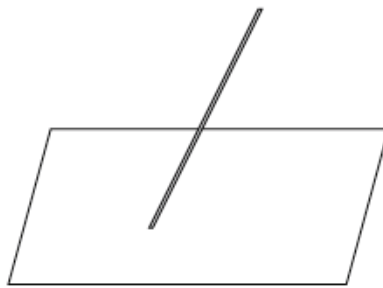


Lesson 12: Modeling Using Similarity

Classwork

Example

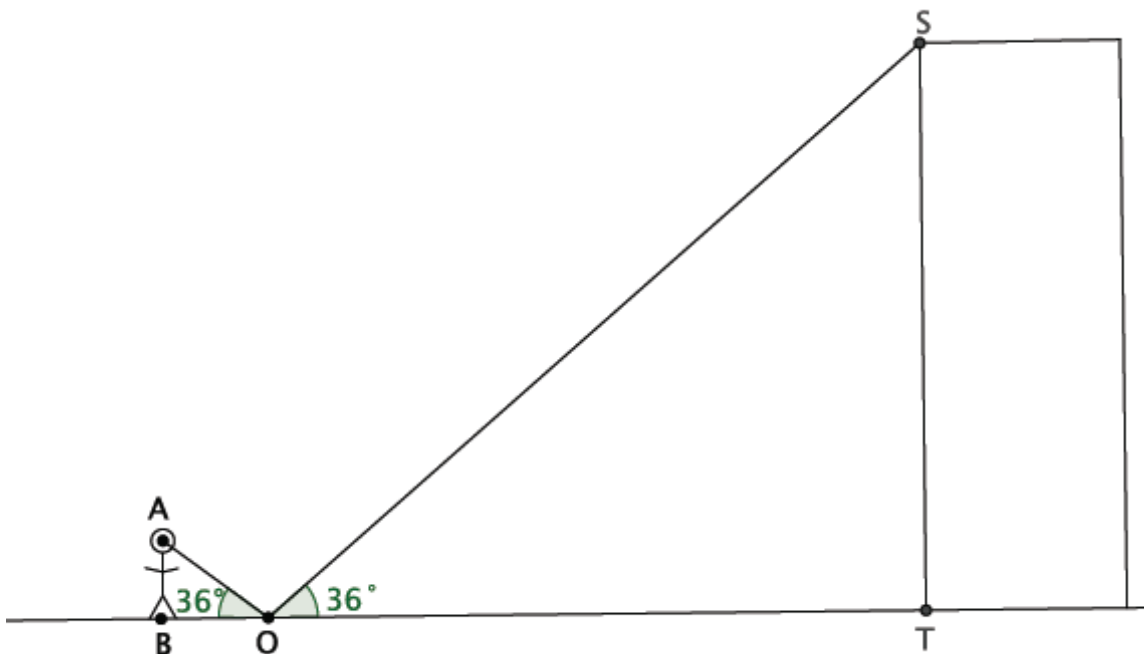
Not all flagpoles are perfectly *upright* (i.e., perpendicular to the ground). Some are oblique (i.e., neither parallel nor at a right angle, slanted). Imagine an oblique flagpole in front of an abandoned building. The question is, can we use sunlight and shadows to determine the length of the flagpole?



Assume that we know the following information: The length of the shadow of the flagpole is 15 feet. There is a mark on the flagpole 3 feet from its base. The length of the shadow of this three-foot portion of the flagpole is 1.7 feet.

Mathematical Modeling Exercises 1–3

1. You want to determine the approximate height of one of the tallest buildings in the city. You are told that if you place a mirror some distance from yourself so that you can see the top of the building in the mirror, then you can indirectly measure the height using similar triangles. Let point O be the location of the mirror so that the person shown can see the top of the building.



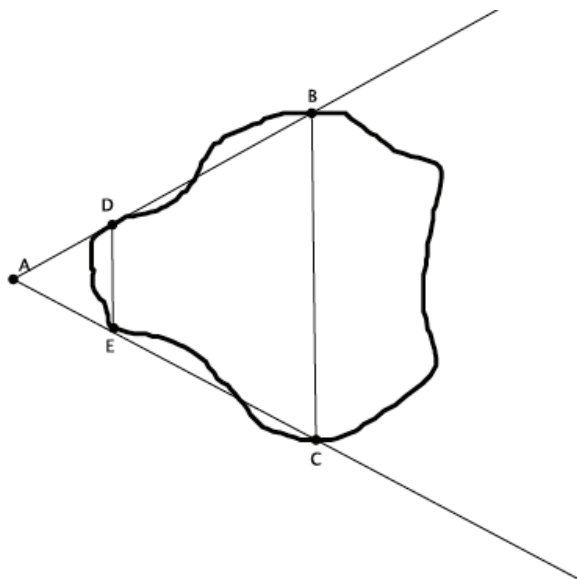
- a. Explain why $\triangle ABO \sim \triangle STO$.

- b. Label the diagram with the following information: The distance from eye level straight down to the ground is 5.3 feet. The distance from the person to the mirror is 7.2 feet. The distance from the person to the base of the building is 1,750 feet. The height of the building is represented by x .

- c. What is the distance from the mirror to the building?

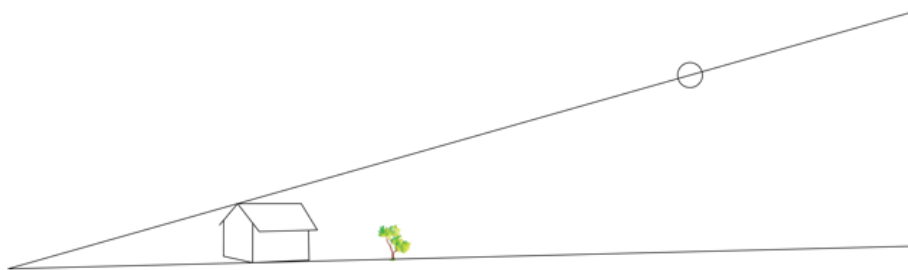
- d. Do you have enough information to determine the approximate height of the building? If yes, determine the approximate height of the building. If not, what additional information is needed?

2. A geologist wants to determine the distance across the widest part of a nearby lake. The geologist marked off specific points around the lake so that the line containing \overline{DE} would be parallel to the line containing \overline{BC} . The segment BC is selected specifically because it is the widest part of the lake. The segment DE is selected specifically because it is a short enough distance to easily measure. The geologist sketched the situation as shown below.



- a. Has the geologist done enough work so far to use similar triangles to help measure the widest part of the lake? Explain.

- b. The geologist has made the following measurements: $|DE| = 5$ feet, $|AE| = 7$ feet, and $|EC| = 15$ feet. Does she have enough information to complete the task? If so, determine the length across the widest part of the lake. If not, state what additional information is needed.
- c. Assume the geologist could only measure a maximum distance of 12 feet. Could she still find the distance across the widest part of the lake? What would need to be done differently?
3. A tree is planted in the backyard of a house with the hope that one day it is tall enough to provide shade to cool the house. A sketch of the house, tree, and sun is shown below.

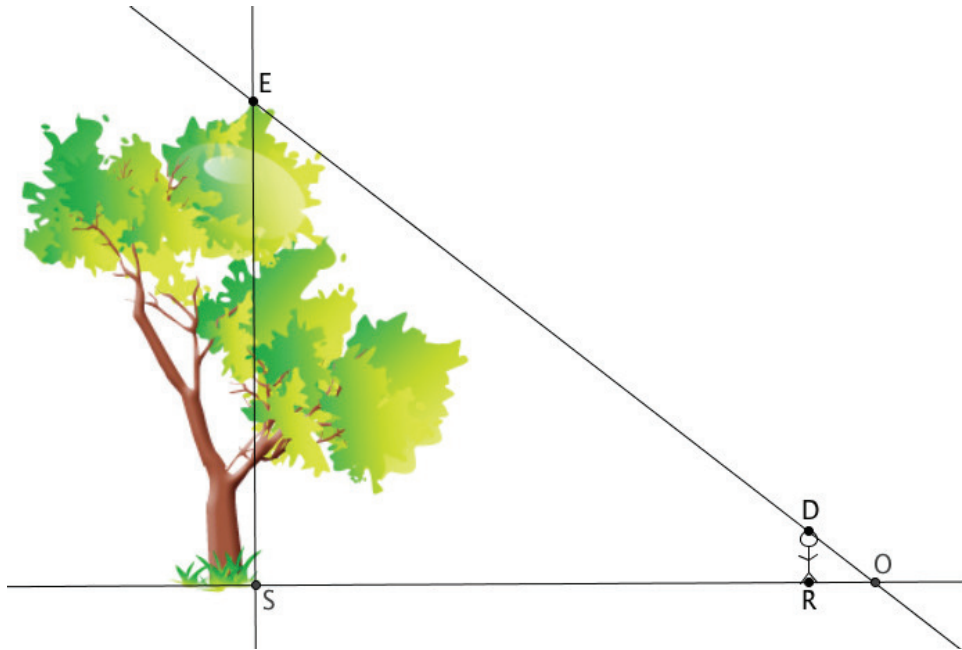


- a. What information is needed to determine how tall the tree must be to provide the desired shade?

- b. Assume that the sun casts a shadow 32 feet long from a point on top of the house to a point in front of the house. The distance from the end of the house's shadow to the base of the tree is 53 feet. If the house is 16 feet tall, how tall must the tree get to provide shade for the house?
- c. Assume that the tree grows at a rate of 2.5 feet per year. If the tree is now 7 feet tall, about how many years will it take for the tree to reach the desired height?

Problem Set

1. The world's tallest living tree is a redwood in California. It's about 370 feet tall. In a local park, there is a very tall tree. You want to find out if the tree in the local park is anywhere near the height of the famous redwood.



- Describe the triangles in the diagram, and explain how you know they are similar or not.
 - Assume $\triangle ESO \sim \triangle DRO$. A friend stands in the shadow of the tree. He is exactly 5.5 feet tall and casts a shadow of 12 feet. Is there enough information to determine the height of the tree? If so, determine the height. If not, state what additional information is needed.
 - Your friend stands exactly 477 feet from the base of the tree. Given this new information, determine about how many feet taller the world's tallest tree is compared to the one in the local park.
 - Assume that your friend stands in the shadow of the world's tallest redwood, and the length of his shadow is just 8 feet long. How long is the shadow cast by the tree?
2. A reasonable skateboard ramp makes a 25° angle with the ground. A two-foot-tall ramp requires about 4.3 feet of wood along the base and about 4.7 feet of wood from the ground to the top of the two-foot height to make the ramp.
- Sketch a diagram to represent the situation.
 - Your friend is a daredevil and has decided to build a ramp that is 5 feet tall. What length of wood is needed to make the base of the ramp? Explain your answer using properties of similar triangles.
 - What length of wood is required to go from the ground to the top of the 5-foot height to make the ramp? Explain your answer using properties of similar triangles.