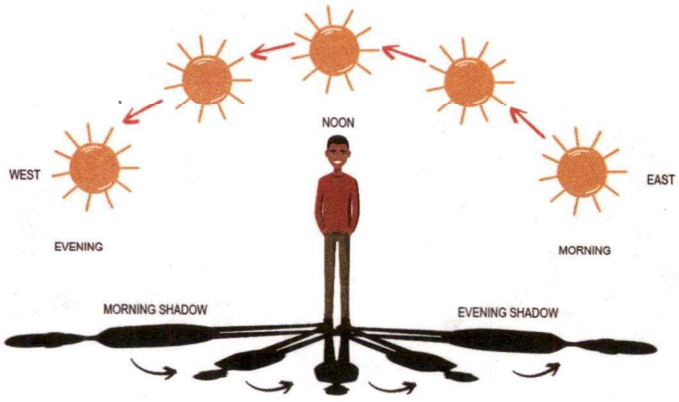
## REQUIREMENT 2
### Estimate the time of day.

As the Earth spins on its axis, the sun's rays reach the Earth at different angles, which causes shadows to move. By marking where objects' shadows land throughout the day, you can see how time passes.

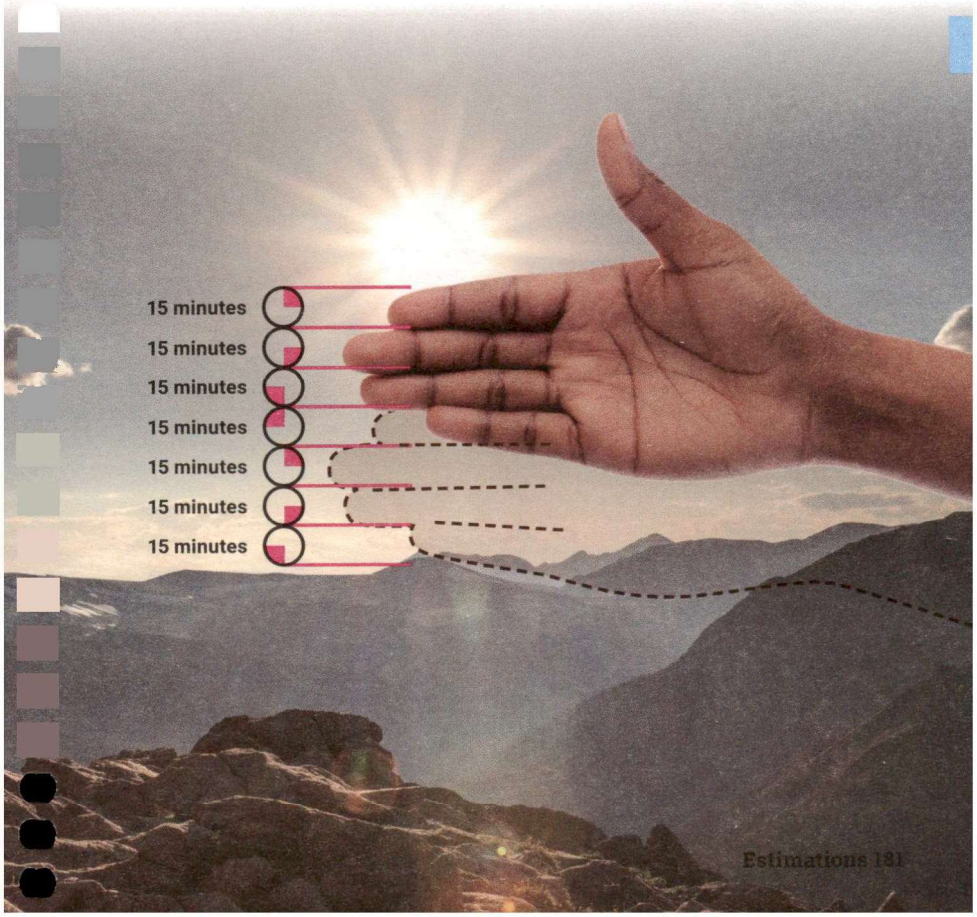



Early in the day the sun will be low in the sky as it rises in the east, so an object's shadow will be long and stretch to the west. As the day gets closer to midday, the object's shadow gets shorter until the sun hits its highest point, when there may not be much of a shadow at all. Then, throughout the afternoon the shadow of an object will stretch longer and longer in the opposite direction as the sun gets lower in the sky and sets in the west. Knowing when the sun rises and sets helps you estimate when the sun will be at its highest and shadows will be at their shortest.

There are 12 hours of sunlight at the equator, but the amount of sunlight in the United States changes based on the season. Since we are estimating, though, we can simply use 12 hours of sunlight

as our base. That would mean that the sun will be at its highest six hours after sunrise and six hours before sunset. If sunrise is at 6:30 a.m., the sun will be at its highest at 12:30 p.m. If the sun is a quarter of the way up, then it's about three hours after sunrise, or 9:30 a.m. If the sun is setting and is about a quarter of the way down, it's about three hours after its peak, or about 3:30 p.m.

When the sun is setting you can estimate how much daylight is left using your fingers. Stretch your hand out in front of you and place the sun at the top of your index finger. Every width of finger is going to be about 15 minutes of sunlight. So, if the sun is only two fingers away from the horizon, you have about 30 minutes before it gets dark.

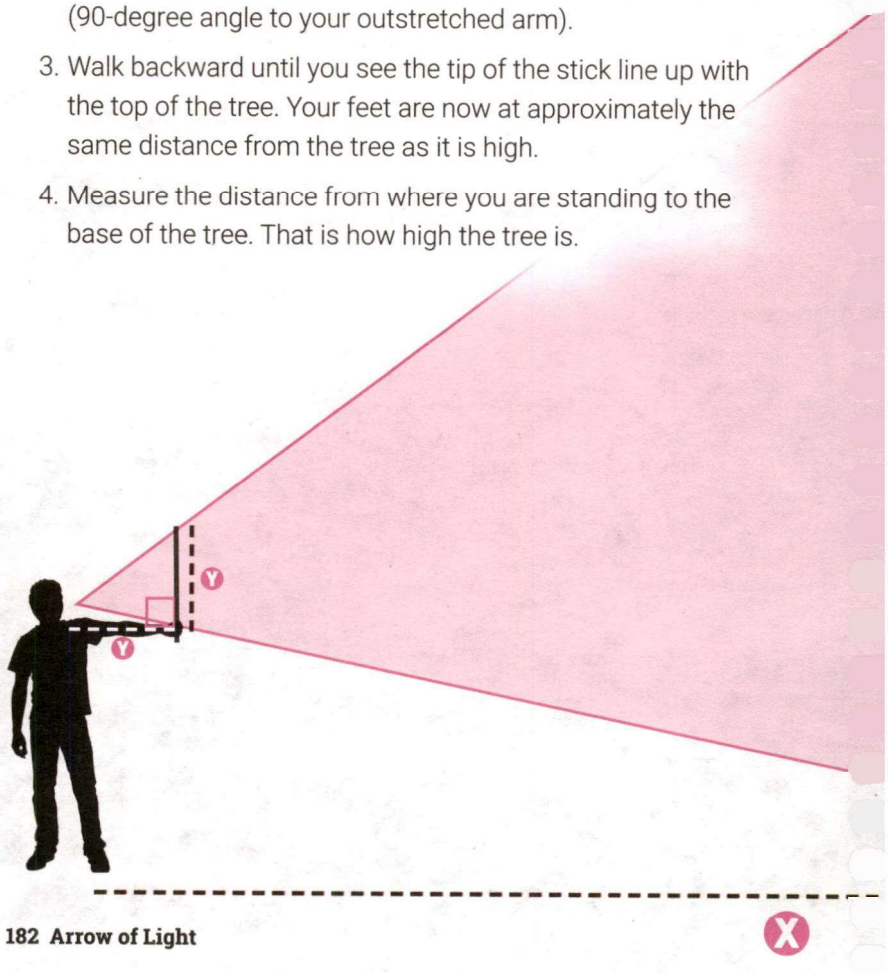


## REQUIREMENT 3

### Estimate the height of a distant object.

Have you ever seen a really tall tree and wondered how tall it is? Here's a way to figure it out. This method requires flat ground to get a good estimation. It's based on the geometry of a right triangle — that the two sides of a right triangle are the same length.

1. Find a stick the length of your arm.
2. Hold your arm out straight with the stick pointing straight up (90-degree angle to your outstretched arm).
3. Walk backward until you see the tip of the stick line up with the top of the tree. Your feet are now at approximately the same distance from the tree as it is high.
4. Measure the distance from where you are standing to the base of the tree. That is how high the tree is.

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## REQUIREMENT 4

**Estimate the distance between two points.**

If you can't actually measure the distance between two points, you would want to be able to estimate it. For instance, what if you want to know how wide a narrow river is? Here are two ways you can do it.

**Napoleon Method**

To measure the width of a narrow river, stand straight on your side of the river looking toward the other side. Tilt your head down until your chin rests on your chest and place your hand across your line of sight as if executing a military salute. Position the edge of your hand in such a way that it is as if is touching the opposite shore. Turn your body 90 degrees and note the distance where the edge of your hand is touching on this new direction. The distance between that spot and your position is an estimate of the width of that river.

**Stride or Step Method**

1. Select an object on the opposite bank of the river, such as a tree, and mark it as point A.
2. On your side of the river, place a stick or another object at the point directly in front of the object that's on the opposite bank of the river and mark it as point B.
3. Walk about 50 paces along the shore at a right angle to line AB. Place another object there, and mark that spot as point C, forming line BC.
4. Continue walking another 50 paces in the same direction to point D. The distance CD is equal to the distance BC.

5. From point D, walk away from the river at a right angle to line CD until you can see point C forming a straight line with point A. Stop and mark your spot as point E.
6. You have now made two identical right triangles (ABC and CDE). Measure the distance between points D and E to get the width of the stream (line AB).