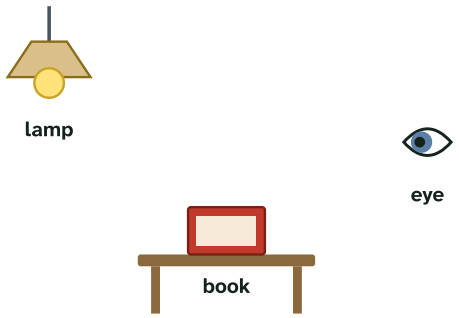
Teach Pip with drawings, and measure some shadows

Name: Class: Date:

Pip the robot knows only what you teach it. Finish the four drawings so that Pip can see where the light goes, write Pip two rules in your own words, then measure some shadows and write Pip the rule for those.

PART 1 Finish the drawings for Pip

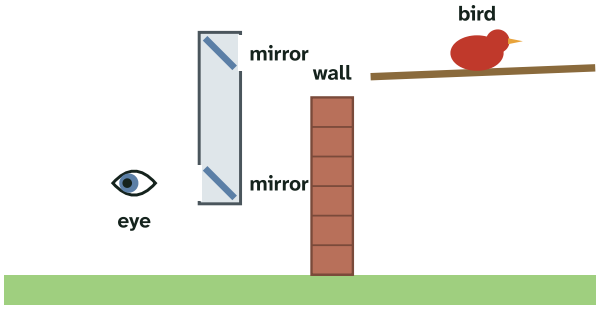


A How do you see the book?

Pip asks: "Does the light come from your eye?"

Draw arrows to show where the light goes. Start at the lamp.

Pip asks why. Write your answer:

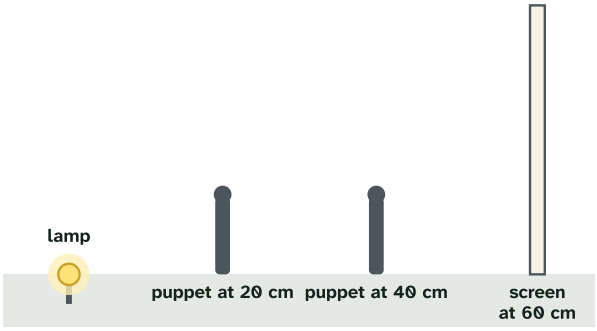


B Seeing over the wall

Pip asks: "How can I see the bird through two mirrors?"

Draw the light's path from the bird to the eye. It turns a corner at each mirror.

Pip asks why. Write your answer:

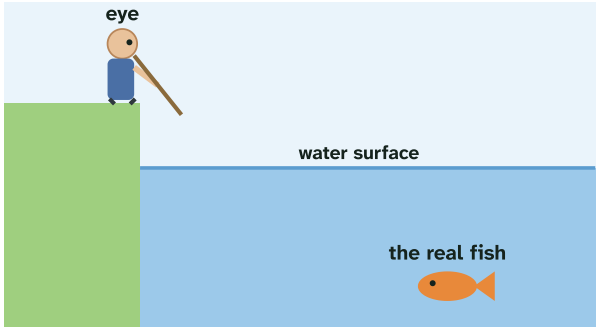


C Two shadows

Pip asks: "Which puppet makes the taller shadow?"

Draw a straight line from the lamp past the top of each puppet to the screen. Mark each shadow's top on the screen.

Pip asks why. Write your answer:



D Where should Pip aim?

Pip asks: "The fish looks like it is just under the surface. Why?"

Light from the fish bends at the surface on its way to the eye. Draw its path, then draw where the fish seems to be and put an X where Pip should aim the spear.

Pip asks why. Write your answer:

PART 2 Teach Pip two rules

Write each rule in your own words, the way you would say it to a friend. A good rule tells Pip what happens and why.

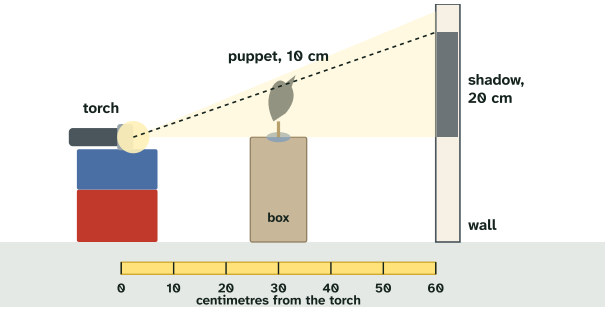
Why does a shadow get bigger when the puppet moves nearer the lamp?

Why does a fish in a pool look higher than it really is?

PART 3 Shadow sizes

Aim: To find out how a shadow's size changes when the object moves nearer the light.

Each group needs: a torch with a wide beam (or a bare bulb in a lamp); a card puppet about 10 cm tall, stuck to a stick or a lump of adhesive putty; a wall or a sheet of white card for a screen; a tape measure or a metre ruler; and a room that can be made dim.



Safety. Never shine the torch into anyone's eyes. Clear the floor before the lights go down, and keep the curtains or blinds where you can reach them.

1. Put the torch on a table or a pile of books, 60 cm from the wall, pointing straight at it. Keep the torch in this place for the whole test: only the puppet moves.
2. Stand the puppet on a box so that its feet are level with the torch, 50 cm from the torch and 10 cm from the wall. Switch the torch on and measure the height of its shadow on the wall, from the bottom of the shadow to the top. The edge may be a little fuzzy: measure to the middle of the fuzz.
3. Move the puppet to 40 cm from the torch and measure again. Do the same at 30 cm, 20 cm and 15 cm. Close to the torch the shadow may run off the top of the lit patch: if it does, write 'bigger than the lit patch' and go on.
4. Each time, write in the table whether the shadow is bigger than the puppet, the same size, or smaller.
5. If you have time, do the whole test again and see whether you get the same heights.

Puppet's distance from the torch	Distance from the wall	Shadow height (cm)	Bigger, the same or smaller than the puppet?
50 cm	10 cm		
40 cm	20 cm		
30 cm	30 cm		
20 cm	40 cm		
15 cm	45 cm		

1. What happened to the shadow as the puppet moved nearer the torch?

2. What did you keep the same each time? Why did that matter?

3. Write the rule for Pip: "When the puppet moves nearer the light, its shadow …"

4. Pip asks why. The light spreads out from the torch in straight lines. Use that to explain your rule.