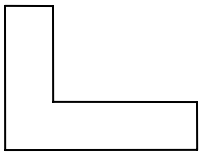
V=_____

11. 

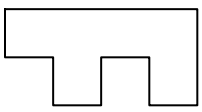
V=_____

12. 

V=_____

13. 

V=_____

14. 

V=_____

You have been given a set of dimensions to assemble a box. Draw your box below and include these dimension in you drawing. Determine the volume of your box and fill in the space provided.

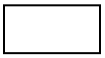
Total Volume = _____

Surface Area Worksheet

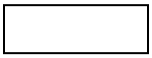
Divide the shapes shown below into smaller boxes if needed. Draw lines to show how you divided them. Then fill in the blank with the surface area of each shape.

1. 

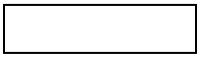
SA=_____

2. 

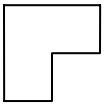
SA=_____

3. 

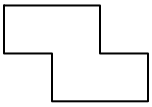
SA=_____

4. 

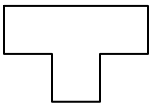
SA=_____

5. 

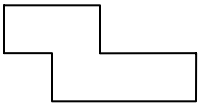
SA=_____

6. 

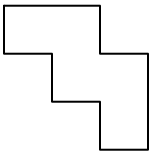
SA=_____

7. 

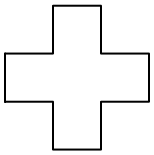
SA=_____

8. 

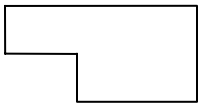
SA=_____

9. 

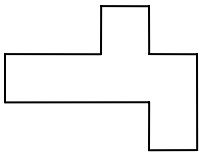
SA=_____

10. 

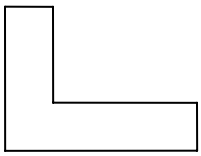
SA=_____

11. 

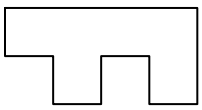
SA=_____

12. 

SA=_____

13. 

SA=_____

14. 

SA=_____

You have been given a set of dimensions to assemble a box. Draw your box below and include these dimension in you drawing. Determine the surface area of your box and fill in the space provided.

Shape Surface Area = _____