

Geometry - Geometric Modeling Applications - Lesson

Common Core G-MG.A.1, G-MG.A.2, G-MG.A.3 · maths-pdf.fr/en/

Geometric modeling describes real objects with shapes such as cylinders, spheres, prisms and polygons so you can compute area, volume and cost. Density is a rate such as people per square mile or grams per cubic centimeter. In design problems you write a constraint, compare designs and choose the best one that meets the requirement.

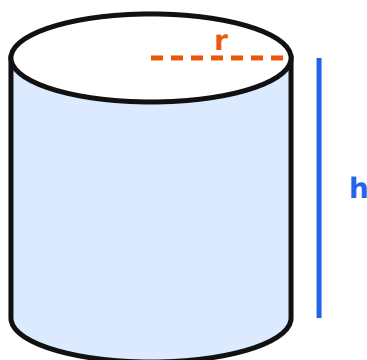
Geometry · Common Core State Standards: **G-MG.A.1, G-MG.A.2, G-MG.A.3**

Key facts

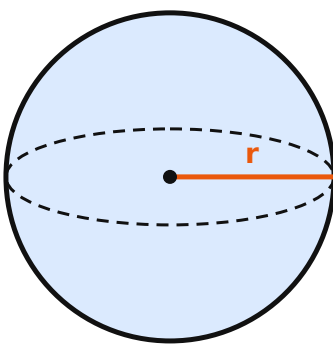
- A model represents a real object with a simple shape, for example a can as a cylinder.
- Density = amount / area or volume (people per square mile, grams per cubic centimeter).
- Mass = density x volume.
- Design problems have constraints such as fixed fencing, minimum volume or a cost limit.
- State answers with units and check they are reasonable.

What does it mean to model an object with geometry?

A **geometric model** describes a real object with a simple shape. A can is a cylinder, a basketball is a sphere, a tree trunk is a cylinder, a room is a rectangular prism and a honeycomb cell is a hexagon. The model is not perfect, but it lets you calculate area, volume and cost.



A soup can is modeled by a cylinder.



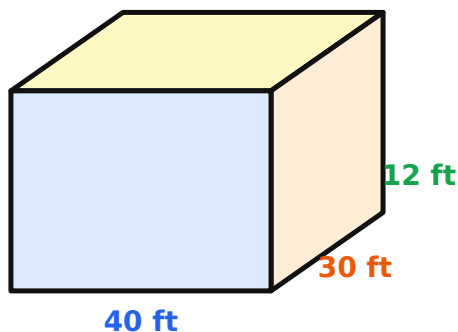
A ball is modeled by a sphere.

How do you use density?

Density is a rate that compares an amount to an area or a volume. Population density is people per square mile, and the density of a material is mass per volume.

$$\text{density} = \frac{\text{amount}}{\text{area or volume}}$$

For example, a town with 31,250 people on 12.5 square miles has a density of $\frac{31,250}{12.5} = 2,500$ people per square mile. A block of aluminum with mass 1,080 g and volume 400 cubic centimeters has density $\frac{1,080}{400} = 2.7$ g per cubic centimeter.

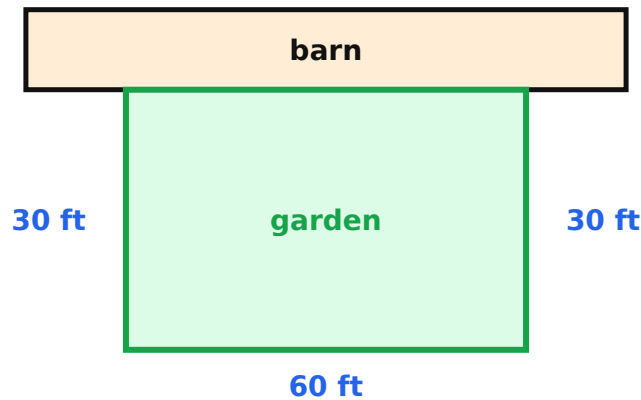


A room modeled by a rectangular prism.

How do you solve a design problem with constraints?

A design problem asks you to meet a requirement, such as a fixed amount of fencing, a minimum volume or a cost limit. Write the constraint as an equation, compare the possible

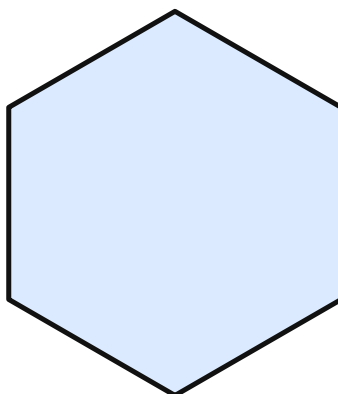
designs, and choose the best one.



Fence on three sides of a rectangular garden next to a barn.

1. Identify the shapes and the quantities you know.
2. Write the constraint as an equation (for example, $2w + l = 120$).
3. Calculate the area, volume or cost for each design.
4. Choose the design that satisfies the constraint and gives the best result, and state it with units.

Quantity	Formula
Area of a regular hexagon	$\frac{3\sqrt{3}}{2}s^2$
Lateral area of a cylinder	$2\pi rh$
Surface area of a sphere	$4\pi r^2$
Cost	$\text{rate} \times \text{quantity}$



A honeycomb cell is modeled by a regular hexagon.

Example: Sofia has 120 feet of fence for three sides of a garden beside a barn. With width 30 feet, the length is $120 - 2 \cdot 30 = 60$ feet and the area is $30 \cdot 60 = 1,800$ square feet. Widths 25 and 35

feet give 1,750 square feet each, so 30 feet is the best of the three.

Questions about geometric modeling applications

What is a geometric model?

A geometric model uses a simple shape to represent a real object. A tennis ball can be modeled as a sphere and a soup can as a cylinder.

How do you calculate density?

Divide the amount by the area or volume. A town with 31,250 people on 12.5 square miles has 2,500 people per square mile.

How do you find mass from density?

Multiply density by volume. A lead cylinder of volume 125.7 cubic centimeters with density 11.34 g per cubic centimeter has a mass of about 1,425 g.

What is a design constraint?

A constraint is a requirement, such as 120 feet of fence or a volume of at least 1,000 cubic feet. You choose dimensions that satisfy it.

Why do you state units in modeling problems?

Units tell what the number measures, so you can check that an answer makes sense, such as square feet for area and cubic feet for volume.