Pushes and pulls – making a change

Critical teaching ideas - Science Continuum F to 10
Level: Moving towards level 4

Student everyday experiences

Understandably, children view the world of moving objects in quite simple terms. This is often in contrast to the precise and complex terminology and definitions described by Science. Some of these ideas are explored in earlier levels (See Pushes and Pulls, Pushes and Pulls – What is a force?)'

Students' day to day experience of moving objects is that they need a constant push to keep them moving. This experience is reinforced by cycling, roller skating and simply sliding heavy objects across a floor. Without a constant force objects in a friction filled world do eventually slow down and stop.

These experiences support the common view that:

- Constant motion requires a constant force
- The greater the amount of motion, the greater the force required to maintain it (See Gunstone & Watts, 1985)

The scientific view

There are often many forces acting on an object. Some, such as those arising from frictional interactions when surfaces slide over each other, are often not thought of as forces in everyday life.

For stationary objects and objects moving with a steady speed in a straight line, all the forces cancel each other out, i.e. they are balanced.

If the total forces acting on an object are not balanced then the motion of the object will change. It may speed up, slow down and/or change direction.

For a given force, an object with a small mass will experience a greater change in motion than an object with a larger mass.

A large unbalanced force on an object will produce a bigger change in motion than a smaller unbalanced force on the same object. This is consistent with the common experience that large massive objects require large forces to make the move, speed up or change direction.

Critical teaching ideas

- We can describe how something moves by using terms such as at rest, constant speed, speeding up and slowing down.
- A force can speed up or slow down an object.
- A force can change the direction in which an object is moving.
- A bigger force on an object will produce a bigger change in the motion.
- A heavier object requires a larger force than a lighter object in order to undergo the same change in motion.

Students should be helped to describe changes in motion using terms such as 'getting faster' and 'slowing down'. They should also be assisted to identify and determine when an object undergoes a change in direction. This should be seen by students as a change in motion of equal importance to a change in speed.

Look to provide teaching experiences that help them understand that in order to change how something is moving it needs to be given a push or a pull (i.e. a force).

Students should be guided towards understanding that:

- Changes in the way things move (i.e. their speed or direction) are caused by forces.
- Big forces can make big changes in the way something moves.

The more material there is in something, the greater the force needed to change the way it moves.

Teaching activities

Open up discussion via a shared experience.
Students should be given opportunities to observe many kinds of moving things, and be asked to describe changes in motion such as speeding up, slowing down or changing directions. Observations can be in the playground, on video clips, at a sporting venue, etc.

Promote reflection on and clarification of existing ideas.
Students need experiences that help them to focus on the effects of pushes and pulls and how they can result in objects speeding up and slowing down (e.g. a person on a swing, moving balls, someone sitting on a skateboard). They also need to experience forces that change the direction of things that are moving (e.g. bike, ball rolling along the ground). (See AAAS Benchmarks)

Challenge some existing ideas.
Students can be set the difficult task of changing the direction or speed of a rolling marble by directing an air stream at it by blowing through a straw. They should try changing its speed, e.g. making it speed up, or change its direction.

Students can stretch a short elastic 'shock cord' to pull a long a student on a skate board. By keeping the extension of the 'shock cord' the same length, they are keeping a steady pulling force on the student and very soon the skate boarding student will be moving very quickly. Have the students investigate how a change in the direction of the pulling force will alter the skate boarder's direction of motion.

Students should experience the force required to stop objects of different weight such as moving balls of different weights (eg. Medicine ball, basketball, shot put billiard ball, golf ball, and tennis ball).

Collect evidence/data for analysis.
Students should be encouraged to think about ways of measuring, and recording, speed and the size of forces. Encourage students to explore changes in motion with respect to road safety. They can investigate stopping distances of bikes moving at different speeds and on different surfaces. They can explore ideas of the difference in force required to stop a truck and a car moving at the same speed.