

## ***Mathematics: The Language of STEM***

### Authentic Outdoor Measurements – Using Proportions with Similar Shapes to Solve

#### **CONTENT AND TASK DECISIONS**

**Grade Level(s):** 7<sup>th</sup> Grade, Math 7 class

#### **Description of the Task:**

This lesson will help students reason through real world problems using similar shapes to find measurements. They will read different strategies to measure objects that are taller than their measuring tool. Then they will try these strategies themselves. (This lesson works nicely as a “hands-on sequel” to the Tree Cutting Business Task Lesson, covering the same standards.)

#### **Indiana Mathematics Content Standards:**

**7.GM.2:** Identify and describe similarity relationships of polygons including the angle-angle criterion for similar triangles, and solve problems involving similarity.

**7.C.6:** Use proportional relationships to solve ratio and percent problems with multiple operations.

**7.C.8:** Solve real-world problems with rational numbers by using one or two operations.

#### **Indiana Mathematics Process Standards:**

**PS.1:** Making sense of problems and persevere in solving them.

**PS.2:** Reasoning abstractly and quantitatively.

**PS.3:** Construct viable arguments and critique the reasoning of others.

**PS.6:** Attend to precision.

#### **Mathematics Content Goals:**

**Objective 1:** 7<sup>th</sup> grade math 7 students will understand how to build the connection of using proportions to solve invisible similar figures using real world problems.

**Objective 2:** 7<sup>th</sup> grade math 7 students will understand that sketching and labeling a good mathematical drawing helps clarify their understanding of a situation and can help reveal steps to solving a problem.

#### **Language Objectives:**

- Students will use their reading skills to carefully decipher between the two methods of using similar figures and proportions represented in the story problems to solve each situation.
- Students will use content words (such as proportional and similar) and expressions to verbally describe and write how they should solve this problem with partners.

#### **Materials:**

- Authentic Outdoor Measurements Handout
- Yardsticks
- Rulers
- Calculators
- Colored pencils

#### **THE LESSON**

**Before:** This phase of the lesson should be designed to get students ready for problem solving. It also provides an opportunity for you to find out what they already know about the topic. Describe how you will accomplish each of the following in this phase of the lesson:

- **Activate prior knowledge** (including the specific questions you will ask to raise students’

curiosity and activate or determine their prior knowledge),

- Talk about what we learned in the Tree Cutting Business Task
- Draw from them methods for solving the problems yesterday (eventually land on that we used proportions to help us solve question 2).
- Review how to set up proportions
- **Be sure the problem is understood**
  - Look at the task and read through the first situation.
  - Point out we are NOT SOLVING the problems in green.
  - Discuss the sun/shadows relationship
  - Have students discuss drawing a good math visual and what it involves (drawings that matter with accurate labeling)
- **Establish clear expectations**
  - Allow students to work with a partner, but both must be writing their answers and sketching their own drawings.
  - Students will spend time drawing in the classroom just the two green situations, understanding the strategies given. This gives the teacher a smaller area to cover to be sure everyone can find the hidden figures and help with understanding the given strategies.
  - Before going outside, be sure students understand they need to choose an object to measure that is taller than any of their measuring tools. Then use the strategies given to solve.
  - Then students will go outside to try measuring their chosen, tall objects, using these strategies given.

**During:** This phase of the lesson should be designed for students to explore the focus task. Describe specifically what the students will be doing in this phase. Include a description of how the students will record their mathematical thinking in writing or drawing throughout the investigation. Describe how you will accomplish each of the following in this phase of the lesson:

- **Let go**
  - Students should be working with a partner to figure out how to draw the given situations. They will then go outside to use proportions to determine the measurements of their chosen, tall objects.
- **Listen actively**
  - Listen for questions about how to draw the situations, how similar figures are even represented in these situations, setting up proportions...
- **Provide appropriate support** (including the specific questions you will ask to focus students' thinking on the critical features of the task or to help students who are stuck), and
  - Look for helpful mathematical sketches of the situation. – What would be included in the sketch that would help us mathematically? What
  - Ask, “Where are the similar figures we were talking about? Are they represented in your drawing?”
  - How does your labeling help you set up the proportion?
- **Provide worthwhile extensions.**
  - Are there any other methods to solving for the height of a building?
  - What if we were to find the blueprints for this building? If the scale of the side of the science classrooms were 1:24 (both in inches), what would the length of the drawn line of the height of the building be?

**After:** In this portion of the lesson, students should work as a community of learners, discussing,

justifying, and challenging various solutions to the problem all have just worked on. Here is where much of the learning will occur. It is critical to plan sufficient time for a discussion and make sure the “During” portion does not go on for too long. Describe how you will accomplish each of the following:

- **Promote a mathematical community of learners** (Describe how the students will present their solution strategies. How will you organize the discussion to accomplish the mathematical goals? Which solutions will be shared and in what order?)
  - About 20 minutes before the end of the day, students will return to the classroom to mark their work with colors showing the different similar figures and the calculations that coordinate with the figures.
  - Then partners will compare their work to others in the classroom. Pick another group to see if your answers seem reasonable
- **Listen actively without evaluation** (How will you respond to students’ presentations of their solutions?)
  - Ask classmates. What do you think? Does this method work?
  - If it does not quite work, what do you think could be changed to make this method work?
- **Make connections** (What questions will you ask to help students make sense of the mathematics, make connections, see patterns, and make generalizations?)
  - Is there a pattern here?
  - What part of this method have you seen before in math class?
  - How do similar figures relate to this problem?
  - In what way do proportions relate to finding the size of a large object?
- **Summarize main ideas** (How will you formalize the main ideas of the lesson? How will you reinforce appropriate terminology, definitions, or symbols?)
  - Speak the word (phrases): Similar figures, equivalent fractions, proportions, proportional relationships
  - Reinforce that proportions should have an equal sign because they are equivalent (equal fractions).

## ASSESSMENT

**Observe:** Describe how you will observe students to gather evidence about what they are learning, and describe the specific evidence of mathematical understanding that you will look for in your observations.

- Are they able to verbally explain to their partner what is happening in the problem or why they are suggesting a certain method for solving the problem?
- Can they “see” the invisible similar figures?
- Their written support of these problems, whether it is in the form of drawings, calculations and resulting algorithms is a great help in determining whether they understand these concepts.
- Their written work at the end will help too in seeing if they came to any conclusions.

**Ask:** List the specific questions you will ask students to assess their learning

- Can you explain the difference between the two methods used for measuring here?
- How does similar figures play into this problem?
- How does proportional reasoning enter this problem?
- What does a proportional relationship mean?