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# PEERING ABOVE THE CROWD

| | |
|---|---|
| **STUDENT BOOK:** | **Chapter 4, pp. 106–110** |
| **CONCEPTS:** | DEVIATION OF LIGHT WAVES |
| **METHOD:** | TECHNOLOGICAL DESIGN |

*Jumping up or perching on a friend's shoulders to peer above the crowd doesn't seem the best way to see what is happening beyond an obstacle. The object that will solve this problem must be lightweight, easy to handle and made from simple materials.*

## IDENTIFYING AND MEETING A NEED

*Read pp. 106–110 in your student book for help in answering the following questions.*

In this activity, you will learn how to make a periscope so you can see over obstacles.

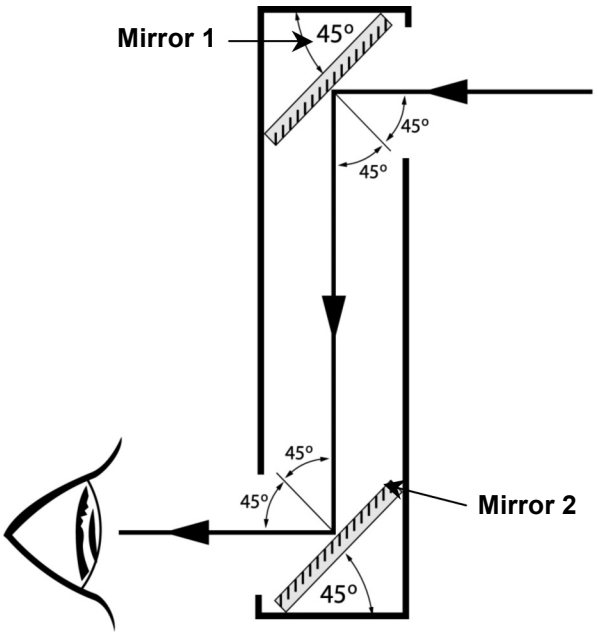
## IDENTIFYING THE WORKING PRINCIPLES

**1.** Complete a design plan for your periscope by drawing:

***a)*** the incident rays, reflected rays and normals

***b)*** the angles of incidence and reflection

**Design plan**



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**2.** Name the phenomenon that allows you to see an image through a periscope.

**3.** What are the basic principles of plane mirrors?

## IDENTIFYING THE DESIGN PRINCIPLES

**4.** A periscope has two main types of parts. Name them.

**5.** You have the following equipment and materials to build your periscope:

| | |
|---|---|
| 2 1-L milk cartons | ruler |
| 2 small plane mirrors (≈ 7 cm square) | pencil |
| retractable utility knife | masking tape |
| cutting mat | plasticine |

After familiarizing yourself with these materials, complete a technical diagram for your periscope by:

***a)*** naming the parts

***b)*** filling in the legend of materials

***c)*** naming the linking components you will use to put your periscope together

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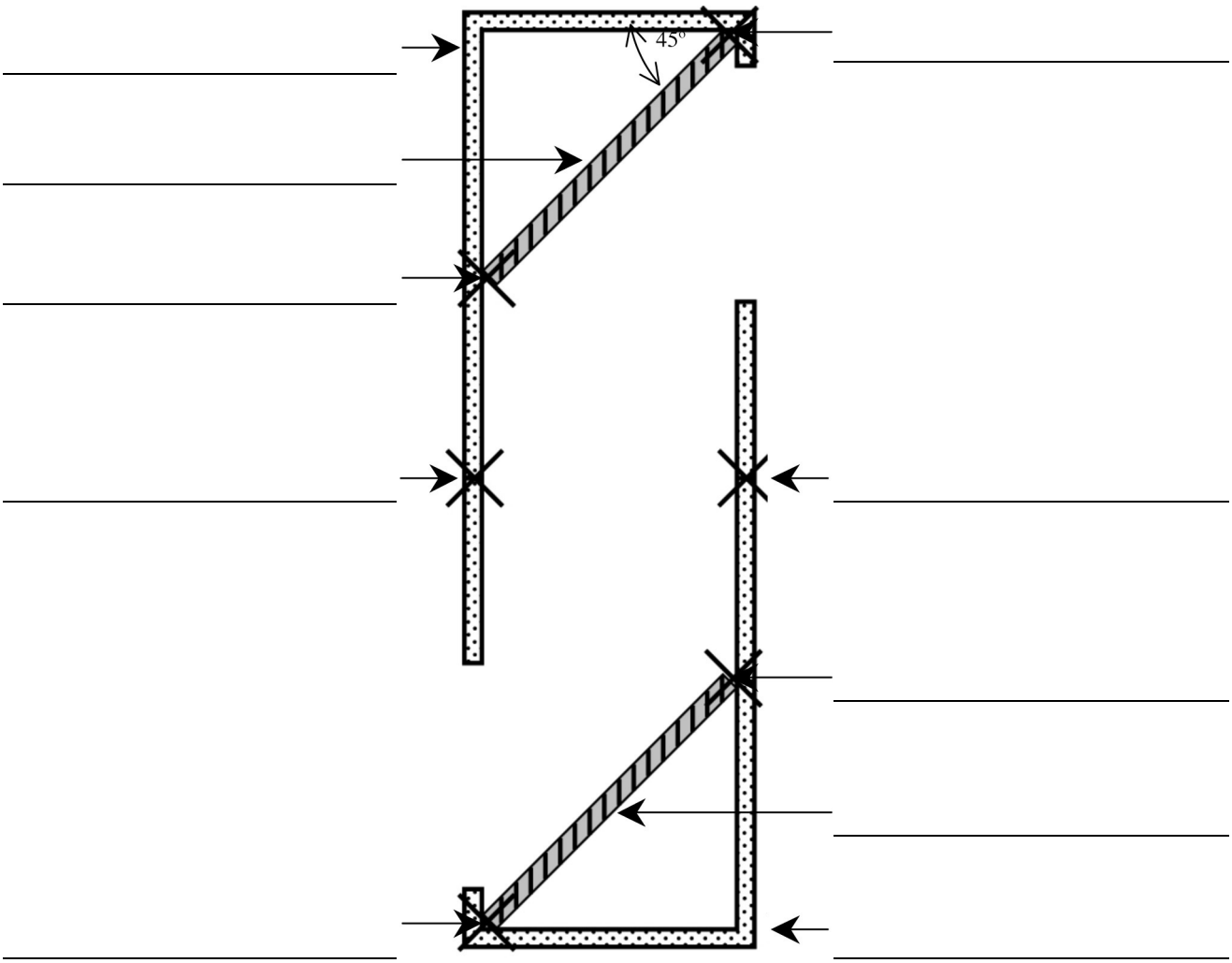
## Technical diagram




### Legend of materials

_____

_____

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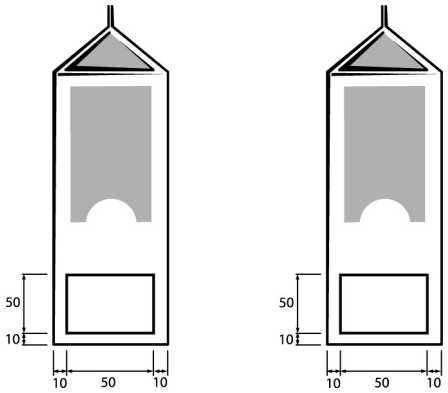
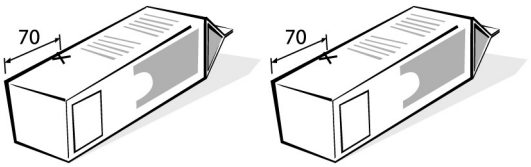
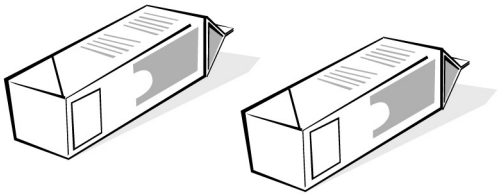
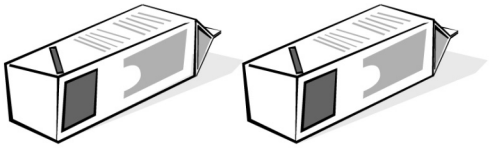
## BUILDING AND TESTING A PROTOTYPE

**6.** Build your prototype following the steps of this manufacturing process:

### Manufacturing process – Periscope

Materials: 2 milk cartons, masking tape, plasticine

| No. | Step | Sketch | Materials |
|---|---|---|---|
| **10** | **Measuring and marking** | | |
| 11 | Mark a square about 50 mm × 50 mm at the bottom on one side of the carton. Leave at least 10 mm of carton around the square. Repeat for the other carton. |   | ruler pencil |
| 12 | Lay the carton down so the side with the marked square is to your right. On the side facing up, measure 70 mm from the bottom left corner and make a reference point. Repeat for the other carton. |   | ruler pencil |
| 13 | Draw a line from the bottom right corner to the reference point you made. Repeat for the other carton. |  | ruler pencil |
| 14 | Measure the thickness of the mirrors, then draw a second line parallel to the first line and at a distance equal to the thickness of the mirrors. Repeat for the other carton. |  | ruler pencil |

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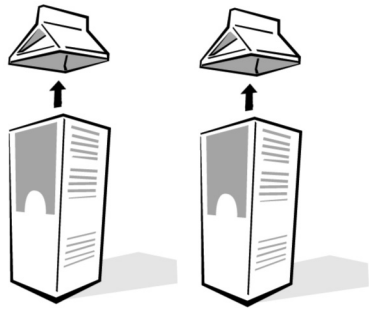
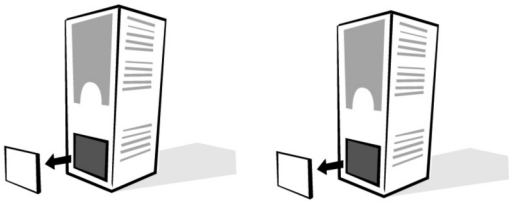
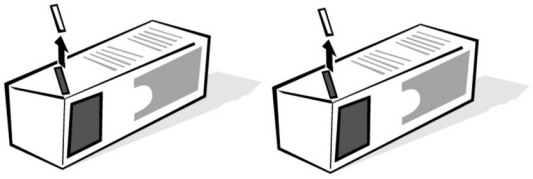
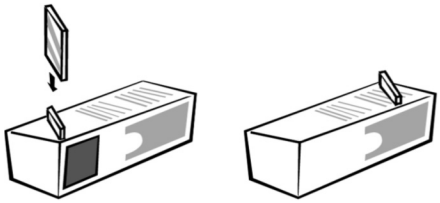
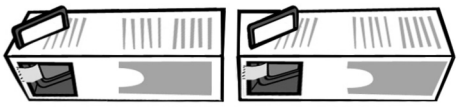
## Manufacturing process (*continued*)

| No. | Step | Sketch | Materials |
|---|---|---|---|
| **20** | **Machining** | | |
| 21 | Cut off the top of each carton. |  | retractable utility knife<br>cutting mat |
| 22 | Cut out the square marked on each carton. |  | retractable utility knife |
| 23 | Cut out the slot for the mirror on each carton. |  | retractable utility knife |
| **30** | **Assembling** | | |
| 31 | Insert the mirrors into the slots, the reflective sides facing the square hole in the carton. |  | |
| 32 | Fasten each mirror to its carton with the linking component named on your technical diagram. |  | |

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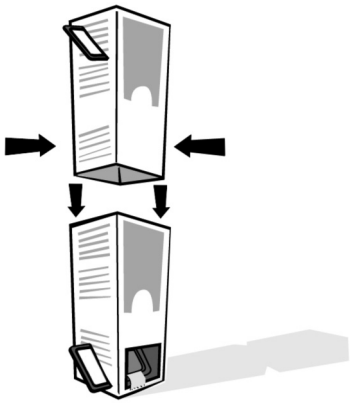
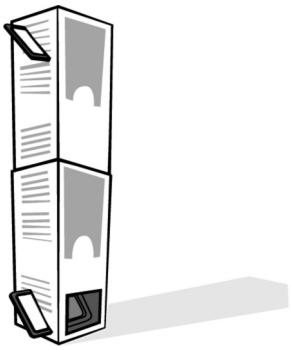
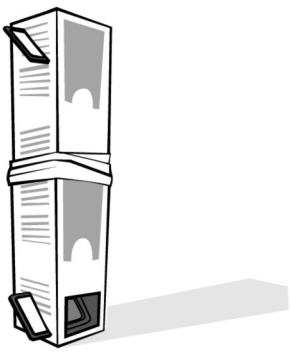
## Manufacturing process (*continued*)

| No. | Step | Sketch | Materials |
|---|---|---|---|
| 33 | Stand one carton on end, with the hole facing you. Turn the other carton upside down, with the mirror and the hole at the top. The hole at the top of the carton must be facing away from you. |  | |
| 34 | Carefully set the top carton onto the bottom carton so they fit together. |  | |
| 35 | Fasten the two cartons together with the linking component you named on your technical diagram. |  | |

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**7.** Test your periscope. Stand in front of an obstacle: a desk, low wall or person, for instance. Look into the periscope through one hole, the other hole positioned above the obstacle. Is your periscope working as expected? If not, what is the problem?

**8.** Is the final image horizontally inverted or not? Explain your answer.

**9.** What do you think would happen if your periscope box were much longer?

**10.** How could you modify your periscope to see higher or lower on the other side of an obstacle?

**11.** What could you add to make your periscope magnify the final image?