Chapter 7: Forces

Experiment 7.1: Measuring forces

Experiment worksheet answers (pages 120–121 and 202)

Results

Draw a column graph showing the amount of force needed to move each object.

Student answers will vary.

Challenge 7.2: Design a ball whacker

Experiment worksheet answers (pages 122–123 and 203)

Processing, analysing and evaluating

Student responses for this challenge will vary based on their own planning and evaluation of their experiment design.

Communicating

Present the various features of your investigation in a formal experimental report.

Student responses will vary, but should include mention of an aim, equipment, method and evaluation of their design.

Challenge 7.3: Can you use the push and pull of a magnet?

Experiment worksheet answers (pages 124–125 and 203)

Questioning and predicting

1 Should you use like or unlike poles?

Like poles will repel each other and generate a push force.

2 Do all magnets have equal force?

No. Some magnets are stronger than others.

3 Which part of a magnet has the strongest force?

The end or pole of the magnet has the strongest force.

Processing, analysing and evaluating

Student responses for this challenge will vary based on their own planning and evaluation of their experiment design.

Communicating

Present the various features of your investigation in a formal experimental report.

Student responses will vary, but should include mention of an aim, equipment, method and evaluation of their design.

Experiment 7.5: What if a balloon were electrostatically charged?

Experiment worksheet answers (pages 128–129 and 204)

Inquiry

Student responses will vary.

Experiment 7.6: What if the amount of friction were changed?

Experiment worksheet answers (pages 130–131 and 205)

Discussion

1 Compare your results to those of others in the class.

Student answers will vary.

2 What was the best way to reduce friction?

Student answers will vary.

3 Would five rollers be better than two for reducing friction?

Yes. Five rollers would divide the weight of the textbook more than two rollers. This means there would be less friction for each roller, reducing friction overall.

4 Would 10 rollers be better than five for reducing friction?

Yes.

5 Would bigger or smaller rollers be better for reducing friction?

Bigger rollers (with less surface area in contact with the ground) have less friction.

6 What are some problems with using rollers?

Small rollers have increased friction on rough surfaces.

7 Write down a practical example of rollers being used to reduce friction.

Building pyramids or ball bearings allowing the movement of wheels on a car.

8 Why wouldn’t square rollers be any good?

Square rollers would need to slide, therefore having more friction.

9 Would fine sand or coarse (large-grained) sand be better for increasing friction?

Large-grain sand has more flat surfaces and sharp edges. Therefore it will have more friction than small grained sand. If the sand is well rounded, then the friction will be reduced.

10 Write down a practical example of sand being used to increase friction.

Sand is sometimes spread on road ice in order to increase friction for cars.

11 What are some problems with using sand for this purpose?

Sand is not as good for the environment as it causes soil to become packed, restricting areas for insects to live.

Conclusion

What do you know about how to reduce friction?

Student answers will vary.

Experiment 7.7A: Using a first-class lever to lift weights

Experiment worksheet answers (pages 132–133 and 206)

Discussion

1 What pattern do you notice between the left-hand side and the right-hand side of your first-class lever?

The weights are equal distance from the fulcrum.

2 What is mechanical advantage?

It is the mathematical advantage assigned to the use of a machine. This may be a decrease in force needed or an increase in the speed produced.

3 Calculate the mechanical advantage of the lever when the single weight on the left-hand side lifts the five weights on the right-hand side.

Mechanical advantage = 5/1 = 5

4 Provide another example of a first-class lever that you have used.

Student answers will vary.

Experiment 7.7B: Using a second-class lever to lift weight

Experiment worksheet answers (pages 132–133 and 207)

Discussion

1 Why did you repeat each measurement three times?

Once is random. Twice is coincidence. Three times is evidence. Repeating each measurement ensures any random discrepancies are noticed.

2 Describe the difference in total effort required when the weight was shifted further from the fulcrum on the second-class lever.

As a weight (load) is moved further from the fulcrum, the mechanical advantage of the wheelbarrow decreases.

3 What does this suggest about how a wheelbarrow should be loaded by its user?

Wheelbarrows should be loaded towards the front of the wheelbarrow.

Conclusion

Describe the mechanical advantage of using a second-class lever.

Student answers will vary.

Experiment 7.8: Calculating mechanical advantage

Experiment worksheet answers (pages 134–135 and 208)

Discussion

1 What happens to the effort needed to lift the 500g load as more pulleys are used?

The mechanical effort increases as more pulleys are used. Therefore less effort is needed.

2 What happens to the distance the effort moves compared to the distance the load moves?

The effort needs to move a greater distance than the load.

3 What would the spring balance read if six pulleys were used to lift the 500g load?

500 g = 5 Newtons. Spring balance would read 5/6 = 0.833 Newtons

4 What length of string would have to be pulled through the pulleys to lift the 500g load 20 cm upwards?

6 x 20 cm = 120 cm

Conclusion

Write a statement that relates the number of pulleys to the size of the effort and the distance moved by the load.

Student results will vary.

Experiment 7.9: Comparing different machines

Experiment worksheet answers (pages 136–137 and 208–209)

Discussion

A Inclined plane

1 Which method provided the greatest mechanical advantage? What evidence do you have to support your conclusion?

Using the ramp should provide the greatest mechanical advantage. Students should use the results they collected to support their answer.

2 A student claimed an incline plane was not a machine. Were they correct? Use evidence from the experiment to support your answer.

No. An inclined plane is a machine as it provides a mechanical advantage.

B Wedges

1 What advantage did using a wedge have on separating the two blocks of wood?

Using a wedge made it easier to separate two blocks.

C Screw

1 Did using the screw mechanism in the G-clamp provide a mechanical advantage in crushing the matchbox? Describe the differences you noticed between using the two methods.

Using the screw mechanism will provide a mechanical advantage. Student descriptions of the differences will vary.

D Wheels and axles

1 How is a force magnifier different from a distance magnifier?

A force magnifier will increase the size of the effort force, however, the effort will need to travel a greater distance than the load. A speed magnifier will increase the speed of the effort, however, the force needed will be greater.

2 What did you change for the second model?

Student answers will be greater.

3 Why did you decide to change this aspect?

Student answers will vary.

Conclusion

A Inclined plane

What do you know about inclined planes?

Inclined planes are a machine as they provide a mechanical advantage.