

Space and Scale

Model density with area and volume.

HIGH SCHOOL • HSG-MG.A.2

CCSS.Math.Content.HSG-MG.A.2 "Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot). *"

NAME _____

DATE _____

DENSITY IN A SPACE

Density compares an amount to the area or volume that holds it. Divide the amount by the area or volume to find density. Multiply density by area or volume to find a total amount, or divide the total amount by density to find needed space.

WORKED EXAMPLE

A community garden has 1,080 tomato plants in 36 square yards. What is the plant density?

1. Density = number of plants / area.
2. $1,080 / 36 = 30$.
3. The garden has 30 plants per square yard.

Answer: 30 plants per square yard

PRACTICE 6 problems

- 1** A library display has 840 books spread across 35 square feet. What is the book density?

ANSWER _____

- 2** An aquarium has 9 fish in a volume of 18 cubic feet. What is the fish density?

ANSWER _____

- 3** A storage unit holds 540 boxes in 45 cubic feet. What is the box density?

ANSWER _____

- 4** A wildlife area has a density of 27 deer per square mile across 16 square miles. Estimate the number of deer.

ANSWER _____

- 5** A shipping crate is packed at a density of $5/8$ package per cubic foot. How many packages fit in 64 cubic feet?

ANSWER _____

- 6** A vertical garden has 1,152 plants at a density of 72 plants per square meter. What area does the garden cover?

ANSWER _____

APPLY IT Show your work

- 1** At a school gaming tournament, 1,176 spectators will use a rectangular viewing area that is 70 feet by 28 feet. The school rule allows no more than $\frac{1}{2}$ spectator per square foot. What is the spectator density, and is it within the rule?

WORK SPACE

ANSWER _____

- 2** A student film club reserves a backstage room that is 12 feet by 15 feet by 10 feet. A ventilation guideline allows 1 person for each 75 cubic feet. Based on volume only, how many people can the room hold?

WORK SPACE

ANSWER _____

CHALLENGE One step up

CHALLENGE

A neighborhood covers $\frac{5}{2}$ square miles and has 4,500 residents. A new housing project adds 1,500 residents, but the neighborhood area stays the same. Find the current population density, the new population density, and the increase in density.

PART 1 • PRACTICE

#	PROBLEM	ANSWER
1	A library display has 840 books spread across 35 square feet. What is the book density?	24 books per square foot
2	An aquarium has 9 fish in a volume of 18 cubic feet. What is the fish density?	1/2 fish per cubic foot
3	A storage unit holds 540 boxes in 45 cubic feet. What is the box density?	12 boxes per cubic foot
4	A wildlife area has a density of 27 deer per square mile across 16 square miles. Estimate the number of deer.	432 deer
5	A shipping crate is packed at a density of $\frac{5}{8}$ package per cubic foot. How many packages fit in 64 cubic feet?	40 packages
6	A vertical garden has 1,152 plants at a density of 72 plants per square meter. What area does the garden cover?	16 square meters

PART 2 • APPLY IT

- $\frac{3}{5}$ spectator per square foot; no, it exceeds the rule.** The viewing area is $70 \times 28 = 1,960$ square feet. Divide 1,176 by 1,960 to get $\frac{3}{5}$, and $\frac{3}{5}$ is greater than $\frac{1}{2}$.
- 24 people** The room volume is $12 \times 15 \times 10 = 1,800$ cubic feet. Divide 1,800 by 75 to get 24 people.

CHALLENGE

Current density: 1,800 residents per square mile; new density: 2,400 residents per square mile; increase: 600 residents per square mile

Accept equivalent fraction, decimal, and unit forms where appropriate. For the tournament problem, students must compare $\frac{3}{5}$ to $\frac{1}{2}$ and conclude that the density exceeds the limit.