

Scale Changes Systems

Track how size changes affect capacity, area, and performance.

GRADE 7 • TEKS 7.5.C

7.5.C "analyze how differences in scale, proportion, or quantity affect a system's structure or performance;"

NAME _____

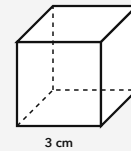
DATE _____

SIZE CHANGES MATTER

When every length in a similar system changes by a scale factor of k , surface area changes by k^2 and volume, or capacity, changes by k^3 . A larger system can hold much more, but it has less surface area compared with its volume, which can affect cooling or exchange.

WORKED EXAMPLE

A cube-shaped juice tank has a side length of 3 cm. A similar tank has a side length of 9 cm. How many times as much juice can the larger tank hold?



1. Find the linear scale factor: $9 / 3 = 3$.
2. Cube the scale factor for capacity: $3 \times 3 \times 3 = 27$.
3. The larger tank holds 27 times the original capacity.

Answer: 27 times as much

PRACTICE 4 problems

- 1** A cube-shaped seed tray has side length 5 cm. A similar tray has side length 10 cm. How many times as much soil can the larger tray hold?

ANSWER _____

- 2** A square solar cell changes from 6 cm per side to 12 cm per side. Its electrical output is proportional to its area. How many times greater is its output?

ANSWER _____

- 3** A small fish tank holds 7 L. A similar tank is made with every dimension 4 times as long. What is the new capacity?

ANSWER _____

- 4** A cube-shaped device has side length 8 cm and releases 15 heat units per minute. A similar device has side length 16 cm. If heat release is proportional to surface area, what is the new heat-release rate?

ANSWER _____

APPLY IT Show your work

- 1** You build a model aquarium at a 1:5 scale, model to real. The model holds 6 L of water. If the real aquarium is similar, how much water can it hold?

WORK SPACE

ANSWER _____

- 2** A gaming laptop uses a square cooling plate with a side length of 10 mm. It removes 32 W of heat. A replacement plate has a side length of 15 mm, and heat removal is proportional to plate area. How much heat can the replacement remove?

WORK SPACE

ANSWER _____

CHALLENGE One step up

Two cube-shaped battery packs are made of the same material. One has side length 12 cm, and the other has side length 24 cm. Write exactly two sentences. In sentence one, give each pack's surface-area-to-volume ratio. In sentence two, explain which pack can release heat more effectively for its size.

WORK SPACE AND ANSWER

PART 1 • PRACTICE

#	PROBLEM	ANSWER
1	A cube-shaped seed tray has side length 5 cm. A similar tray has side length 10 cm. How many times as much soil can the larger tray hold?	8 times as much soil
2	A square solar cell changes from 6 cm per side to 12 cm per side. Its electrical output is proportional to its area. How many times greater is its output?	4 times greater
3	A small fish tank holds 7 L. A similar tank is made with every dimension 4 times as long. What is the new capacity?	448 L
4	A cube-shaped device has side length 8 cm and releases 15 heat units per minute. A similar device has side length 16 cm. If heat release is proportional to surface area, what is the new heat-release rate?	60 heat units per minute

PART 2 • APPLY IT

- 750 L** The real aquarium has a linear scale factor of 5, so its volume scale factor is $5 \times 5 \times 5 = 125$. Multiply 6 L by 125.
- 72 W** The area scale factor is $(15 / 10) \times (15 / 10) = 9/4$. Multiply 32 W by $9/4$.

CHALLENGE

The 12-cm pack has a surface-area-to-volume ratio of $1/2$, and the 24-cm pack has a ratio of $1/4$. The 12-cm pack can release heat more effectively for its size because it has more surface area for each unit of volume.

Accept equivalent wording for multiplicative comparisons and correct units. For the challenge, accept equivalent ratios, such as 6:12 and 6:24, with a correct explanation about surface area per volume.