

### **Student Activity Instructions**

- 1) Choose a Lego minifigure from your teacher. Measure the character's height to the nearest cm. Record that measurement in the entire column marked "*Height of the Minifigure (cm)*" for both tables on the *Student Data Collection Sheet*.
- 2) Now use a stack of three textbooks to make your shadow exploration tool bend at a 90 degree angle. You can use a small piece of tape to hold your file folder in place if needed.
- 3) Place your minifigure inside the left square. He/She needs to be able to stand without assistance. Trace around the feet of your figure.
- 4) With your minifigure inside the left square, place the end of your meter stick on the line that says ruler. The light should be pointed down, shining on the top of the head of your minifigure. Note that your meterstick is positioned at a 90 degree angle.
- 5) Using your red pencil, trace the shadow that is created by the light. Remove the meter stick and minifigure so that you can write 90 degrees inside your drawing (not the shaded area).
- 6) Which direction was the shadow pointing? To the left or the right? Record this in the top table on the Student Data Collection Sheet.
- 7) Measure the length (cm) of the shadow from the farthest edge of the figure's feet to the edge of the shadow. Record that measurement in the chart for the 90 degree row on the *Student Data Collection Sheet*.
- 8) Now replace the light and minifigure and repeat this procedure, but this time lower the top end of the meter stick towards the right until the meterstick lines up with the 60 degree mark on the Shadow Collection Tool. Trace the figure's new shadow. Label the new shadow drawing with the angle of the meter stick. Record the other related measurements in the table for the 60 degree mark.
- 9) Continue repeating this procedure for angles of 30 degrees and 0 degrees.
- 10) Now repeat the entire procedure (steps 3 - 9) with the figure in the right square. The meter stick top will now be bending towards the left. Record your measurements.

**Student Data Collection Sheet**

*Distance of Light Source to Figure = 20 cm*

*(LEFT Square)*

	<i>Height of the Minifigure (cm)</i>	<i>Direction the Shadow is Cast</i>	<i>Length of the Shadow (cm)</i>
Light source directly <i>above</i> the figure (90 degrees)			
Light shining from the <i>right</i> of the figure at 60 degrees			
Light shining from the <i>right</i> of the figure at 30 degrees			
Light shining from the <i>right</i> of the figure at 0 degrees			

*Distance of Light Source to Figure = 20 cm*

*(RIGHT Square)*

	<i>Height of the Minifigure (cm)</i>	<i>Direction the Shadow is Cast</i>	<i>Length of the Shadow (cm)</i>
Light source directly <i>above</i> the figure (90 degrees)			
Light shining from the <i>left</i> of the figure at 60 degrees			
Light shining from the <i>left</i> of the figure at 30 degrees			
Light shining from the <i>left</i> of the figure at 0 degrees			

### Discussion Questions

- 1) Were you able to change the direction of your shadow? Or was the shadow cast the same direction through the entire activity? If you were able to change the direction of the object's shadow, how were you able to do it?
- 2) Were you able to change the length of your shadow? Or did the shadow stay the same length through the entire activity? If you were able to change the length of the object's shadow, how were you able to do it?
- 3) At what point during the activity did the object have the longest shadow? What did you notice about the shadow at that time? How was the meterstick angled?
- 4) At what point during the activity did the object have the shortest shadow? What did you notice about the shadow at that time? How was the meterstick angled?
- 5) Who can summarize how the angle at which light hits an object affects the length of the shadow it casts?

### Activity Extensions

- Have students try to come up with the angle at which the object's shadow in the same length as the object's height. Explore the mathematical relationship that exists here. It's an opportunity to talk about right isosceles triangles.
- Have the students recreate the same experiment with the flash light placed at greater distances on the meter stick. Try 40 cm and/or 60 cm. Did the shadow length change at the various angles? What about how dark the shadow was comparatively?

**Post Activity Quiz**

- 1) When the light source was placed directly overhead (90 degrees), the minifigure's shadow was \_\_\_\_\_ (longer, shorter) than when the light was placed at lower angle.
- 2) The angle when the object's shadow was the most blurry and difficult to measure was...
  - a) 0 degrees
  - b) 30 degrees
  - c) 60 degrees
  - d) 90 degrees
- 3) Circle the correct answer below the statement. As the angle of the light decreased from 90 towards 0, I noticed the object's shadow...

Got longer

Stayed the Same Length

Got Shorter

- 4) Circle the correct answer below the statement. When the angle of the light increased from 0 towards 90, I noticed the object's shadow...

Got longer

Stayed the Same Length

Got Shorter

- 5) Thinking about what I learned during this activity, I would expect that as the sun rises in the sky, my shadow would.....
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- 6) Thinking about what I learned during this activity, I would expect that as the sun sets in the sky, my shadow would.....
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