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## Instructional Strategies and Activities

### Grades 6-8

**Essential Question:**
How do we scale up objects and figures in three dimensions?

**Materials**
- Paper cube patterns (provided at the Teacher’s Diner)
- Scissors
- Tape for assembly before class

**For Day 1**
- At least 193 assembled 1-cm paper cubes
- Toys, dolls, and accessories
- 1 or more yard sticks
- 1 or more meter sticks
- 5 or more 12-inch/cm rulers
- Base Ten blocks if available

**For Day 2**
- Shoebox
- At least four 2-cm cubes and one 4-cm paper cube for each student (assembled before class)
- Base Ten blocks if available

**For Day 3**
- Materials for creating 2-D models of the planets (rulers, yard/meter sticks, pencil, bulletin board paper, scissors, paint or markers, string, tape, etc.)

**Length:** 1-5 days

### Concept/Objectives:
Students will develop an understanding of scale, surface area, and volume. Students will learn how to apply formulas to solve problems related to surface area and volume. Students will apply skills in proportional reasoning and number sense to solve problems.

### Activity:
Students will use information about scale to determine the measurements of given objects using proportional reasoning. Students will use a video prompt, computer models, classroom manipulatives, and household objects to solve problems related to scale, volume, and surface area. Students will apply understanding of unit conversion to solve problems.

### Resources Used in This Lesson Plan:
- **Scale City Video:** Greetings from Miniature World
- **Online Interactive:** House of Scales
- **Assessments (included in this lesson)**
- **Classroom Handouts (PDFs)**

All resources are available at [www.scalecity.org](http://www.scalecity.org)

### NOTE TO TEACHER:
**Manipulatives:**
Cube manipulatives will be helpful in explaining the concepts of this lesson. At the Teacher’s Diner, we have provided three patterns for creating paper cube manipulatives: 1 cm³, 2 cm³, and 4 cm³. If you would like to use these to explain the concept of scale, you could have students create cubes as homework before Day 1. If each student makes eight or nine 1-cm cubes, you would likely have enough to demonstrate how one dimension of a building increases using the 1:192 architectural scale, although that scale uses inches instead of centimeters.

To demonstrate how much larger a real building is than an architectural model using three dimensions, start with a single cm³ cube and then use meter sticks to show how it scales up in 3D. Since 1:192 is almost 1:200, you could lay out a square on the floor that is 2 m x 2 m. Then build up each corner 2 m in height. Comparing this to the original cm³ cube gives students a clear idea of what that 1:192 scale looks like in three dimensions.

Day 2 uses 2-cm and 4-cm cubes to explore surface area and volume problems in which the length of each edge increases proportionally. You will need a minimum of four 2-cm cubes and one 4-cm cube per student. However, you also could use Base Ten blocks to explore three-dimensional scale, or use interlocking 2-cm cubes, if those are available.

**Length of Lesson:**
This lesson can be easily adapted to fit into available class time. If time is very limited, a one-day lesson would include the video, online interactive, and the practice problems and homework from Day 2.
DAY ONE: HANDS-ON ACTIVITIES EXPLORING SCALE AND WATCHING VIDEO

Before the Lesson:
Direct students to collect and bring in toys that illustrate the concept of proportional reasoning (e.g., dolls, doll clothing and dollhouse furniture, miniature cars, action figures, stuffed animals, etc.). Lead a class discussion about how the toys are scaled.

1. Students begin by exploring how toys and their accessories follow rules of proportionality. Toys are scaled-down replicas of real-world items (or in a few cases, scaled-up versions). Give students “Handout 1: Are Toys Proportional?” which includes self-assessment checklists for individuals and/or groups. This handout will guide students through the activity.

Students can work individually or in groups. Individual exploration could begin as a homework project that the students then discuss with classmates. Students would apply skills in proportional reasoning to examine objects and determine if they are proportionally sound before sharing their observations with their peers. In this case, each student would present his or her findings to the class.

For group exploration, divide the students into groups of three to four. Divide the toys so that each group has sufficient items for exploration.
Instruct students to:
   A. Measure each item.
   B. Compare each item to actual size. Dolls could be compared to the average height and dimensions of people, for example. Students may need to research standard sizes for items like cars, trucks, refrigerators, etc. WikiAnswers.com is often an excellent source for this kind of information.
   C. Discuss your findings with the class.

2. Use the toys that students brought in to discuss proportion in relation to miniatures and models.

Questions to Consider:
   • Does the doll or action figure appear proportional? (For example, some figures have features that are physically impossible in real people.)
   • Do the accessories appear proportional? How does the math check out? (For example, is the doll’s phone or purse comparable to an actual phone or purse? Is its size proportional to the doll’s size?)
   • Why would the toymakers create the object as it is? In what instances might adhering to scale be problematic?

3. Discuss the meaning of scale and how proportional reasoning is involved. Why is scale a ratio? Compare a miniature replica to its real-world counterpart.

4. Use an Internet projector to watch the “Greetings from Miniature Land” video at www.scalecity.org. Give students “Handout 2: Scales for the Miniature Video” as a viewing guide. Divide the worksheet slip into thirds to save paper. As students watch the video, ask them to write down the scales mentioned in the video. (These scales are 1:12, 1:24, and 1:192.)
5. Use 1-cm cubes or Base Ten blocks to discuss and illustrate the different scales discussed in the videos. Base Ten blocks are excellent for building a model of a 1:12 or even a 1:24 scale. To show the 1:12 scale in three dimensions, you need to use 12 x 12 x 12 or 1728 cm cubes. You can show this using the 10-cm cube from the Base Ten blocks, along with several hundreds, tens and ones.

6. Ask the students how tall a model of a six-foot tall person would be on the architectural scale of 1:192. One way to express this scale is 1/16 of an inch for every foot. Another way to express it is 1 inch for every 16 feet. Allow students a moment to calculate. On a 1:192 scale, a six-foot tall person would be 6/16 or 3/8 of an inch tall. Discuss different approaches to this problem.

7. Give students “Handout 3: Practice Scaling.” In the practice problem, students will determine the dimensions for the Empire State Building using the architectural scale of 1:192. As you work through this problem, the answers will be to the nearest 1/16 of an inch. Again, a person six feet tall would be 3/8 of an inch tall next to this model. Students might want to calculate how tall they would be on this scale as well. This scale is possible to visualize using a wall in the classroom.

8. Give students “Handout 4: Scaling Miniatures.” Use the worksheet for class work or homework.

9. “Handout 5: Scale Challenge” provides additional practice, if desired.

**DAY TWO:** MORE HANDS-ON PRACTICE WITH SCALE, SURFACE AREA, AND VOLUME, AND WORKING WITH THE INTERACTIVE

1. Use paper cube manipulatives (included in handouts) or another cube manipulative to demonstrate how increasing dimensions affects surface area and volume.

   A. Distribute at least four of the assembled 2-cm cubes and one of the assembled 4-cm cubes to each student without revealing what size they are. You also could have the students cut out the patterns and assemble the cubes themselves.

   B. Instruct students to measure the smaller and the larger cube using a 12-inch/cm ruler. They will find that the smaller cube is 2 cm x 2 cm x 2 cm and the larger is 4 cm x 4 cm x 4 cm.

   C. Ask, “How does the larger cube compare to the smaller one?” *(Its edges are twice the length of the small cube’s edges.)*

   D. Have students predict how many smaller cubes it would take to equal the volume of the larger cube.

   E. Discuss students’ predictions and their reasoning. Then have them use the cubes to check the accuracy of their predictions.

2. Using an Internet projector, go to the “House of Scales” page at [www.scalecity.org](http://www.scalecity.org) and follow the prompts to explore the concept. As students fill in the answers as a class, you will be able to decorate the house using several options.
3. Measure all the dimensions of a shoebox and have the students record the measurements. (Alternatively, a student or a pair of students could be enlisted to do the measuring.) Ask students to figure out the total surface (outside) area of the shoebox. Students should realize that there are six sides altogether, and that the two longer sides, the two shorter sides, and the top and bottom are pairs of similar rectangles. By solving this problem, they will arrive at the formula for the surface area of a rectangular prism:

\[ SA = 2lw + 2wh + 2lh \]

4. Solve the problems from “Handout 6: Surface Area and Volume Practice Problems” as a class. The handout requires students to use the information from the online interactive to determine the surface area of the interior walls of the little and big houses.

Questions for discussion as you work the problems:
- Why might you use a slightly different formula for finding the volume of a cube vs. finding the volume of other rectangular prisms?
- If each dimension is four times the original, why is the surface area and volume more than four times the original?
- Why is the unit of measurement so important to describing the value? (Examine the difference between 8 cm, 8 cm², and 8 cm³)

5. Assign “Handout 7: Surface Area and Volume Homework Problems.”

**DAY THREE: CREATING MODELS OF THE PLANETS USING SCALE**

**NOTE TO TEACHER:**

Day 3 requires students to use scale to create models of the planets. Students will compare each planet’s size to the earth’s size, consider how commonly found balls can be used in planetary models, calculate planetary model sizes, and then measure and create their own two-dimensional models.

1. Distribute “Handout 8: Planet Scale.” Scale helps us compare the size of two objects. Work through the comparisons of the sun and the moon with students. As students discuss ways to determine scale you might ask:
   - What is the radius?
   - What does knowing the radius tell us about the size of a circle?
   - Why do you think the terminology for the planets is mean equatorial radius?
   - How could we use estimating to make sure our answers are reasonable?

2. Go over the scale comparisons in Handout 8 with students. Discuss students’ ideas for using these comparisons to create models.

3. Students will use the scale comparisons to choose balls that would be suitable for models of the planets using “Scale of Planets: Ball Models.”

4. Discuss students’ ideas about matching balls up with planets.

5. The scale for creating this planetary model is one to one hundred million and allows students to create models of the planets that will fit on a classroom bulletin board. Marking off a length of 6.955 meters (the radius of the sun) somewhere in the school before class might help students compare the sun with the planets. You also could tell them to imagine the sun as a ball that would cover about half the basketball court.

**Kentucky Core Content for Assessment 4.1**

| Grade 6         | MA-06-1.4.1
| Grade 7         | MA-07-1.4.1
| Grade 8         | MA-08-1.4.1
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6. Students will be determining the scale and converting from kilometers to meters to centimeters. After doing many kinds of conversions and scaling throughout this lesson, students will directly see the benefit of the metric system in conversion and calculation.

7. After students complete the calculations for the model sizes, they will calculate what the distance from the sun would be on a scale of 1 to 100,000,000. In doing these calculations, students will see that it is difficult to create a model of the solar system on this scale in which the dimension of the earth and the distance between the planets are both represented in a visible space. You can use an online calculator to create models of the solar system given the space for display at thinkzone.wlonk.com/Space/SolarSystemModel.htm — 59,100 meters for size of model calculates numbers close to those you’re looking for.

8. Discuss ways you could use the numbers to create models.
   - How could you use string and the radius calculation to create circles?
   - How would you use the diameter to draw a circle?
   - What technology exists that could help?

9. For homework or class work, create and display the models. The art teacher may be interested in working with the class to create the models as a means of exploring texture, media, or color.

**DAY FOUR: GAME AND ASSESSMENTS**

**NOTE TO TEACHER:**

There are a variety of activities you could use on Day Four. Below is a brief explanation of three possible choices to introduce individually or in combination.

**Game** (“Handout 9: Race to the Top of the Washington Monument”)
In this activity, students earn points by answering three sets of problems—multiple choice, short answer, and true/false—to help them scale a model drawing of the Washington Monument. The first to scale the model drawing wins. The problems, 10 in each set, also can be used for additional assessment.

**Multiple-Choice Assessment** (see page 12)
Twenty questions formally assess concepts related to proportional reasoning, volume, and surface area.

**Key to Multiple-Choice Assessment**

**Open Response** (see pages 11 and 12)
Students write about the concepts of volume and surface area as they relate to increases in the size of a box.
Key to Open Response A

Your class is sending shoeboxes filled with toothbrushes, socks, and small school supplies to children in need. A child’s shoebox is 7 inches in length, 4.5 inches in width, and 2.5 inches in height. An adult shoebox is 14 inches in length, 9 inches in width, and 5 inches in height.

A. Since each edge of the adult shoebox is two times the corresponding edge of the child’s shoebox, would it take twice as much paper to wrap the larger box for shipping? Support your answer with computation. Students should determine that the surface area of the child’s shoebox is one-fourth the surface area of the adult’s (120.5 square inches vs. 482 square inches). Based on this they would conclude that it would take four times as much paper, not twice as much, to wrap the larger package.

B. Since each edge of the adult shoebox is two times the corresponding edge of the child’s shoebox, would the larger box hold twice as much? What is the volume of each box and how do they compare? Students’ computations should reveal that the volume of the larger box is much greater than two times the volume of the child’s shoebox. The volume of the child’s box is 78.75 cubic inches vs. 630 cubic inches for the adult’s box. So the volume of the larger box is 8 times greater than the volume of the smaller box.

Key to Open Response B

Use the following measurements of a right rectangular prism to answer questions 1-3 below:

Length = 12 inches, Height = 9 inches, Width = 5 inches

1. Calculate the areas of the prism’s faces, its outside surface area, and its volume.

Two of the prism’s faces are 108 square inches; two are 60 square inches; and two are 45 square inches. The surface area of the prism is 216 + 120 + 90 or 426 square inches. The volume of the prism is 12 x 9 x 5 or 540 cubic inches.

2. Increase the dimensions of the prism by a factor of three. Determine the new face areas, surface area, and volume.

The new face areas are 972, 540, and 405 square inches, and the surface area is 2 x 972 plus 2 x 540 plus 2 x 405 or 3,834 square inches. The volume of the larger prism is 36 x 27 x 15 or 14,580 cubic inches.

3. Are the faces of the two figures proportional to one another? Why or why not?

The lengths and widths are proportional to one another, but the areas and volumes are not. The lengths and widths of the faces of the larger figure have increased proportionally (each by three times). 12/36 = 9/27 = 5/15 = 1/3. The surface area of the larger prism is 3•3 or 9 times the surface area of the smaller prism, and the volume of the larger prism is 3•3•3 or 27 times the volume of the smaller prism.

Support/Connections/Resources


The Empire State Building
www.bankstreet.edu/eb/

This web site, created by the Bank Street College of Education in New York, provides lessons related to the Empire State Building in the areas of social studies and global studies; science and technology; and American history and geography.
Writing for the Lesson

Select an item for which you would like to make a scale model. You might choose a dinosaur or a whale, a car, a spacecraft, your house or school, etc. Discuss what scale you would use and why scale is important when creating a model. If you like, include a sketch or scale drawing with your writing.

Adaptations for Diverse Learners/Lesson Extensions

The paper cubes used as a means of exploring scale and proportion provide an excellent hands-on activity for students. Kinesthetic learners may benefit from additional access to and experience with these and other manipulatives.

Day 3: The Solar System activity provides a rich opportunity for multiple lesson extensions and additional research or exploration by students. There are numerous web sites for enrichment (see science applications below for some examples).

Applications Across the Curriculum

Social Studies
Researching buildings from around the world will stimulate discussion and questions about other cultures and geography. The web sites below offer good starting points for such an exploration.

The Official Site of the Eiffel Tower
www.tour-eiffel.fr/teiffel/uk/
This site has variety of information about one of the world’s most famous buildings, including a PDF, “All You Need To Know About the Eiffel Tower” with measurements, history, and fun facts; articles; detailed information about the tower’s structure; and more.

The Great Buildings Collection
www.greatbuildings.com/buildings/
A collection of resources about more than 1,000 great buildings worldwide, this web site includes features like the building of the day, opportunities to tour 3-D models created in Design Workshop®, links to architects whose buildings are described on the site, photographs and drawings of buildings, and much more.

SkyscraperPage.com
skyscraperpage.com
This site features diagrams of famous skyscrapers, including the world’s 10 tallest buildings, historical skyscrapers, and skyscrapers in 330 cities worldwide. Dozens of American cities large and small (among them Louisville and Lexington) are represented. New scaled drawings are added weekly.

Empire State Building Official Internet Site
www.esbnyc.com
This web site has pages with information and activities for students as well as a virtual tour of the building. It also links to the Bank Street College of Education site described above.
The Space Needle
www.spaceneedleinfo.com
Students can learn about the history and structure of Seattle's famous Space Needle, built in 1961 for the World Fair.

World’s Tallest Buildings: A Timeline for the 20th Century
www.bbc.co.uk/dna/h2g2/A32873871
This web site describes the various buildings that have held (and lost) the title of the world’s tallest building, starting with New York’s Park Row Building, constructed in 1899, and ending with Taipei 101 in Taipei, Taiwan.

Science
Day 3 is a good launch for further exploration of the solar system in science class. The following web sites provide information, data, and/or activities for this exploration.

Build a Solar System
www.exploratorium.edu/ronh/solar_system/
A calculator and other tools are provided to help students and teachers create a scale model of the solar system.

Comparison of the Planets
solarsystem.nasa.gov/planets/charchart.cfm
This chart, developed by NASA, compares the planets based on their distance from the sun; their mean equatorial radii; their volume, mass, and density; and a variety of other categories such as surface gravity and orbital velocity.

Texas Instruments Activities Archive: Scaling Our Solar System
timidgrades.com/sciencearchive/327/
This activity shows students how to use a TI-73 calculator to create a scale model of the solar system.

The Maine Solar System Model
www.umpi.maine.edu/info/nmms/solar/
This site documents a model of the solar system built by the people of Aroostook County, Maine along U.S. Route 1 between Presque Isle and Houlton.

Solar System Scale Model Calculator
thinkzone.wlonk.com/Space/SolarSystemModel.htm
This site provides a calculator for scaling the diameters and sun-planet distances for a solar system model, either in meters or feet. (Entering 59,100 meters for the size of the model calculates numbers close to the numbers on “Handout 9: Scale of Planets: Ball Models.”)
Your class is sending shoeboxes filled with toothbrushes, socks, and small school supplies to children in need. A child’s shoebox is 7 inches in length, 4.5 inches in width, and 2.5 inches in height. An adult shoebox is 14 inches in length, 9 inches in width, and 5 inches in height.

A. Since each edge of the adult shoebox is two times the corresponding edge of the child’s shoebox, would it take twice as much paper to wrap the larger box for shipping? Support your answer with computation.

B. Since each edge of the adult shoebox is two times the corresponding edge of the child’s shoebox, would the larger box hold twice as much? What is the volume of each box and how do they compare?

### OPEN RESPONSE A SCORING GUIDE

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<th>2</th>
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<td>• The answer shows excellent understanding of the concepts of volume and surface area.</td>
<td>• The answer shows good understanding of the concepts of volume and surface area.</td>
<td>• The answer shows basic understanding of the concepts of volume and surface area.</td>
<td>• The answer shows minimal understanding of the concepts of volume and surface area.</td>
<td>• Blank or no response.</td>
</tr>
<tr>
<td>• The response is accurate and thorough.</td>
<td>• The computation is correct with few errors.</td>
<td>• The computation may have several errors.</td>
<td>• The computation is incomplete or inaccurate.</td>
<td></td>
</tr>
<tr>
<td>• The computation is correct.</td>
<td>• The writing is generally accurate and logical.</td>
<td>• The response may indicate gaps in understanding.</td>
<td>• The response indicates limited effort and/or understanding.</td>
<td></td>
</tr>
<tr>
<td>• The writing is clear, well-organized, and uses appropriate mathematical terminology.</td>
<td></td>
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</table>
Use the following measurements of a right rectangular prism to answer questions 1-3 below:

Length = 12 inches, Height = 9 inches, Width = 5 inches

1. Calculate the areas of the prism’s faces, its outside surface area, and its volume.

2. Increase the dimensions of the prism by a factor of three. Determine the new face areas, surface area, and volume.

3. Are the faces of the figures proportional? Why or why not?

**OPEN RESPONSE B SCORING GUIDE**

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</tr>
<tr>
<td>3</td>
<td>Student correctly performs the calculations with few or no errors. The student demonstrates good understanding of proportion, volume, and area. The explanation is generally complete and demonstrates appropriate use of mathematical terminology and understanding of concepts.</td>
</tr>
<tr>
<td>2</td>
<td>Student performs the calculations with several errors. The student demonstrates general understanding of proportion, volume, and/or area. The writing indicates basic understanding, but may be incomplete or inaccurately applied.</td>
</tr>
<tr>
<td>1</td>
<td>The student demonstrates limited understanding of proportion, volume, and/or area. The writing indicates minimal understanding or effort. The response may be incomplete or inaccurate.</td>
</tr>
<tr>
<td>0</td>
<td>Blank or no response</td>
</tr>
</tbody>
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**SCALE CITY**

MINIATURE LAND: Three-Dimensional Scaling 11
MULTIPLE CHOICE ASSESSMENT

Name: ___________________________________________ Date: ___________________________________________

1. An exhibit of miniatures is on a 1:12 scale. A figure made to represent a man who was 5 feet 6 inches tall would be
   A. 5 1/2 inches tall
   B. 6 1/4 inches tall
   C. 6 1/2 inches tall
   D. 12 inches tall

2. An architect’s office uses a scale in which 1/16 of an inch represents 12 inches. If the actual door height is 6 feet 8 inches, then the height of the door in the architect’s model will be
   A. 1/3 inch
   B. 1/4 inch
   C. 5/12 inch
   D. 1/2 inch

3. The height of the towers of the Cathedral of Notre Dame in Paris is 69 meters. A replica of the cathedral in Covington, Kentucky is 1/3 the size of Notre Dame. The height of the towers would be
   A. 34.5 meters
   B. 23 meters
   C. 13 meters
   D. 6 meters

4. The Behringer-Crawford Museum has a model of Ludlow, Kentucky in the 1940’s in which 0.5 inches represents 12 inches of actual size. A tree 10 feet tall should be represented by a model tree that is
   A. less than 1/2 inch
   B. 3 inches
   C. 5 inches
   D. 1 foot

5. In designing a model of the town square, your class determines the scale will be one inch for every foot. If the flagpole is 13 feet high, then the flagpole in the model should be
   A. 5 inches high
   B. 6.5 inches high
   C. 9 inches high
   D. 13 inches high

6. An architect’s model building is eight inches tall. Each foot of the actual building is represented in the model by 1/16 of an inch. The actual building would be
   A. 96 feet tall
   B. 72 feet tall
   C. 128 feet tall
   D. 156 feet tall
7. Mr. Caro’s class is creating models of significant landmarks and buildings. The scale is 1/32 of an inch for every foot. The Statue of Liberty is 305 feet one inch tall to the tip of the torch. The model should be
A. less than 6 inches tall
B. less than 10 inches tall
C. more than 2 feet tall
D. more than 10 feet tall

8. One of the most extensive collections of miniatures in the world is at the Kentucky Gateway Museum Center in Maysville. The scale is 1/12. A desk from the late nineteenth century has these measurements:
Height: 47.5 inches  
Width: 4 feet 8.25 inches  
Depth: 27.75 inches
The model size would be
A. height: 4.75 inches, width: 4.82 inches, depth: 2.75 inches
B. height: 4.25 inches, width: 5.35 inches, depth: 3.5 inches
C. height: 4.18 inches, width: 4.75 inches, depth: 2.65 inches
D. height: 3.96 inches, width: 4.69 inches, depth: 2.31 inches

9. Craig’s uncle is purchasing a steel box for keeping tools in his pick-up truck. One box is 18 inches high, 18 inches wide, and 18 inches deep. Another box is 24 inches high, 24 inches wide, and 24 inches deep. The volume of the larger box is
A. 1/3 bigger than the volume of the smaller box
B. more than two times bigger than volume of the smaller box
C. 6 times bigger than the volume of the smaller box
D. 27 times bigger than the volume of the smaller box

10. Given a cube with edges of 4 inches each, what is the surface area of the cube?
A. 48 in²
B. 16 in²
C. 96 in²
D. 64 in²

11. Decrease each edge of the cube in #10 by one half. What is the surface area of the new cube?
A. 32 in²
B. 48 in²
C. 12 in²
D. 24 in²

12. How does the volume of the cube with 4-inch edges compare to the volume of the cube with 2-inch edges?
A. Two times greater
B. One-half as much
C. Four times greater
D. Eight times greater

13. What is the surface area of a shoebox that is 13 inches long, 7 inches wide, and 4 inches high?
A. 24 in²
B. 468 in²
C. 342 in²
D. 195 in²
14. What is the volume of a cube that has edges 3 inches long?
A. 9 in³
B. 27 in³
C. 18 in³
D. 12 in³

15. Given the cube from #14, double the size. What is the volume of the new cube?
A. 81 in³
B. 18 in³
C. 216 in³
D. 36 in³

16. What is the volume of a shoebox that is 13 inches long, 7 inches wide, and 4 inches high?
A. 364 in³
B. 728 in³
C. 91 in³
D. 24 in³

17. Sara’s dollhouse measures 15 inches by 15 inches. She has three windows measuring 3 inches by 3 inches. The door measures 3 inches by 12 inches. Sara wants to paint the floor, walls, and ceiling of her dollhouse. One wall of her house is missing so you can see inside. The total surface area for painting could be found by subtracting the area of the door and windows and area of the missing wall from the total surface area. The surface area for painting would be
A. 3312 square inches
B. 1287 square inches
C. 1062 square inches
D. 225 square inches

18. The history club is putting together a time capsule. One metal box measures 4 inches by 6 inches by 2 inches. Another metal box measures 12 inches by 18 inches by 6 inches. The volume of the larger box is
A. twice the volume of the smaller box
B. three times the volume of the smaller box
C. nine times the volume of the smaller box
D. twenty-seven times the volume of the smaller box

19. You are designing a refrigerator for a dollhouse with a 1 to 12 scale. The dimensions of your actual refrigerator are:
Height = 6 feet  Length = 2 feet  Width = 3.5 feet
What are the dimensions of the miniature refrigerator?
A. height: 72 inches, length: 24 inches, width: 42 inches
B. height: 3 inches, length: 1 inch, width: 1.75 inches
C. height: 6 inches, length: 2 inches, width: 3.5 inches
D. height: 12 inches, length: 4 inches, width: 7 inches

20. After thinking about your design for your dollhouse, you decide to change the scale to 1 to 24. What are the new dimensions of your refrigerator?
A. height: 72 inches, length: 24 inches, width: 42 inches
B. height: 3 inches, length: 1 inch, width: 1.75 inches
C. height: 6 inches, length: 2 inches, width: 3.5 inches
D. height: 12 inches, length: 4 inches, width: 7 inches