Forces and their effects

Lesson plan and teacher's notes · Form 1 Physics · 1 period of 40 minutes

School	(write school name)	**Teacher**	(write name)
Date	(date)	**Class**	Form 1
Subject	Physics	**Enrolment**	Boys ___ Girls ___ Total ___
Time	40 minutes	**Topic**	Forces and their effects

Learners say what a force is, name six kinds of force, explain balanced and unbalanced forces, and describe what a force can do to the shape, size, speed and direction of a body. Every example comes from daily life: a wheelbarrow, a football, a tug-of-war and a water bucket on a rope.

Specific outcomes

By the end of the lesson, learners should be able to:

1. Say what a force is
2. Name and describe applied, frictional, gravitational, normal, tension and air resistance forces
3. Explain balanced and unbalanced forces and what each does to an object
4. Describe the effects of a force on the shape, size, speed and direction of a body
5. Give everyday examples of forces

Prior knowledge

- Pushing and pulling objects
- Objects at rest and objects that move
- Rough and smooth surfaces

Teaching and learning materials

- a box or a book
- a rope or a piece of string
- a spring or a rubber band
- a ball
- a lump of dough or clay if available
- chalk and board

References

Ministry of Education (CDC) Form 1 Physics syllabus and module; 25Schools learners' note: Forces and their effects.

Lesson development

Stage and time	Teacher activities	Learner activities
Introduction 5 min	Push a box along the floor and pull a rope. Ask what you are doing and tell learners that a push or a pull is a force.	Name pushes and pulls they use at home and copy the lesson title.
Development: what a force is and kinds of force 13 min	Teach that a force has magnitude, direction and a point of application, so it is a vector quantity. Teach the six kinds of force with the box diagram: applied, friction, gravitational, normal, tension and air resistance.	Match each kind of force with its meaning and an everyday example.
Development: balanced and unbalanced forces 10 min	Work the tug-of-war example, then show that the box moves to the right only when the applied force is greater than friction.	Decide whether forces are balanced or unbalanced in three situations and say what happens.
Development: effects of a force 9 min	Squeeze the spring or dough and kick or roll the ball to show change of shape, size, speed and direction.	Name the effect of the force in each demonstration.
Conclusion 3 min	Ask for one kind of force and one effect of a force. Set the homework.	Answer orally and copy the homework.

Teacher's content notes

Read these before the lesson. They are what you need to know, not what to copy onto the board.

What is a force

A force is a push or a pull that causes an object to change its state of motion. A force can change the speed of an object, its direction, or both. A force has a size, called its magnitude, and a direction. The point where the force is applied is the point of application. Because a force has both size and direction, it is a vector quantity.

Kinds of force

An applied force is a force that a person or an object applies to another body, such as pushing a cart. Friction opposes the motion between two surfaces in contact, which is why a box slides more slowly on rough ground. Gravitational force attracts objects towards each other because of their mass. The normal force acts at right angles to the surface where two objects touch. Tension acts along a string or wire, such as a rope pulling a bucket. Air resistance opposes the motion of an object through the air.

Balanced and unbalanced forces

Balanced forces act on an object from opposite directions and are equal. An object acted on by balanced forces will most likely stay still. Unbalanced forces act from opposite

directions and are not equal. An object acted on by unbalanced forces moves. In the drawing of the box, the box moves to the right only when the applied force is greater than the friction acting against it.

The effects of a force on a body

A force can change the shape or size of an object. This is called deformation. Examples are compressing and stretching a spring, kneading dough and kicking a football. A force can also change the speed or direction of a moving object. Pushing a stationary ball makes it move, and a player's kick can change the direction of a rolling ball.

Questions to ask during the lesson

Question	Expected answer
A boy pushes a cart at the market and a girl pulls a rope tied to a bucket. (a) Say what a force is. (b) Name the force that acts along a rope or wire. (c) Say what the size of a force is called.	(a) A push or a pull that causes an object to change its state of motion. (b) Tension force. (c) Its magnitude.
A learner pushes a box over a rough floor and notices that it slows down when he stops pushing. (a) Name the force that opposes motion between two surfaces in contact. (b) Name the force that acts at right angles to the surface where the box and floor touch. (c) Name the force that opposes the motio	(a) Frictional force. (b) Normal force. (c) Air resistance.
Two teams of learners pull on a rope with equal forces in opposite directions and nobody moves. (a) Say what kind of forces these are. (b) Say what happens to an object acted on by these forces. (c) Say what happens to an object acted on by unbalanced forces.	(a) Balanced forces. (b) It will most likely stay still. (c) It moves.
A learner kneads dough, stretches a spring and kicks a stationary ball. (a) Name the effect on the dough and spring. (b) Name the effect on the ball. (c) Give two effects a force can have on an object.	(a) A change of shape or size, called deformation. (b) It makes the ball move, which is a change of speed. (c) Any two of: change its shape, change its size, change its speed, change its direction.

Worked examples for the board

Example 1: tug-of-war

Two learners in a tug-of-war pull on a rope with equal forces in opposite directions. What happens to the rope, and why? The two forces are equal and act in opposite directions, so they are balanced forces. An object acted on by balanced forces will most likely stay still. So the rope does not move.

Example 2: the box and the applied force

A box is pushed along the ground with an applied force while friction acts against it. The box moves to the right only when the applied force is greater than the friction. Then the forces are unbalanced, and an object acted on by unbalanced forces moves.

Example 3: a ball in a game

A stationary ball is pushed and moves, and later a player's kick changes the direction of the rolling ball. Pushing the stationary ball changes its speed and the kick changes its direction. A force can change the speed or direction of a moving object, or both.

Board plan

Write the title and key words. Left: the box diagram with the four forces labelled. Centre: the table of the six kinds of force. Right: the balanced and unbalanced comparison and the list of effects.

Force	What it does	Example
Applied force	A person or object pushes or pulls another body	Pushing a cart
Frictional force	Opposes motion between two surfaces in contact	A box slides more slowly on rough ground
Gravitational force	Attracts objects towards each other because of their mass	Objects with mass are attracted to each other
Normal force	Acts at right angles to the surface where two objects touch	Where a box and the ground touch
Tension force	Acts along a string or wire	A rope pulling a bucket
Air resistance	Opposes motion of an object through the air	Air opposes a moving object

Kinds of force

Mistakes to expect

Learners often think	Put it right
A force is only a push, never a pull.	A force is a push or a pull that causes an object to change its state of motion.
Balanced forces make an object move.	Balanced forces are equal and act from opposite directions, so an object acted on by balanced forces will most likely stay still.
A box moves as soon as any applied force acts on it.	The box moves to the right only when the applied force is greater than the friction acting against it.
A force can only change how fast something moves.	A force can change the speed or direction of a moving object, and it can also change the shape or size of an object, which is called deformation.

Differentiation

Learners who struggle

Give learners a card with the six kinds of force and their meanings and ask them to draw arrows on a box diagram. Use real objects, such as the box and the rope, to show each force before learners name it.

Learners who finish early

Ask learners who finish early to draw a diagram of a rope pulling a bucket and label the tension force, and to explain why a force is a vector quantity.

Hearing or visual impairment

For learners with hearing impairment, write each kind of force on the board and demonstrate it with an object. For learners with visual impairment, let them feel the push and pull on the rope and the squeeze of the spring, and describe each diagram aloud.

No projector, no printing

Use a book or a school bag for the box, a piece of string for the rope and a ball or a rolled paper ball. Draw all the diagrams on the board with chalk.

If time is short

Teach what a force is, the six kinds of force and balanced and unbalanced forces. Leave the effects of a force on a body for the next lesson.

Evaluation

Question or task	A correct answer shows
A farmer pushes a loaded wheelbarrow along a sandy path at a village in Luangwa. At first it does not move, then it moves when he pushes harder. (a) Name the force that the farmer applies and the force that acts against it. (b) Say whether the forces are balanced or unbalanced when it does not move and when it moves. (c) Explain why it moves when h	(a) The farmer's applied force, and friction. (b) Balanced when it does not move, unbalanced when it moves. (c) When he pushes harder the applied force becomes greater than friction, so the forces are unbalanced and the wheelbarrow moves.
A boy kicks a football along the ground at a school field. The ball starts moving, then a girl kicks it from the side and it changes direction, and later it slows down and stops on the grass. (a) Say what effect each kick had on the ball. (b) Name the forces that slow the ball. (c) Say whether the forces are balanced or unbalanced when it slows dow	(a) The first kick made it move and the side kick changed its direction. (b) Friction between the ball and the grass, and air resistance. (c) Unbalanced, because the forces opposing the motion are greater than the force driving it.
Two learners in a tug-of-war pull on a rope with equal forces in opposite directions and the rope does not move. (a) Say whether the forces are balanced or unbalanced. (b) Explain why the rope does not move. (c) Name the force that acts along the rope.	(a) Balanced. (b) The forces are equal and act in opposite directions, and an object acted on by balanced forces will most likely stay still. (c) Tension force.

Homework

A girl in a village pulls a bucket of water up from a borehole with a rope, and when she stops pulling the bucket stays still. A boy squeezes a lump of dough in his hands and it changes shape. (a) Name the force that acts along the rope. (b) Say whether the forces on the bucket are balanced or unbalanced when it stays still. (c) Name the effect of the force on the dough.

Extra practice with answers

Question	Answer
1. A man at a village pushes a cart loaded with maize along the road and the cart does not move even though he pushes hard. (a) Name the force that the man applies. (b) Name the force that acts against it. (c) Say whether the forces are balanced or unbalanced and why.	(a) Applied force. (b) Friction. (c) Balanced, because the cart does not move and balanced forces will most likely leave an object still.
2. A girl pulls a bucket of water up from a borehole with a rope and the rope is tight. (a) Name the force that acts along the rope. (b) Say what a force has besides its size. (c) Say why a force is a vector quantity.	(a) Tension force. (b) A direction. (c) Because it has both size and direction.
3. A boy kneads dough for bread, then a girl compresses a spring and lets it stretch back. (a) Name the effect of the forces on both. (b) Say what this effect is called. (c) Give one more example from the note.	(a) The forces change the shape or size of the dough and the spring. (b) Deformation. (c) Kicking a football.
4. A boy slides a box along rough ground and then along smooth ground. (a) Say on which ground the box slides more slowly. (b) Name the force that explains the difference. (c) Say what this force does between the two surfaces.	(a) The rough ground. (b) Friction. (c) It opposes the motion between two surfaces in contact.
5. A player kicks a rolling ball from the side and it changes direction. (a) Name the effect of the force on the ball. (b) Say whether the speed or direction changed. (c) Name two forces that act against the moving ball.	(a) It changed the direction of the rolling ball. (b) The direction. (c) Friction and air resistance.

Answers to the learners' check-yourself questions

1. What is a force?
   A push or a pull that causes an object to change its state of motion.
2. Name the force that opposes motion between two surfaces in contact.
   Frictional force.
3. What happens to an object acted on by balanced forces?
   It will most likely stay still.
4. Give two effects a force can have on an object.
   Any two of: change its shape, change its size, change its speed, change its direction.

5. What is the force that acts along a rope or wire called?
   Tension force.
6. You are a learner at a school in Luangwa. A farmer pushes a loaded wheelbarrow along a sandy path. At first it does not move, then it moves when he pushes harder. (a) Name the force that the farmer applies and the force that acts against it. (b) Say whether the forces are balanced or unbalanced when
   (a) The farmer's applied force, and friction. (b) Balanced when it does not move, unbalanced when it moves. (c) When he pushes harder the applied force becomes greater than friction, so the forces are unbalanced and the wheelbarrow moves.
7. A boy kicks a football along the ground at a school field. The ball starts moving, then a girl kicks it from the side and it changes direction. Later it slows down and stops on the grass. (a) What effect did each kick have on the ball? (b) Name the force that slows the ball on the grass. (c) Say whe
   (a) The first kick made it move and the side kick changed its direction. (b) Friction between the ball and the grass, and air resistance. (c) Unbalanced, because the forces opposing the motion are greater than the force driving it, so the ball does not keep moving.

Teacher's reflection

What went well:

What I will change next time:

Learners who need follow-up: