IT'S A DRAG!

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Objective

To learn that shape affects the amount of drag on an object.

MATERIALS

Per Group

block of heavy foam
10 cm X 10 cm X 15 cm
30-cm wooden skewer
duct tape
metric ruler
scissors
wooden ruler with holes
flexible drinking straws
box fan with three speeds
clear tape
shape patterns (p. 3 and 4)

Per Student

science journal

Procedure

Teacher Prep

1. To make the drag stand (one per class), insert the wooden skewer 5 cm into the center of the foam block so that the measurement from the top of the wooden skewer to the bottom of the foam, where inserted, is 15 cm.
2. Measure and cut a 10 cm X 1 cm piece of duct tape.
3. Wrap the tape around the straw 2 cm from one end, making sure the tape is evenly wrapped and forms a level surface.
4. Slide the straw over the wooden skewer until it makes contact with the foam block. See diagram 1.
5. Place the box fan on a table or flat surface and plug in.
6. Loop a piece of duct tape to make a double-sided tape. Attach the duct tape to the bottom of the foam block to hold the foam in place.
7. Measure 1 m from the front center of the box fan and place drag stand at that point, making sure it is secured to the surface. See diagram 2.
8. For each group, assemble the drag arms by inserting two flexible straws into the outer holes of a wooden ruler an equal distance from the center hole (pivot point).
9. Secure straws to the ruler by placing two small pieces of duct tape around the top of the straw. See diagram 3.
10. Cut out the shapes (p. 3 and 4), bend on the dotted lines, and tape the edges together (cone, cube, tetrahedron, and pyramid). Note: Depending on the abilities of your students, this step may be completed by the students.
11. Assess your students' knowledge of drag by asking them: What is drag? How would shape affect drag? How does drag affect an airplane's ability to fly?
12. Have students copy this Data Chart in their science journals.

    Note: Discuss a matrix and why some of the spaces in the chart will be either duplicated or not used. For example, you will not test a cone and a cone because they are the same shape.

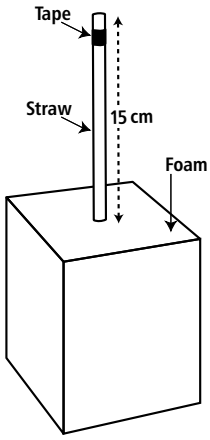

Diagram 1

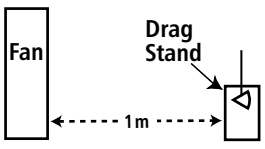

Diagram 2

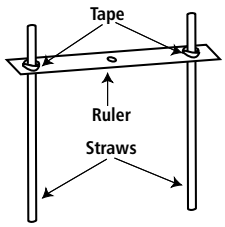

Diagram 3

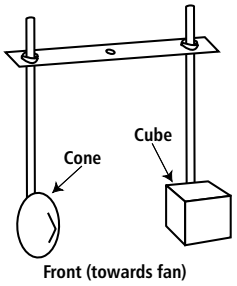

Diagram 4

Data Chart

Shape	Cone	Cube	Pyramid	Tetrahedron
Cone	X			
Cube		X		
Pyramid			X	
Tetrahedron				X

13. Beginning with the cone and the cube, attach shapes to the bottom of each straw using clear tape. See diagram 4.

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Pokémon TRADING CARD GAME

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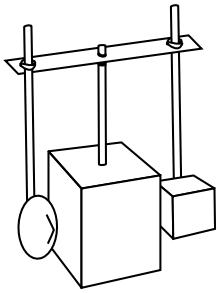


Diagram 5

14. Place the drag arm onto the drag stand by placing the ruler over the straw on the drag stand. See diagram 5.
15. Ask the students to predict which shape will have the most drag. Record their predictions in their science journals.
16. Turn the fan on low speed.
17. Observe and note which shape moves closer to the fan. This shape will be the one that has the least amount of drag. Record the shape that had the least amount of drag on the Data Chart.
18. Compare student predictions with the results. Discuss.
19. Repeat steps 13-17 with the following combination of shapes:
    - cone and pyramid
    - cone and tetrahedron
    - cube and pyramid
    - cube and tetrahedron
    - pyramid and tetrahedron
20. Using the data from the Data Chart, ask the students which shape had the least amount of drag (the shape that appears in the chart the most often).

Conclusion

1. Does shape affect drag? Why or why not?
2. Would changing the size of the shape affect the outcome of this experiment? Why or why not?

Extension

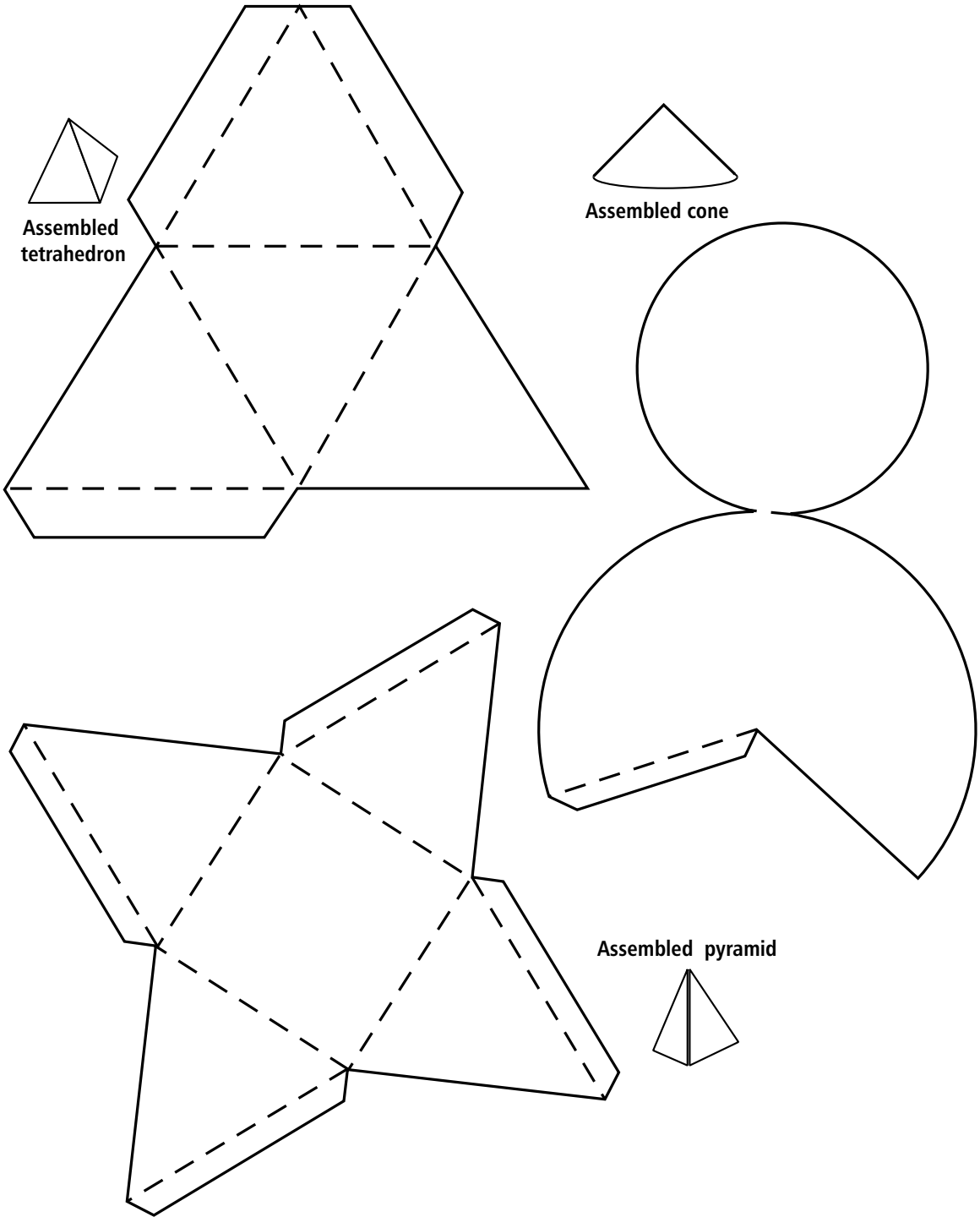
1. Design a vehicle for NASA, determining which shape would have the least drag? Have students draw a picture of their vehicle and justify their design.
2. Discuss how the shape of an object would be affected by drag in space.
3. Cut out various sized squares of cardboard (10 cm, 20 cm, 40 cm, and 60 cm). Have students stand in front of the box fan holding each square one at a time to feel how the size of an object affects drag. The larger squares should "push" on the students more than the smaller squares. Discuss why.

Explanation

The shape that has the least amount of drag will move closer to the fan. This is because certain shapes, in particular shapes that are rounded, allow air to flow around them better than other shapes. These shapes produce less drag. When air flows around a shape, there is less air pressure between the shape and the fan. The shapes will move toward the fan.

Nature models this in the bodies of birds and fish. Their shapes allow air and water to travel around them, producing less drag and increasing their lift.

Photocopy at 125%.



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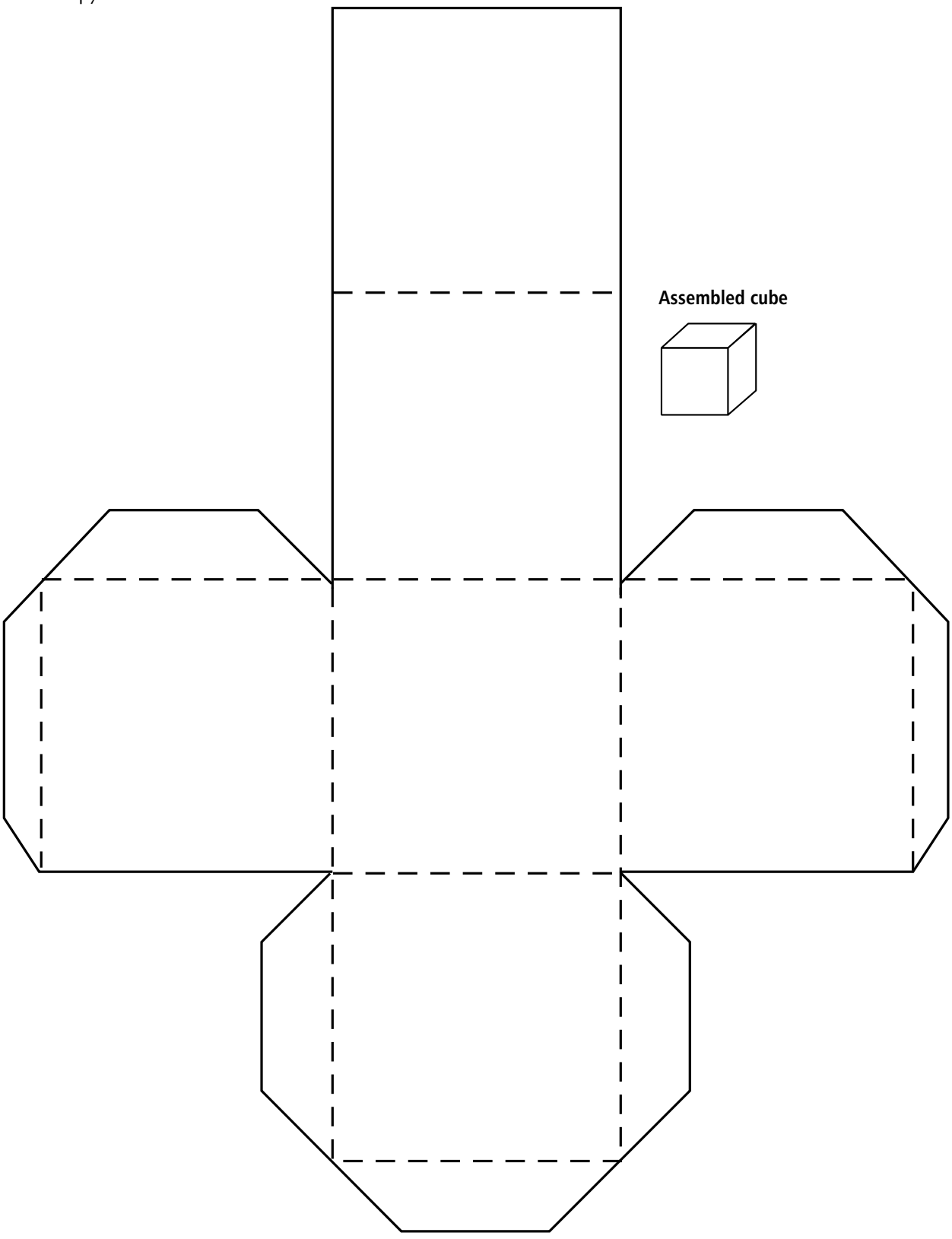

Assembled cube