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Resources: Please visit the SchoolsNEXT website: Design Competition Resources, Teacher/ Mentor Resources and Additional Resources for enrichment materials.

UNIT 3: Designing the Floor Plan I

STEM and Visual Arts Connections To Green Schools

Grades 5-8

LESSON TITLE: Introduction to Scale Drawings

Math Standard(s) Addressed: Understands how scale in maps and drawings shows relative size and distance; understands the relationship between two- and three-dimensional representations of a figure (e.g., scale drawings, blueprints).

Approximate Time Needed for Lesson: 30-45 minutes

Students will engage in:

- [ ] independent activities
- [ ] cooperative learning
- [ ] peer tutoring
- [x] visuals
- [x] pairing
- [x] hands-on activities
- [ ] centers
- [ ] lecture
- [x] whole group instruction
- [ ] technology integration
- [x] creating a project
- [ ] guest speakers

Class Starter: Put several drawings on the board. Discuss which are probably drawn to scale and which are not (one example is attached).

Objectives: To learn how to construct and interpret scale drawings.

Materials: paper and pencil, ruler, compass, calculator

Step-By-Step Procedures:

- Do Scale Drawing Exercises as explained in attachment (Scale Drawing).
- Begin working in small groups and taking measurements of the classroom.
- Compare measurements through class discussion and reach consensus on what measurements will be used to create classroom blueprint.
- Begin creating classroom blueprint using scale.

Guided/Independent Practice: Model drawing the teacher's desk to scale on board.

Assessment: Review scale drawing lesson worksheet for accuracy.

Differentiation Ideas:

- Have students work in pairs or groups.
- Have one team be the checkers that verify measurements within the classroom.

Adaptations & Extension Ideas:

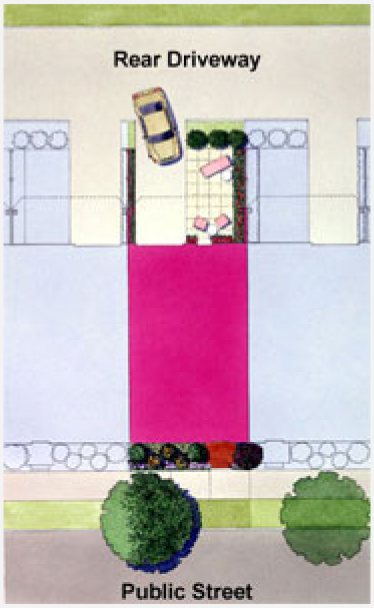
- Cut out pictures from magazines showing objects to scale and not to scale.
- Demonstrate which architectural features help prevent mold growth, which help promote good IAQ and what materials selected for floors, walls, ceilings also help

Closure: Now that scale has been understood and agreement reached in drawing our classroom begin to look beyond to the grade level and this portion of the school for next time.

Connections to other Content Areas:

Additional Resources: Download Google's Sketchup for free at http://www.sketchup.com
Students can view completed projects in Google's 3D warehouse at http://sketchup.google.com

CLASS STARTER:



STEM and Visual Arts Connections To Green Schools

Grades 5-8

LESSON TITLE: Refining and Reasoning behind Scale Drawings

Math Standard(s) Addressed: Understands how scale in maps and drawings shows relative size and distance; understands the relationship between two- and three-dimensional representations of a figure (e.g., scale drawings, blueprints).

Approximate Time Needed for Lesson: 30-45 minutes

Students will engage in:

- [ ] independent activities
- [x] cooperative learning
- [ ] peer tutoring
- [x] visuals
- [ ] pairing
- [x] hands-on activities
- [ ] centers
- [ ] lecture
- [x] whole group instruction
- [ ] technology integration
- [ ] creating a project
- [ ] guest speakers

Class Starter: Lead class in discussion about accuracy and the need for it in blueprints in order to create the final project.

Objectives: To further refine and perfect drawings as part of the school building project.

Materials: paper and pencils
sticky notes
drawings from *Introduction to Scale Drawing* lesson

Step-By-Step Procedures:

- Put up all previous drawings on the walls for student to view.
- Using sticky notes have students jot down constructive criticism that would help their fellow student refine their drawing.
- Pass out drawings and allow time for further work and refinement to be completed on them.

Guided/Independent Practice: Use blueprints to show accuracy of drawings.

Assessment: Informal assessment based on discussion and individual attention to detail.

Differentiation Ideas:

- Have students work in small groups on refining their drawings.

Adaptations & Extension Ideas:

- Have students begin to write the narrative describing the planning process and the physical environment they have created.

Closure: Lead a discussion on the importance of input from other students on getting their drawings refined. Brainstorm a list of elements to still consider in their refining process.

Connections to other Content Areas:

Additional Resources:

STEM and Visual Arts Connections To Green Schools

Grades 5-8

LESSON TITLE: Checking Scale Drawings for Accuracy

Math Standard(s) Addressed: Understands how scale in maps and drawings shows relative size and distance; understands the relationship between two- and three-dimensional representations of a figure (e.g., scale drawings, blueprints).

Approximate Time Needed for Lesson: 30-45 minutes

Students will engage in:

- [ ] independent activities
- [x] cooperative learning
- [ ] peer tutoring
- [x] visuals
- [ ] pairing
- [x] hands-on activities
- [ ] centers
- [ ] lecture
- [x] whole group instruction
- [ ] technology integration
- [x] creating a project
- [ ] guest speakers

Class Starter: Review with students terms and process for accuracy. Put the list that was brainstormed at the end of the refining lesson on the board for consideration.

Objectives: To check and further refine drawings to ensure accuracy.

Materials: pencils sticky notes
paper drawings from last two lessons

Step-By-Step Procedures:

- Once again put the drawings as they stand now up on the walls.
- Have student view the drawings making constructive suggestions on sticky notes.
- Using this criticism have student rework the drawings for accuracy and completion.

Guided/Independent Practice: Using a previous drawing model checking for accuracy.

Assessment: Turning in the final drawings for project.

Differentiation Ideas:

- Have students work in pairs or small groups to refine their drawings.

Adaptations & Extension Ideas:

- Have students continue to write their planning and physical environment narratives while starting their narrative on the learning environment they have created within the school building.

Closure: Congratulate the process that all the students have completed. Describe the difference between a two dimensional drawing and three dimensional model.

Connections to other Content Areas:

Additional Resources:

The following related teacher information can be found on the internet at
http://scidiv.bcc.ctc.edu/Physics/Measure&sigfigs/B-Acc-Prec-Unc.html

B. Accuracy vs. Precision, and Error vs. Uncertainty

When we discuss measurements or the results of measuring instruments there are several distinct concepts involved which are often confused with one another. This section describes four important ideas and establishes the differences between them. The first distinction is between Accuracy and Precision.

Accuracy

Accuracy refers to the agreement between a measurement and the true or correct value. If a clock strikes twelve when the sun is exactly overhead, the clock is said to be accurate. The measurement of the clock (twelve) and the phenomena it is meant to measure (The sun located at zenith) are in agreement. Accuracy cannot be discussed meaningfully unless the true value is known or is knowable. (Note: The *true* value of a measurement can never be known. Read more about this.)

Accuracy refers to the *agreement* of the measurement and the true value and does *not* tell you about the quality of the instrument. The instrument may be of high quality and still disagree with the true value. In the example above it was assumed that the purpose of the clock is to measure the location of the sun as it appears to move across the sky. However, in our system of time zones the sun is directly overhead at twelve O'clock only if you are at the center of the time zone. If you are at the eastern edge of the time zone the sun is directly overhead around 11:30, while at the western edge the sun is directly overhead at around 12:30. So at either edge the twelve O'clock reading does not agree with the phenomena of the sun being at the local zenith and we might complain that the clock is not accurate. Here the accuracy of the clock reading is affected by our system of time zones rather than by any defect of the clock.

In the case of time zones however clocks measure something slightly more abstract than the location of the sun. We define the clock at the center of the time zone to be correct if it matches the sun, we then define all the other clocks in that time zone to be correct if they match the central clock. Thus a clock at the Eastern edge of a time zone that reads 11:30 when the sun is overhead would still be accurate since it agrees with the central clock. A clock that read 12:00 would not be accurate at that time. The idea to get used to here is that accuracy only refers to the agreement between the measured value and the expected value and that this may or may not say something about the quality of the measuring instrument. A *stopped* clock is accurate at least once each day.

Precision

Precision refers to the repeatability of measurement. It does not require us to know the correct or true value. If each day for several years a clock reads exactly 10:17 AM when the sun is at the zenith, this clock is very precise. Since there are more than thirty million seconds in a year this device is more *precise* than one part in one million! That is a very fine clock indeed! You should take note here that we do not need to consider the complications of edges of time zones to decide that this is a good clock. The true meaning of noon is not important because we only care that the clock is giving a repeatable result.

Error

Error refers to the disagreement between a measurement and the true or accepted value. You may be amazed to discover that error is not that important in the discussion of experimental results. This statement certainly needs some explanation.

As with accuracy, you must know the true or correct value to discuss your error. But consider what science is about. The central objective is to discover *new* things. If they are new, then we *do not know* what the true value is ahead of time. Thus it is not possible to discuss our error. You might raise the possibility that the experiment has a defective component or incorrect assumption so that an error is made. Of course the scientist is concerned about this. Typically there has been much discussion with other scientists and a review of the methods to try to avoid exactly this possibility. However, if an error occurs we simply will not know it. The true value has not yet been established and there is no other guide. The good scientist *assumes the experiment is not in error*. It is the only choice available. Later research, attempts by other scientists to repeat the result, will hopefully reveal any problems, but the first time around there is no such guide.

Students in science classes are in an artificial situation. Their experiments are necessarily repetitions of previous work, so the results are known. Because of this students learn a poor lesson about science. Students often are very conscious of error to the point where they assume it happens in every experiment. This is distracting to the project of becoming a scientist. If you want to benefit most from your laboratory experiences, you will need to do some judicious pretending. After the experiment has been conducted, while you write up the result in your lab report, assume that error is not a consideration. Your team has done the best it can have done in the lab and you must account for the results on that basis. Do not write "human error" as any part of your lab report. It is in the first place embarrassing, and in our experience as faculty members, *it is rarely the source of experimental problems*. (Well over half of problems producing bad laboratory results are due to *analysis errors* in the report! Look here first.)

Uncertainty

Uncertainty of a measured value is an interval around that value such that any repetition of the measurement will produce a new result that lies within this interval. This uncertainty interval is assigned by the experimenter following established principles of uncertainty estimation. One of the goals of this document is to help you become proficient at assigning and working with uncertainty intervals.

Uncertainty, rather than error, is the important term to the working scientist. In a sort of miraculous way uncertainty allows the scientist to make completely certain statements. Here is an example to see how this works.

Let us say that your classmate has measured the width of a standard piece of notebook paper and states the result as 8.53 ± 0.08 inches. By stating the uncertainty to be 0.08 inches your classmate is claiming with confidence that every *reasonable* measurement of this piece of paper by other experimenters will produce a value not less than 8.45 inches and not greater than 8.61 inches.

Suppose you measured the length of your desk, with a ruler or tape measure, and the result was one meter and twenty centimeters ($L = 1.20$ m). Now the true length is not known here, in part because you do not have complete knowledge of the manufacture of the measuring device, and because you cannot see microscopically to confirm that the edge of the table exactly matches the marks on the device. Thus you cannot discuss error in this case. Nevertheless you would not say with absolute certainty that L = 1.20 m.

However it is quite easy to imagine that you could be certain that the desk was not more than ten centimeters (~ five inches) different than your measurement. You may have experience with tape measures. And based on that experience, you are sure that your tape measure could not be stretched out by five inches compared to its proper length. If you do not have this confidence, perhaps ten inches or a foot would make you confident. After measuring you might say "This desk is not longer than 1.35 m and not shorter than 0.95 m." You could make this statement with complete confidence. The scientist would write L = 1.20±0.15 m. The format is "*value* plus or minus *uncertainty*."

Notice that it is *always* possible to construct a completely certain sentence. In the worst case we might say the desk is not shorter than zero meters and not longer than four meters (because it would not fit the room). This measurement may be nearly useless, but it is completely certain! By stating a confidence interval for a measurement the scientist makes statements that any reasonable scientist must agree with. The skill comes in getting the confidence intervals (the uncertainty) to be as small as possible.

This is your task in the laboratory. Every measurement you make should be considered along with a confidence interval. You should then assign this uncertainty to the measurement at the time that you record the data.

Uncertainty: Having presented the example, here is the definition of uncertainty.

- The uncertainty in a stated measurement is the interval of confidence around the measured value such that the measured value is certain not to lie outside this stated interval.

  Uncertainties may also be stated along with a probability. In this case the measured value has the stated probability to lie within the confidence interval. A particularly common example is one standard deviation (SD) for the average of a random sample. The format "value±1 SD" means that if you repeat the measurement, 68% of the time your new measurement will fall in this interval.

  True values vs. Accepted values

Check your understanding of these terms by working through the example below.

A metal rod about 4 inches long has been passed around to several groups of students. Each group is asked to measure the length of the rod. Each group has five students and each student independently measures the rod and records his or her result.

Student Group	Student 1	Student 2	Student 3	Student 4	Student 5
Group A	10.1	10.4	9.6	9.9	10.8
Group B	10.135	10.227	10.201	10.011	10.155
Group C	12.14	12.17	12.15	12.14	12.18
Group D	10.05	10.82	8.01	11.5	10.77
Group E	10	11	10	10	10

Which group has the most accurate measurement?

- A
- B
- C
- D
- E

Answer

Which group has the most precise measurement?

- A
- B
- C
- D
- E

Answer

Which group has the greatest error?

- A
- B
- C
- D
- E

Answer

Which group has the greatest uncertainty?

- A
- B
- C
- D
- E

Answer

We now receive a report from the machine shop where the rod was manufactured. This very reputable firm certifies the rod to be 4 inches long to the nearest thousandths of an inch. Answer the questions below given this new information. Note that the questions are slightly different.

(4.000 inches = 10.160 cm)

A B C D E	**Which group has the least accurate measurement?** Answer	A B C D E	**Which group has the least precise measurement?** Answer
A B C D E	**Which group has the smallest error?** Answer	A B C D E	**Which group has the smallest uncertainty?** Answer

STEM and Visual Arts Connections
To Green Schools
Grades 5-8

LESSON TITLE: Measure Around and Within

Math Standard(s) Addressed: Solves problems involving perimeter and area of various shapes; understands the relationship among linear dimensions, area, and volume and the corresponding uses of units, square units, and cubic units of measure.

Approximate Time Needed for Lesson:
30 – 45 minutes

Students will engage in:

- [x] independent activities
- [x] cooperative learning
- [ ] peer tutoring
- [x] visuals
- [ ] pairing
- [x] hands-on activities
- [ ] centers
- [ ] lecture
- [x] whole group instruction
- [ ] technology integration
- [x] creating a project
- [ ] guest speakers

Class Starter: Put area and perimeter formulas on board and lead a discussion on the difference between the two. Do Randy Rat worksheet (http://www.mathprojects.com/downloads/geometry/dido.pdf) to reinforce these calculations.

Objectives: The student will clearly understand how to determine and differentiate perimeter and area.

Materials: Attached sheets String or ribbon

Step-By-Step Procedures:

- Complete maximizing/minimizing lesson attached (adapted from www.iit.edu/~smile/ma9601.html.
- Discuss different ways of finding the answer (manipulatives, algebraically).
- Go over answers to each question.

Guided/Independent Practice: Model using a string (or ribbon) for the perimeter of a square vs. the area on the board.

Assessment: Turn in Randy Rat and max/min lesson for review and grade.

Differentiation Ideas:

- Have students determine the area and perimeter of different items within the classroom.

Adaptations & Extension Ideas:

- Princess Dido – The geometry of an Ox skin (http://www.mathprojects.com/downloads/geometry/dido.pdf)

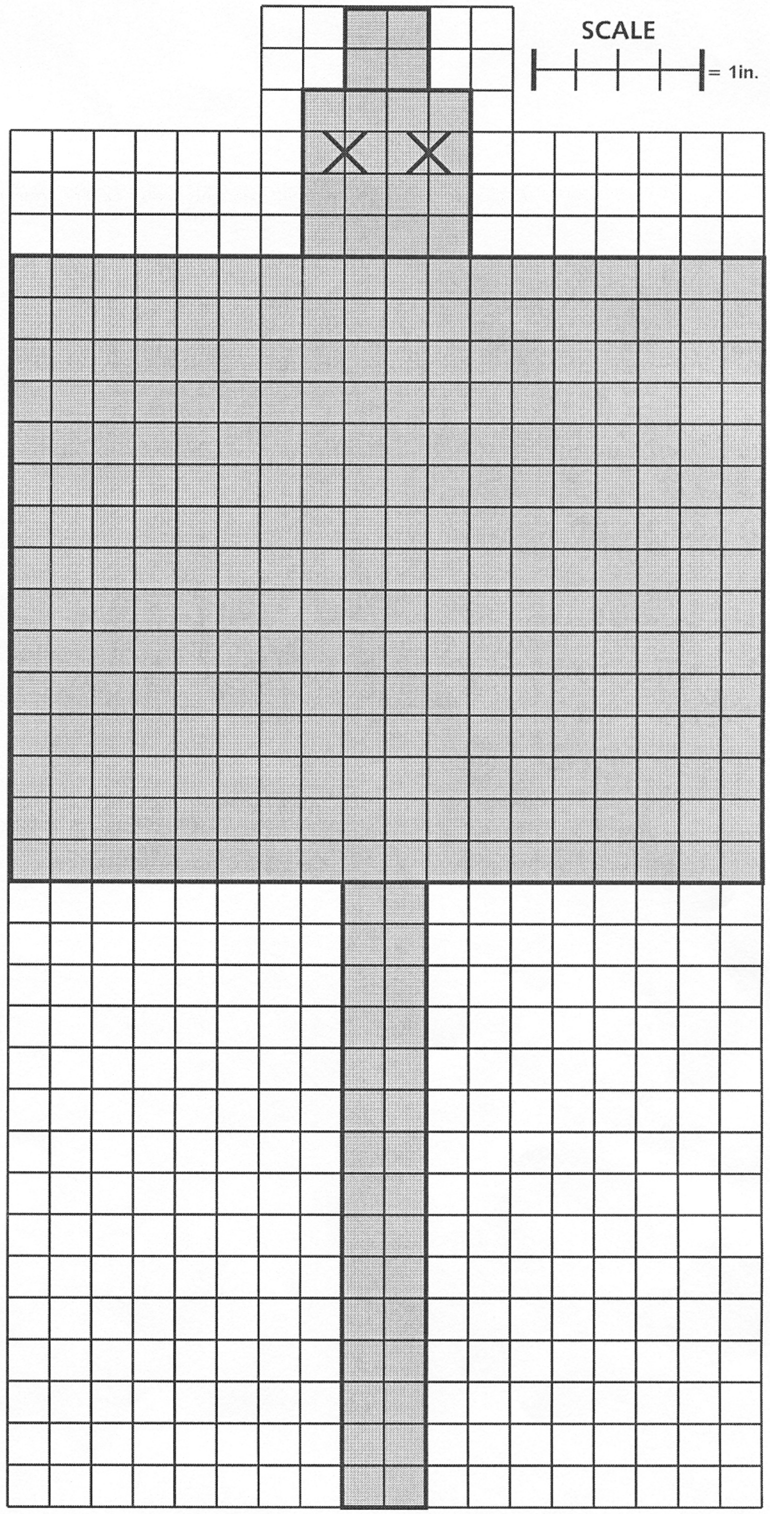
Closure: Discuss the perimeter and the area and how they interrelate but are not the same. Construct a Venn diagram to show similarity and differences.

Connections to other Content Areas:

Additional Resources: Princess Dido – The geometry of an Ox skin (http://www.mathprojects.com/downloads/geometry/dido.pdf)

The following activity is available on the internet from the Math Projects Journal, lesson plans and articles, page 4 of "Princess Dido & the Ox Skin" and can be accessed at http://www.mathprojects.com/lessons.asp.

Randy Rat



1. What is the area of the rat skin? Use drawings and calculations of the sub-problems to show your thinking.

   Area = ______ in^2

2. If you were to cut the rat skin into 1/2 inch strips, what would be the length of the rat skin band, barring any overlap? (Hint: visualize the band as a long rectangle, 1/2 inch wide.)

   Length = ______ in

3. Choose three different shapes and use the perimeter from #2 to determine the area of each. At least one should have more than 4 sides.

   a. Which of your three shapes yields the largest area?

   ____

   b. What shape do you think will give the largest area for any given perimeter? If you have not done so already, calculate the perimeter and area for the optimal shape.

   A ___________ with a

   perimeter of __________ and an

   area of ____________

4. Assume that you cut the rat skin into $^1/_4$ inch strips. Calculate the perimeter and area of one of your shapes.

   a. What is the ratio of the perimeters between the two similar shapes?

   P_1/P_2 = _____ A_1/A_2 = _____

   b. What is the ratio of the areas between the two similar shapes?

   c. How do these numbers compare?

Maximizing and Minimizing the Area of Rectangles Given a Fixed Perimeter
Teacher Information

The information on this page and the student worksheet which follows have been adapted from the Internet site http://www.iit.edu/~smile/ma9601.html

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Materials Needed:

(1) A fixed length of ribbon, or string, which will be used to represent a fixed length of fencing
(2) Paper or cardboard rectangles of given, fixed perimeter
(3) Tiles, ceramic or paper
(4) Inch tiles (tiles with 1 sq. in. area)
(5) Scientific calculators
(6) Graph paper

Strategy:

(1) Students will be given 3 paper rectangles with identical perimeters (such as 5 in. by 25 in., 10 in. by 20 in., and 15 in. by 15 in.) They will additionally be given 5 in. tiles (square tiles whose sides are each 25 sq. in.) Give the following instructions and questions: (1) Use your ruler to find the perimeter of each rectangle. (b) What do these rectangles have in common? (c) Which rectangle requires the most tiles to completely cover it? (d) Which rectangle requires the fewest tiles to completely cover it? (Students will work in pairs)
(2) Next, the students will be presented with this problem, "You have a plot of land and a dog. Your dog has run away a couple of times and often runs on your neighbors' property. You decide to fence in a rectangular section of your land so that your dog doesn't run away but has room to play. You have 72 feet of fencing. You want each side of the rectangular "pen" to be a whole number in length. Your goal is to allow your dog the maximum amount of space to run around and play. Design the rectangle that achieves this goal." The students will model this problem using a length of string or ribbon 72 cm. long. Students are to experiment with at least 5 different rectangles. They are to record the dimensions (bottom edge, side edge, perimeter, area) for each of their fence models. We will then discuss the fact that, geometrically speaking, we are maximizing area given fixed perimeter. (Students will work in pairs or in groups of four)
(3) Next, the students will be presented with these two problems:
(i) "You run a business that puts on banquets. For one small banquet you need to seat 12 people. You construct your banquet tables from small square tables (which individually seat 1 person on each side). Each small table costs your company $1 per day (for rental or moving). Your banquet tables are always rectangular. (a) What are the dimensions of the table that will seat these 12 people most cheaply? (b) What are the dimensions of the table that would seat the 12 people in the most expensive way possible?
(ii) The same basic problem will be repeated for a banquet in which 24 people need to be seated. For both of these problems, charts will be compiled in which the dimensions (bottom edge, side edge, perimeter, and area) are recorded for all possible perimeter of 12 and perimeter of 24 rectangles.

Maximizing and Minimizing the Area of Rectangles Given a Fixed Perimeter

Name ______________________

You should have:

3 paper rectangles
5 1-in. tiles
Ruler

(1) (a) Use your ruler to find the perimeter of each rectangle. Write your results below.

(b) What do these rectangles have in common?

(c) Which rectangle requires the most tiles to completely cover it?

(d) Which rectangle requires the fewest tiles to to completely cover it?

(2) You have a plot of land and a dog. Your dog has run away a couple of times and often runs on your neighbors' property. You decide to fence in a rectangular section of your land so that your dog doesn't run away but has room to play. You have 72 feet of fencing. You want each side of the rectangular "pen" to be a whole number in length. Your goal is to allow your dog the maximum amount of space to run around and play. Design the rectangle that achieves this goal.

(a) Model this problem using a length of string or ribbon 72 cm. long.

(b) Experiment with at least 5 different rectangles. Record the dimensions (bottom edge, side edge, perimeter, area) for each of their fence models.

(c) In pairs or in groups of four discuss the fact that, geometrically speaking, we are maximizing area given fixed perimeter.

side 1

(3) (a) You run a business that puts on banquets. For one small banquet you need to seat 12 people. You construct your banquet tables from small square tables (which individually seat 1 person on each side). Each small table costs your company $1 per day (for rental or moving). Your banquet tables are always rectangular.

(i) What are the dimensions of the table that will seat these 12 people most cheaply?

(ii) What are the dimensions of the table that would seat the 12 people in the most expensive way possible?

(b) Re-work (i) and (ii) above for a banquet in which 24 people need to be seated.

(c) For both problems (3a) and (3b), compile a chart that displays the dimensions including bottom edge, side edge, perimeter, and area for all possible 12-person and 24-person tables.

The following supporting lesson plans which can be used as an additional resource can be found on the internet at http://www.leeric.lsu.edu/bgbb/7/ecep/math/n/n.htm. This plan originated with the Louisiana Energy & Environmental Resource & Information Center, Energy Conservation Enhancement Project at Louisiana State University and was originally created for the vocational technical schools in Louisiana, USA.

Area: What's a SQUARE Foot?

GOAL:

To compute accurate measurements of area.

OBJECTIVES:

The student will be able to:

1. Define area.
2. Explain how area is computed.
3. Find the area of basic figures and objects.

ENERGY OBJECTIVES:

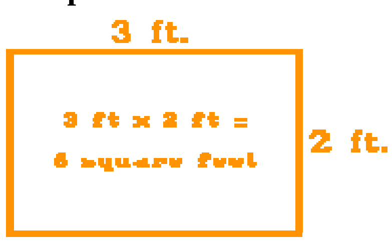
The student will be able to:

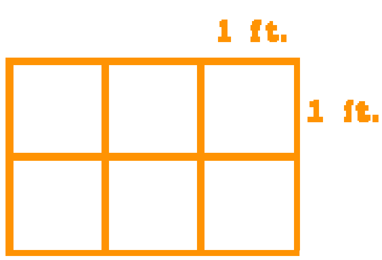
1. Determine the proper amount of glassed area to be placed on a structure for maximum energy efficiency.

LESSON INFORMATION:

Area refers to the amount of surface covered by a figure or object. The area of simple square or rectangular objects is obtained by multiplying the length of the object times its width. In the case of a building or home, area is found by measuring the length and the width of the outside walls and multiplying the measurements together. See Example 1.

Example 1:



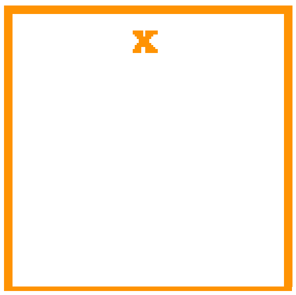


Example 1a shows the mathematical equation while Example 1b helps you see the "6 square feet" in the given rectangle.

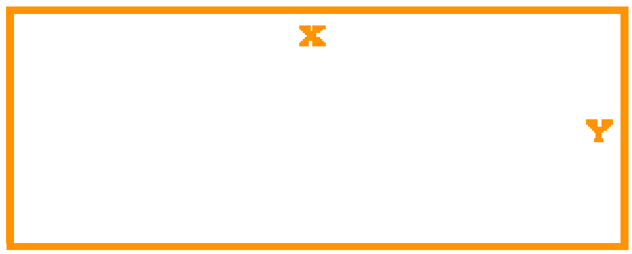
These variables will be used in the area formulas.

Variable	Meaning
X, Y	Length of a side of an object.
b	Length of the base of a triangle.
h	Height of a triangle equal to the perpendicular segment from the base to the angle opposite the base.
r	Radius; length of a line segment from the center of a circle to the circle's edge.
π	Pi; constant approximately equal to 3.14; used in determining area of a circle.

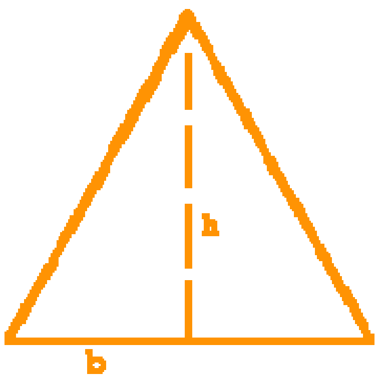
Square: X × X or X^2



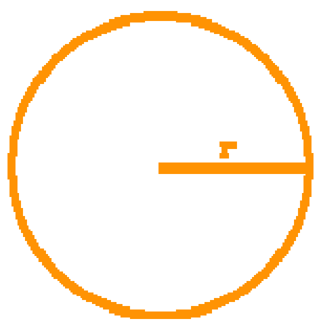
Rectangle: X × Y



Triangle: 1/2(b × h)

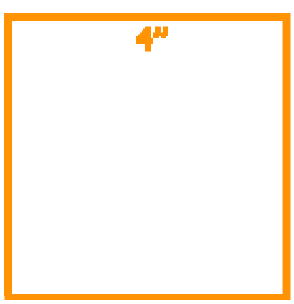


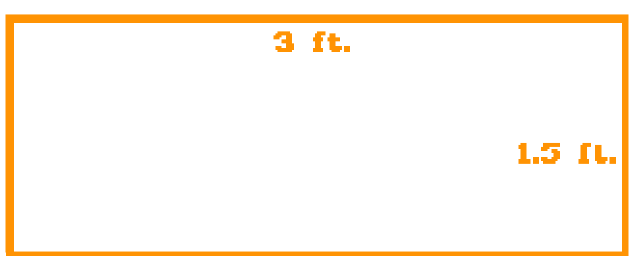
Circle: πr^2



ACTIVITY D-1:

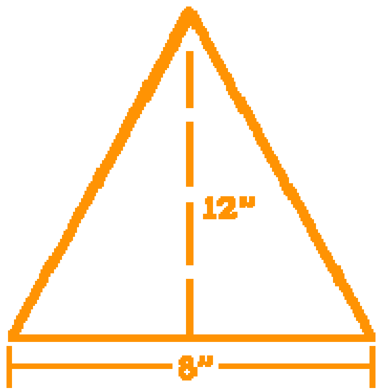
Find the area of the following figures. Write the equations used and show all of your work. Include the proper units (feet, inches) as part of your answer.



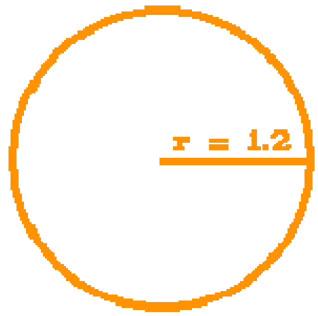


1. __________

2. __________



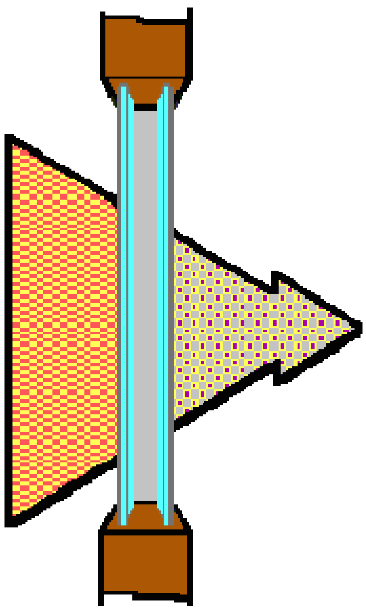
3. __________



4. __________

Learning to apply area formulas can be useful to the home builder. Determining the total square footage of the home is necessary for many reasons, one of which is to aid in assessing heating and cooling needs. Also, it is important to know that the most energy efficient homes have glassed areas equaling only about 10% of total floor area.

There are many reasons why windows are placed on a home. Many people like to take advantage of natural lighting and ventilation options. It is important to remember, however, that unprotected window glass accounts for up to one-fourth of heat lost during the winter and of heat gained during the summer.

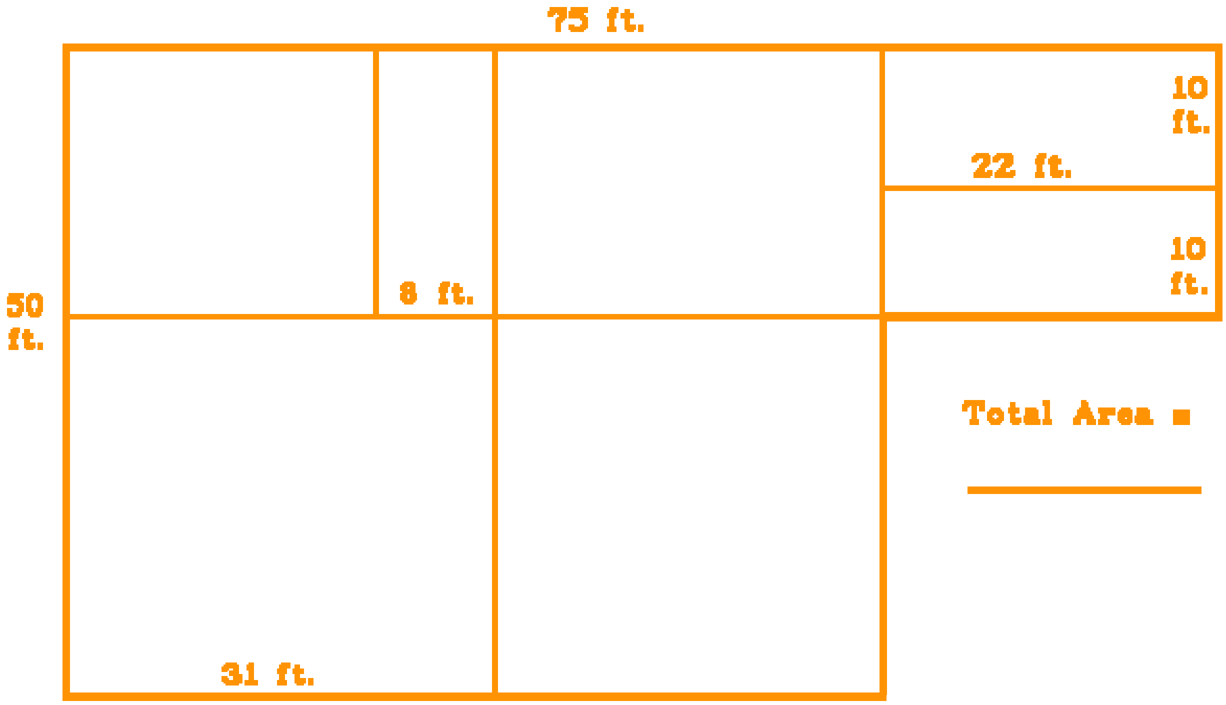


In addition to reducing the amount of window glass on the home, there are other window placement hints that can aid in saving home energy dollars:

• Place windows on the north or south sides of the home where they can be protected with trees or a roof overhang.
• Install windows with double-paned glass. This can double the efficiency of the glassed area.
• Use shading devices inside the home, such as curtains, shades, or blinds.

ACTIVITY D-2:

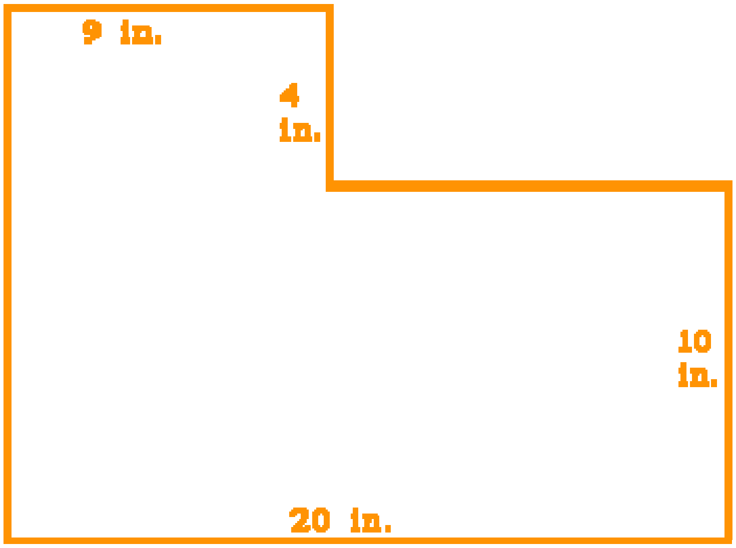
Calculate the area of each room in the home shown below. Add up your answers to calculate the total of the interior floor area of the home. **You do not need to take into account wall thickness.**



For energy efficiency, how many square feet of glassed area should be used on this home? (**Remember: Finding 10% is done by multiplying by .10!**)

Finding the area of objects that do not have one of the given formulas is a little bit more difficult. The best action to take is to divide the object into shapes that you **ARE** able to calculate the area and then add them together. See Example 2:

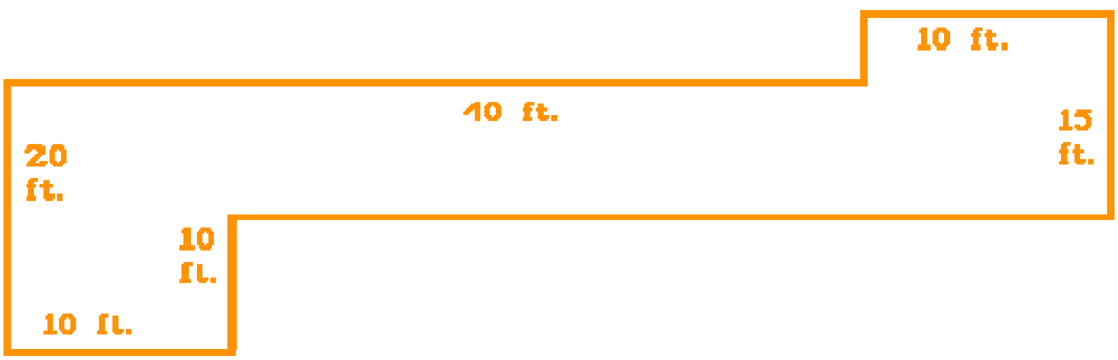
Example 2:



Total Area:
4 × 9 = 36 sq. in.
10 × 20 = 200 sq. in.
36 + 200 = 236 sq. in.
Is there another way you could have divided the object?

ACTIVITY R-1:

Determine the total floor area of the home shown below. Remember to divide into shapes with known area formulas.



Work Space:

Total Floor Area: __________

Calculate the total square footage of glassed area suggested for this home to be energy efficient.

Work Space:

Total Suggested Glassed Area: __________

ACTIVITY R-2:

Based on your answers to Activity R-1, complete the following questions.

1. If using all 3' × 3' windows:

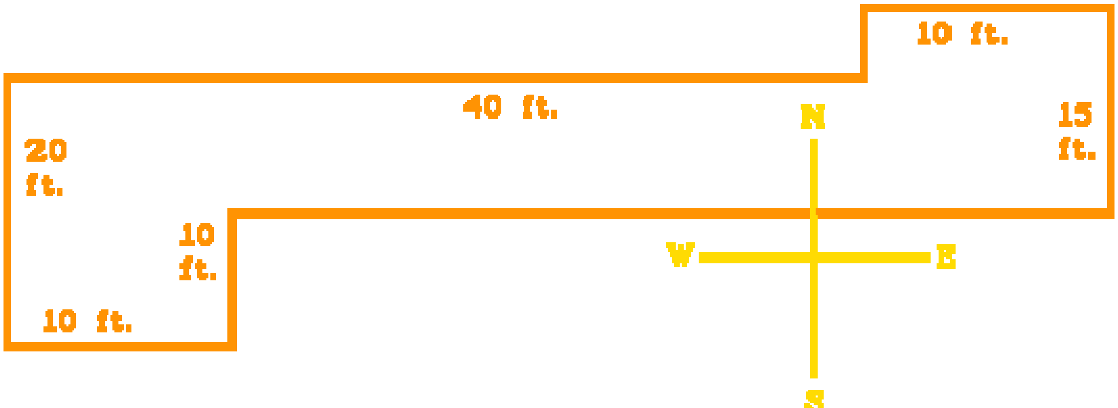
a. What is the total area of one window?

____

b. How many of these windows would you place on this house keeping energy efficiency in mind?

____

2. Where would you locate these windows? Draw them on the house below. Provide reasons why you placed the glass areas as you did.



Reasons:

RECOMMENDED READING:

Manual for Building Energy Efficient Homes in Louisiana. Louisiana Department of Natural Resources, Baton Rouge, LA, n.d.

Energy Conservation for Limited Income and Senior Citizens. SLEMCO, Lafayette, LA, n.d.

INFORMATION CHECK

1. Define area.

2. Give the area formula for the following shapes:

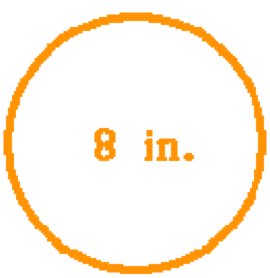
a. circle

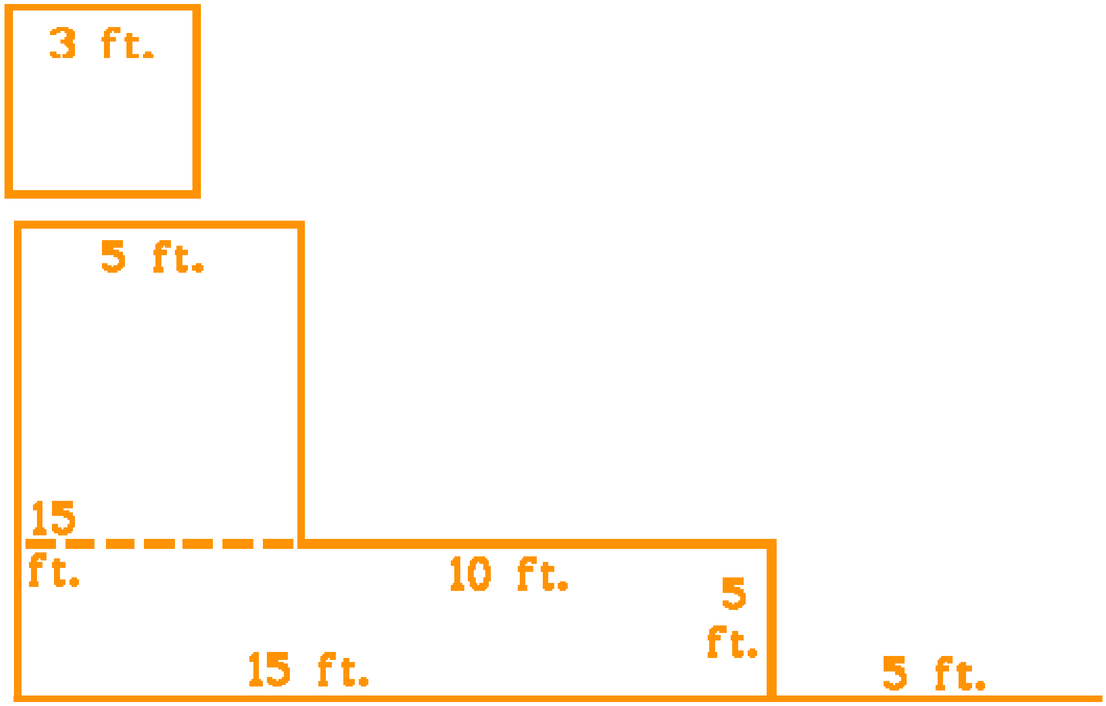
b. rectangle

c. square

d. triangle

3. Calculate the area of the following shapes. Show all of your work. Include the proper units.





4. Describe how to calculate the ideal amount of glassed area on an energy efficient home.

5. List three other suggestions to prevent heat losses and gains through window glass.

TEACHER'S NOTES

Activity D-1:

1. 16 sq. inches	3. 48 sq. inches
2. 4.5 sq. feet	4. 4.52 sq. feet

Activity D-2:

Master bedroom	460 sq. ft.
Bath	160 sq. ft.
Bedroom 2	440 sq. ft.
Utility	220 sq. ft.
Bath 2	220 sq. ft.
Living room	930 sq. ft.
Kitchen	660 sq. ft.

Total area: 3090 sq. ft.

Glassed area: 309 sq. ft.

Activity R-1:

Total Area:

10 ft. × 15 ft. = 150 sq. ft.

10 ft. × 40 ft. = 400 sq. ft.

10 ft. × 10 ft. = 100 sq. ft.

Total = 650 sq. ft.

Total glassed area = 650 × .1 = 65 sq. ft.

Activity R-2:

1a. 9 sq. ft.

b. 7 windows

2. Examine student's sketch. Reasons may include:

• Group windows on long walls of house.

• Best to put most windows facing south.

• Place windows where they can be most easily shaded.

Answers to Information Check:

1. Area refers to the amount of surface covered by a shape or object.

2a. Circle = πr^2

b. Rectangle = X × Y

c. Square = x^2

d. Triangle = 1/2(b × h)

3a. $\pi(4)^2$ = 50.24 sq. inches

b. 3^2 = 9 sq. ft.

c. 10 × 5 = 50 sq. ft.

15 × 5 = 75 sq. ft.

1/2(5) × 5 = 12.5 sq. ft.

Total = 137.5 sq. ft.

4. An energy efficient home has 10% of the total floor area in glassed area. Find the total area of the home and multiply by .1 to calculate total desirable glassed area.

5. Use shading devices outside the windows.

Use shading devices inside the home.

Use caulking around windows to prevent air infiltration.

STEM and Visual Arts Connections To Green Schools

Grades 5-8

LESSON TITLE: Design Your Space

Math Standard(s) Addressed: Understands how scale in maps and drawings show relative size and distance; selects and uses appropriate units and tools; understands characteristics of lines and angles.

Approximate Time Needed for Lesson: 30-45 minutes

Students will engage in:

- [x] independent activities
- [ ] cooperative learning
- [ ] peer tutoring
- [x] visuals
- [ ] pairing
- [x] hands-on activities
- [ ] centers
- [ ] lecture
- [ ] whole group instruction
- [ ] technology integration
- [x] creating a project
- [ ] guest speakers

Class Starter: Show students a blueprint on the overhead. Discuss the process of designing a blueprint or a floor plan of a room. Explain that students will be creating a floor plan of the classroom. Determine criteria for evaluation of floor plans once completed. Create a rubric for assessment of student floor plans.

Objectives: Students will create a realistic floor plan of the classroom.

Materials:

paper	blueprint sample (attached)
pencils	graph paper
ruler	compass

Step-By-Step Procedures:

- Have students draw the outside walls of a classroom on graph paper given a scale (for example, 1 square = 1 foot).
- Students must indicate location of doors, windows, tables, desks, bookshelves, sink, etc.
- Display student-made floor plans and provide feedback to students based on criteria for evaluation.

Guided/Independent Practice: Model creation of a bathroom floor plan on board by sketching walls, sink, toilet, bathtub, etc.

Assessment: Using the rubric created by teacher and students at the beginning of class, score the student-created floor plans of the classroom.

Differentiation Ideas:

- Allow students to work in teams.
- Allow students with limited abilities to make a very rough sketch of the floor plan of the classroom with NO SCALE if the concept of scale is above the ability of the individual.

Adaptations & Extension Ideas:

- Create a grade level floor plan of classrooms including bathrooms, faculty rooms and hallways (i.e., the sixth grade wing of classrooms).

Closure: Discuss the importance of meeting criteria determined to be critical and which floor plans met these requirements.

Connections to other Content Areas: Art (drafting)

Additional Resources: Download Google's Sketchup for free at http://www.sketchup.com
Students can view completed projects in Google's 3D warehouse at http://sketchup.google.com

The following information can be found on the internet at http://www.math-kitecture.com/what.htm.

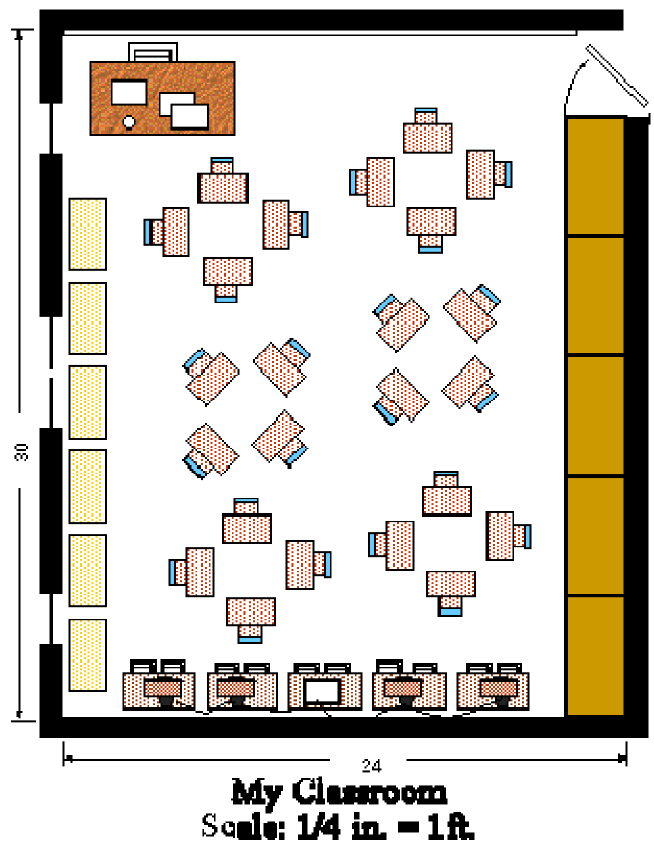
What is a Floor Plan?

A **floor plan** is a drawing that shows a room as seen from above. Everything in a floor plan appears flat. Architects use floor plans to show what a room or building will look like. Anyone who draws (or **drafts**) a floor plan is called a **draftsperson**.

Floor plans usually show the measurements (called **dimension lines**) for how long things are in real life. In the example to the right, the back wall is 24 feet long in real life and the side wall is 30 feet long. Other dimension lines may show the length of windows, the distances from walls to windows, and so on.

Floor plans may be drafted to **scale**, which means reducing the size of a drawing so the whole room can fit on a piece of paper. A common scale is 1/4 inch equals 1 foot. This means that if something is drawn 1/4 inch long in a floor plan, it is 1 foot long in real life. In the drawing to the right, the back wall is 6 inches long on paper, so it is 24 feet long in real life. If something is drawn the exact same size as it is in real life, it is called "full scale." A draftsperson always indicates the scale used in a floor plan.

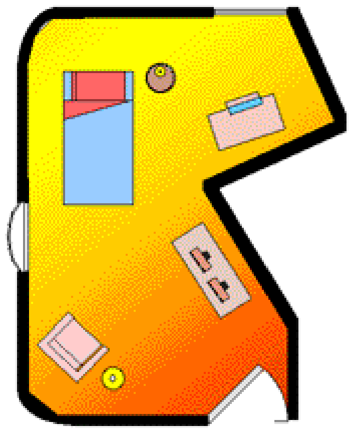
Floor plans may be drafted by hand with a **pencil** (to draw thick or thin lines), **ruler** (to draw straight lines to a specific length), a **protractor** (to draw the angles where walls meet), and **graph paper** (which usually has 1/4 inch boxes, to make floor plans easier to draft in 1/4"=1' scale). They can also be drafted by computer, using **CAD** (computer-aided design) software, such as **Sketchup**, **TurboCAD** or **ClarisWorks**. Download **Google's Sketchup** for free at http://www.sketchup.com
CAD software makes it very easy to draft scale drawings.



The above picture is a floor plan, drawn to scale using CAD software (AppleWorks), with dimensions shown.

The following activity can be found on the internet at
http://www.math-kitecture.com/bedroom.htm

Design a Fantastic Bedroom



In this activity, create a floor plan of the bedroom you wish you had! Include furniture, Jacuzzi, entertainment system, and more. Try to draft it to scale and add dimension lines.

Variations:

- **Include descriptions and prices of all furniture and special features in a text file.**
- **Add thumbnail images of your furniture/features using [Google Images (Use Strict Filtering)]**
- **Set a budget of $1000 (or $1 million) to buy stuff. Keep a spreadsheet budget.**
- **Design the room with no right angles to any of the walls.**
- **Create a classified newspaper ad to rent the room.**
- **Include the amount of carpet/paint/tiles to use.**

The following lesson plan can be found at http://www.math-kitecture.com/lessonplans/floorplanLESSON.doc

Ricardi Bien-Aime **Math-kitecture**

Promoting Architecture in Mathematics

Unit: Drawing a Floor Plan

How can we use the drawing of a floor to calculate its perimeter and area?

Prerequisite: Students should already know how to find perimeter and area of the basic geometric shapes (such as square, rectangle, triangle, parallelogram, and trapezoid).

Performance Standards

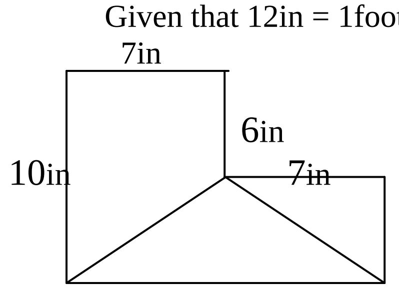
- Geometry and measurement concepts
- Communicate using mathematical terms.
- Extend and create geometric patterns using concrete and pictorial models.
- Relate to real world application.
- Carry out proportional reasoning
- Make and use rough sketches, precise scale diagrams.

Performance Objectives: Students will be able to

1. Identify different geometric shapes;
2. Use measurements, estimation, and unit of conversion;
3. Understand the concepts use by architects such as dimension and scaling;
4. Solve area and perimeter of irregular polygon;
5. Explain how the lesson can be applied to real world.

Material: Room, measuring device, graph or construction papers, pencils, and calculators, floor plan model.

Do Now: Find the perimeter and area of the figure below using a ruler and a calculator.
Given that 12in = 1foot, convert the perimeter and area found into feet.



Motivation:
How can drawing our classroom floor plan help us in finding its perimeter?

Development:

Use a floor plan model found in Charles Bender's Math-kitecture web site. Have students work in group to analyze and write a few sentences about what they see in the chosen floor plan model (hint: shapes, words, numbers, and their meanings). The students should then discuss and debate their conjectures about the model. The teacher should then elaborate on their conjectures and elicit the need for measuring, labeling, and scaling. The teacher should also emphasize the importance of creating a floor plan as a framework for the next lesson.

Instructions:

Draw the floor plan of the classroom. The drawing should include your name, the date, the dimensions, the labels, and the scale use. Find the perimeter and the area of the floor drawn.

- Students should work in pairs to measure the room using a measuring device.
- Instruct them that they should each draw their own floor plan.
- Remind them to label all parts of their drawing with a universal name.
- Have all students draw a quick bird-view sketch of the classroom as a blueprint for their work.
- Let them decide on whether they should measure the walls, the windows, and any other details included in their drawing.
- Instruct them to use the scale 1/4 inch is equal to one foot. Tell them to round their measurement to the nearest whole number.
- They should then use a strategy to calculate the perimeter and the area of their floor plan.

Conclusion:

What are the different shapes found in the drawing?
What was the most difficult part of the task?
Explain the steps used in finding the perimeter and the area?

Homework:

Student should reproduce the same drawing on graph paper. This drawing should include the desks, the chairs, and any other appliances all drawn to scale.

STEM and Visual Arts Connections To Green Schools

Grades 5-8

LESSON TITLE: Best Design of a Floor Plan

Math Standard(s) Addressed: Knows basic geometric language for describing and naming shapes; understands how scale in maps and drawings shows relative size and distance; reads and interprets data in charts, tables, plots, and graphs.

Approximate Time Needed for Lesson: 30-45 minutes

Students will engage in:

[x] independent activities	[ ] pairing	[x] whole group instruction
[ ] cooperative learning	[ ] hands-on activities	[ ] technology integration
[ ] peer tutoring	[ ] centers	[ ] creating a project
[x] visuals	[ ] lecture	[ ] guest speakers

Class Starter: Displaying sketches from the "Design Your Space" lesson, initiate discussion on the correlation of each design to the opinions given in class, determining the ***best design*** based on the stated criteria.

Objectives: To be able to determine the *"best design"* based on the criteria outlined in the survey results.

Materials:
school survey results; Sketchup or other CAD program results
sketches of school building designs as completed with mentor
classroom sketches from "Design Your Space" lesson
class results from "Design Your Space" lesson

Step-By-Step Procedures:

- Readdress samples of school buildings as completed previously under the guise of the architectural mentor.
- Discuss the pros and cons of each sketch and the correlation to the survey results.
- Select the best attributes from each design and form consensus on major design elements.

Guided/Independent Practice: Model and organize data (pros/cons) on board during discussions.

Assessment:
Class participation in all discussions

Differentiation Ideas:

- Provide opportunities for students to write pros and cons down instead of speaking them.
- Provide class time to do a written interpretation for input.

Adaptations & Extension Ideas:

- Create a new school building using the best design elements reached by consensus in class.

Closure: Students write a statement and share verbally their favorite design element of the newly developed floor plan of the school.

Connections to other Content Areas:

Additional Resources: Download Google's Sketchup for free at http://www.sketchup.com

The following lesson plan can be found on the internet at
http://www.planning.org/resourceszine/display_article.asp?article=66

Lesson Plan: Great Place/Lousy Place

Audience: Adaptable for students in grades 1st through 12th.

Purpose:

The purpose of this activity is to increase students' awareness of the design of the places they use everyday. They will gain insight into their reactions to their environment and the emotional and physical (design) criteria they use to evaluate places.

This activity enables teachers and students to participate in the **City Gallery** **www.planning.org** section of the APA Web site. This section is dedicated to posting student artwork and ideas about their communities. Specific technical requirements for submission, including information on permission slips, are found in number 5, below.

Introduction:

Becoming aware of the places we use everyday, their design, and our reactions to them is the first step in the process of becoming active citizens who can intelligently contribute to shaping the future of our communities. While some places we visit provoke an immediate and strong reaction, more often than not we become so used to the places in which we live, work, and play that they become almost invisible. We learn to tune out our environment, which can result in our not reacting to negative changes until it is too late.

Every place has been designed by someone for a specific purpose, and some places accomplish their goals better than others do. It is important for students to learn how to articulate their feelings about places and understand that there are criteria they use, consciously and unconsciously, to evaluate these places. Some of the criteria is based on feelings and can be the result of positive and negative emotional experiences (e.g. "the place where I had my most embarrassing moment"). Other criteria are more objective: the physical, design elements. Designers use a tool kit of things like color, lighting, scale, materials, and shape to evoke emotional responses. They also consider things like how people will use the space in determining its design. This determines things like whether you are able to easily move about or whether you can see when you need to read. All these factors intertwine to make evaluating a place a bit tricky, but definitely worth doing.

Once students learn to pay attention and articulate their reactions to places in their community they can begin to offer ideas for improving them and effectively work with planners to achieve them.

This activity meets the following two Performance Standards for the National Council for the Social Studies Curriculum Standards in Theme III: People, Places and Environments:

- Describe how people create places that reflect ideas, personality, culture, and wants and needs as they design homes, playgrounds, classrooms, and the like;
- Examine the interaction of human beings and their physical environment, the use of land, building of cities, and ecosystem changes in selected locales and regions.

Objectives:

Students will:

1. identify and articulate the emotional and physical/design criteria they use to evaluate places;
2. identify a place they like and in around their neighborhood;
3. sketch or photograph a place they dislike in or around their neighborhood;
4. write a short caption describing their feelings about the place and why it works well or doesn't work well;
5. and, interview others to compare perspectives.

Materials:

- Select materials appropriate for students to draw or photograph. Paper should be no larger than an 8.5 x 11 sheet.
- Pens, colored pencils, or crayons.

Procedure:

1. Have the class generate a list of their favorite places. These can be anywhere in the world—a vacation cabin, Disneyland/amusement park, a restaurant, etc. Record them on the board. As students call out a place ask them to give one or two reasons why they like it. One way to do this is to have them use key words or adjectives to describe the place (e.g. fun, peaceful, lots of action). Ask them if they think their parent and sibling or friend would agree with their assessment.
2. Have students look for patterns in the places they listed: Were similar types of places chosen? Why? Do they like the place because of an experience they had that affected their feelings toward it (e.g. special occasion, fun things to do, good things to eat)? What physical/design characteristics were listed (e.g. the building had a really neat looking entrance, there was a wonderful fountain)?
3. Initiate a discussion about factors that contribute to making a "great place."As students discuss, incorporate the idea that developing generic criteria can be challenging because each place is designed to accomplish a specific task. Places with similar functions can have different degrees of success in achieving their goal. Discuss how the physical/design criteria can affect our feelings about places (e.g. the sound of the fountain in the park makes me feel calm; I loved the amusement park because everything was so easy to find). Discuss why other people may feel differently about the place.
4. Then, focus on places that students dislike. Repeat the first two steps. The places some students dislike might turn out to places that are other students' favorites.

5. Repeat the discussion in number three using a "lousy place." An example of how design can affect feelings is: "The library was so badly lit that I couldn't read; I walked into a glass door."
6. Give each student the assignment to identify two places in their neighborhood: one that is great and one that is lousy. Ask them to draw a picture (by hand or computer) or take a photograph of the place and write a short caption of about 40 words each describing his/her reasoning. Encourage them to include feelings/emotions and physical/design issues. Have them note where the place is and its purpose (e.g. movie theater, park, and supermarket).
7. Click here for information and requirements for submitting student work to the American Planning Association for posting on the Kids and Community Web page. Students will need to send permission slips, which are described on the site. **[http://www.planning.org]**
8. Have students look for patterns in their choices. Did several students pick the same places? Was their reasoning similar? How much of their reasoning was based on feelings or design factors?
9. Have students generate suggestions for improving both the great places and lousy places.

Extensions:

1. Have students interview their parents and siblings or friends to see how they feel about the places the students chose. Discuss why other people may feel differently than they do.
2. Take a walk with students to several places in or around the school and ask them to evaluate them.
3. Ask students to list places in the school that are good for the following....
   - Hiding
   - Relaxing
   - Running
   - Feeling important

Evaluation:

Compare the reasons and criteria students generated in the initial discussion with those described after doing the assignment. Note any changes in their ability to articulate their descriptions of what makes a place work well or poorly and the factors that are emotional and design based.

The following lesson plan can be found at http://www.michigan.gov/hal/0,1607,7-160-17451_18670_18793-53468--,00.html

www.michigan.gov Release Date: January 01, 2001
Last Update: March 24, 2004

Bungalow Floor Plans - Lesson Plan

Background Notes

People live in all different kinds of homes: houses, apartments, condominiums. They live in the city, the country and in the suburbs.

The bungalow is a one-story or one-and-a-half story design with a broad, low-gabled room with wide overhanging eaves typical of the Great Depression era.

Doing a floor plan of one's home is a way to practice math skills and drawing. Sharing these drawings in class will provide an opportunity for students get to know each others' lives and homes better.

Students can also practice measuring and drawing to scale by creating floor plans of their classroom or drawing their "dream house" floor plan.

Objectives

1. Students will measure and draw to scale.
2. Students will use math skills including finding perimeters and areas.
3. Students will think about their homes in ways that they might not have thought of before.
4. By sharing their floor plans in class, students will appreciate a variety of living styles.
5. Students will compare and contrast the different floor plans with a 1930s bungalow.

Materials Needed

Measuring tape, ruler, pencil, paints, markers or crayons; paper, the two sample floor plans and pictures [PDF] of bungalow-style houses. They include the shape and measurements of each room.

Directions

- Ask students to take a measuring tape and measure each room in their home.
- Have them take a piece of paper and draw a floor plan of their home with each room in it.
- To make the drawing to scale, they need to use 1/4 inch to represent 1 foot (1 inch will represent 4 feet). If large paper is available and you want to simplify the exercise, use 1 inch to one foot.
- Students will need to include the measurements of each room and figure out the square feet for each room. Have them figure out the total square footage of the house by adding the square footage of all the rooms together.
- Have students draw a picture of the outside of their homes.
- Ask students to find out what kind of materials were used to build their home—the inside and the outside.

Vocabulary

- **Bungalow:** A home of one-story or one-and-a-half story design with a broad, low-gabled roof with wide overhanging eaves; a front porch often extending the full width of the house; an open floor plan with relatively few room barriers; and made airy and bright through the use of interior lighting.

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