Lesson 10.1 Measuring forces

Recommended teaching time for this lesson: 1 x 60 minute period

• 35 minutes of explicit teaching

• 25 minutes of suggested classroom activities

• 30 minutes homework

Getting started

Key ideas

* Forces can be contact or non-contact.
* When forces are balanced, there is no change in motion. However, when forces are unbalanced, there is a change in motion.
* Forces are vector quantities measured in the SI unit of newtons.
* A resultant force is the vector sum of all forces acting on an object.

Curriculum links

Science understanding

* Identify forces acting on an object.
* Construct free-body diagrams representing forces such as the force due to gravity (weight), the normal force, tension, friction, drag and applied forces acting on an object.
* Determine the resultant force acting on an object in one dimension.

Advice for teaching this lesson

Things to know before you start teaching

The first activity requires students to use a scale. It also provides some suggestions of items that you could provide for students to engage with.

Drawing free-body diagrams is a useful skill to continually apply as you move through this module, so if you are not comfortable with them it is worthwhile watching some YouTube videos of people solving questions involving free body diagrams. This approach does make solving more complex problems significantly easier as it reduces the need to keep track of multiple variables in your mind.

Common misconceptions

* Ensure students are consistently applying their learning from Lesson 9.1 on vector directions, as this will be important as they move through the entirety of this module.
* Students may get turned around on the use of language versus signed values. Negative east being mathematically equivalent to west for example.

Differentiation strategies

For students who struggle with using the language for directions, it may be beneficial to just have them skip the language element and jump straight to mathematical representation. Encourage students to draw a compass with positive/negative along their directions as part of their communication for exams.

Starter activity: Remember the force

Approximate time: 5 minutes

**Activity placement:** Place directly after Lesson overview

**Activity summary:** A recall activity to connect back to prior learning in junior science.

Notes for the teacher

Forces are generally taught in Year 7 science, but your school’s work program may vary.

You could get students to share some names to the class at the end.

Instructions for students

Recall knowledge from your junior science studies.

* 1. Name as many types of forces you can recall. Remember that a force is something that pushes or pulls.

Answers

1. Student answers will vary. Some examples: applied, push/pull, gravity, tension, spring, friction, electrical, magnetic, nuclear.

Classroom activity: What does 1 N feel like?

Approximate time: 10 minutes

**Activity placement:** Place directly above “How is force measured?”

**Activity summary:** A physical activity to get students to contextualise what a Newton feels like.

Notes for the teacher

Providing some equipment to help students with this activity will benefit them. Two tennis balls, two small brass cubes from thermodynamics, a 250 mL beaker – all are about 100 g/1N.

If you have Newton meter/spring balances (there is an example in Figure 2), this can also be useful to get out so that students can practice pulling for a range of newtons.

A scale is needed for this activity. Providing a small glass beaker (100 mL) that students can put water into to make 100 g of mass is also useful.

Instructions for students

Step 1: Gravity is an example of a force you will be learning about in this module, and as such you can feel the force of gravity by lifting objects with different masses.

1. Research how much mass has a weight of 1 newton.

Step 2: Attempt to create this in the lab. You may need to use some of your items from your pencil case, or your teacher may provide some equipment. The teacher will provide a scale for you to check your items against.

Answers

1. About 102 grams.

Classroom activity: Drawing practice

Approximate time: 10 minutes

**Activity placement:** Place directly above “How do you calculate resultant forces?”

**Activity summary:** A practice activity doing free-body diagrams.

Notes for the teacher

You may like to provide another example of a free body diagram with students. You could do an object sitting on a bench, and then a book sitting on a desk which is on a floor for some complexity. Adjust to your own teaching environment.

Remind students that in physics, everything becomes either a box or a circle – this isn’t an art class.

Instructions for students

Hold up your school bag.

1. Draw a free body diagram of your school bag hanging from your arm. Make sure to draw the two forces with a proportional size. This means if the forces are balanced, their arrows should be the same size.

Helpful hints

* The size of the arrows only matters in how they compare to each other. At this point you are not expected to calculate the force.

Support activity

Notes for the teacher

This provides some scaffolding questions to help students identify what the name of the forces is.

Instructions for students

Step 1: Hold up your school bag.

1. Identify the name of the force pulling your bag down.
2. Identify the name of the force pulling your bag up.
3. Draw a free body diagram of your school bag hanging from your arm. Make sure to draw the two forces with a proportional size. This means if the forces are balanced, their arrows should be the same size.

Challenge activity

Notes for the teacher

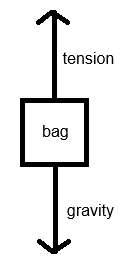
This creates a challenge for creating a two-object system.

Instructions for students

Step 1: Hold up your school bag.

1. Draw a free body diagram of your school bag hanging from your arm. Make sure to draw the two forces with a proportional size. This means if the forces are balanced, their arrows should be the same size.
2. Attach another object to your bag showing the forces acting on you as well. You will need to look up the name of the force where two objects meet – unless you remember it from your junior studies.

Answers

1. 

Support activity

1. Gravity
2. Applied from the hand or tension in the strap. Both are acceptable.
3. A black square with black text

   Description automatically generated

Challenge activity

1. A black square with black text

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2. 