

# Scaling the Skyline

## Similar 3-D Figures

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Published by *K20 Center*

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| **Subject** | Mathematics | **Time Frame** | 95 minutes |
| **Course** | Geometry | **Duration** | 2-3 class periods |

## Essential Question

How can we compare and measure similar 3D figures?

## Summary

In this lesson, students investigate the relationships between the measurements of similar 3-dimensional figures and develop rules explaining the effects of scale factors on the areas and volumes of similar figures. Students then watch a career-focused video of a civil engineer who uses math to estimate the size and cost of projects. Students take on the role of a civil engineer and submit a proposal to a potential client outlining costs and comparing possible designs.

## Snapshot

**Engage**

Students play a game of Would You Rather to discuss pizza surface area.

**Explore**

Students investigate the differences in the volume and surface area of similar shapes on GeoGebra.

**Explain**

Students compare their findings from the previous activity, formalize rules governing similar figures, and practice applying those rules.

**Extend**

Students watch a video about shapes and civil engineering, and then work in groups to create a building modeled after the Louvre.

**Evaluate**

Students use their knowledge about similar figures to answer an ACT practice question.

## Standards

*ACT College and Career Readiness Standards - Mathematics (6-12)*

**G601:** Use relationships involving area, perimeter, and volume of geometric figures to compute another measure (e.g., surface area for a cube of a given volume and simple geometric probability)

*Oklahoma Academic Standards Mathematics (Geometry)*

**G.3D.1.2:** Use ratios derived from similar three-dimensional figures to make conjectures, generalize, and to solve for unknown values such as angles, side lengths, perimeter, and circumference of a face, area of a face, and volume.

## Attachments

- Building Proposal—Scaling the Skyline.docx
- Building Proposal—Scaling the Skyline.pdf
- Exit Ticket—Scaling the Skyline.docx
- Exit Ticket—Scaling the Skyline.pdf
- Explore Notes—Scaling the Skyline.docx
- Explore Notes—Scaling the Skyline.pdf
- Guided Notes—Scaling the Skyline.docx
- Guided Notes—Scaling the Skyline.pdf
- Lesson Slides—Scaling the Skyline.pptx

## Materials

- Lesson Slides (attached)
- Explore Notes (attached; one per student)
- Guided Notes (attached; one per student)
- Building Proposal (attached; one per student)
- Exit Ticket (attached; one half-sheet per student)

10 minutes

# Engage

Use the attached **Lesson Slides** to guide students through the lesson. Display **slide 2** and introduce students to the lesson. Use **slides 3–4** to go over the essential question and lesson objectives. Move to **slide 5** and explain to students the game Would You Rather. Use **slides 6–8** to engage students in choosing and discussing their rationale. On **slide 9**, take time to have students discuss which pizza they would rather have and give their reasons why.

### Teacher's Note

When considering which pizza(s) to buy, the area is the most important factor. Students may assume that they would get twice the amount of pizza from one that is 10 inches versus a 5-inch pizza. However, based on the area, the 10-inch pizza is actually 4 times larger.

30 minutes

# Explore

Move to **slide 10** and remind students what it means for two shapes to be similar versus congruent. Note that congruent means that two figures have the same size and shape, while similar figures have the same shape but are different (proportional) sizes.

Have students pair up or assign partners to students. Pass out a copy of the **Explore Notes** to each student. Transition to **slide 11** and ask students to navigate to the GeoGebra activity, Investigating Similar Figures, using the URL on the slide. Display the formulas for volume and surface area on **slide 12** to assist students as they work through the activity.

### Teacher's Note: Scaffolded Instruction

Consider measuring and calculating the cylinder A together so students have guidance in finding and using the measure tool, as well as a reminder of how to use the formulas.

Walk about the room and assist students where needed, and remind them to fill in the information on their notes. When students are finished calculating the volume and surface area for the figures, instruct them to answer the reflection questions on the back of their notes with their partner. Ask students to share their responses to the questions with another pair.

Use **slides 13–14** to facilitate a discussion with the whole class about what they found during the activity.

15 minutes

# Explain

Pass out a copy of the **Guided Notes** handout to each student. Use **slides 15 & 16** to explain to students the rule of increasing volume with similar figures. Discuss with students when you multiply the length of a figure by *r,* then it multiplies the area by $r^2$ and the volume by $r^3$. Move to **slides 17–20** to provide students with sample problems.

**Teacher's Note: Additional practice**

These examples may or may not be enough practice for your students. If more practice is needed, add more examples to the slides.

25 minutes

# Extend

Transition to **slide 21** and play the video interview with the civil engineer. Facilitate a discussion with students about how similar shapes are used in engineering.

**Embedded video**
https://youtube.com/watch?v=qrQ2Mrg6Vg0

**Teacher's Note: Video Times**

The video “Civil Engineer and Rectangular Prisms” has a longer discussion about different architecture that civil engineers encounter. This lesson is written with the intention of stopping the video at the 4:45 mark. However, you should review the full video prior to facilitating the lesson. Depending on your specific class needs, you may want to include the entire video.

Move to **slide 22** and explain to students that they will imagine they are an engineer. They have been given the task of designing a new building based on the Louvre in Paris. Explain that they will need to determine the cost and energy efficiency of the building at different sizes and propose one size and cost to their client.

5 minutes

# Evaluate

Transition to **slide 23** and introduce students to the Exit Ticket instructional strategy. Pass out a copy of the **Exit Ticket** to each student. Instruct students to read the practice question on their paper. Remind students to show their work in the blank space provided. If there is time at the end of the lesson, go over the correct answer with the class.

## Resources


- K20 Center. (n.d.). Bell ringers and exit tickets. Strategies. https://learn.k20center.ou.edu/strategy/125
- K20 Center. (n.d.). GeoGebra. Tech Tools. https://learn.k20center.ou.edu/tech-tool/2352
- K20 Center. (2024). *Civil Engineer and Rectangular Prisms* [Video file]. https://www.youtube.com/watch?v=qrQ2Mrg6Vg0