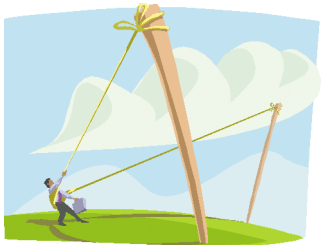
SENSOR(S) - Internal Light



INVESTIGATE

- Predict the effect of stretching elastic bands by different amounts
- To make comparisons and draw conclusions from results, indicating whether the prediction was supported
- Explain the conclusions in terms of the size of the force
- Practice knowledge of the relation between distance and time (speed)

INTRODUCTION TO THE INVESTIGATION

This investigation looks at the way an elastic band can be used to produce a force – either a push or a pull depending on how it is used. It also looks at how the amount of force produced can be changed by stretching the elastic band by different amounts. Throughout the investigation the pupils should be encouraged to discuss what is happening in terms of the forces involved e.g. 'the further I pulled the band, the faster the car went because there was a bigger push on it'.

Before carrying out the investigation it is important that the pupils have already experienced the basic ideas behind forces by 'playing' with various objects to see how they can me moved by pushing and pulling and how they continue in the one direction until another force is applied to them e.g. a push or pull to change direction or friction that slows them down.

The choice of using time or speed is partly dependent on the abilities and knowledge of the pupils. Because only one light sensor/switch is used a known length of card is required so that the speed can be calculated - the Explorer starts timing when the front edge of the card passes the sensor and stops timing when the back edge passes i.e. it times how long it takes the card to pass in front of the sensor. By knowing the length of the card and how long it took to pass the speed can be calculated (if using Explorer's built in speed display a 10cm length of card MUST be used).

This investigation can be carried without logging by simply measuring the distance travelled, however, problems can occur when the 'vehicle' goes too far or when pupils are having difficulty in producing measurements. By measuring the speed or the time it takes to pass the same point for each run the results are produced quickly and are fairer so enabling more time for discussion.

TIME/SPEED – ELASTIC FORCE

RESOURCES

- Explorer datalogger , datalogging software, computer, LogIT computer link cable
- Dynamics trolley, toy car or similar vehicle.
- Matt black card or similar to attach to the top of the vehicle to trigger the light switch.
- A light source e.g. lamp, torch, sunny day.
- Test track – a ţat board with, at one end, an elastic band stretched between two nails. Dowel rods or wood sides could be added to help the 'vehicle' remain on the track.
- Ruler to measure the pull of the elastic band.

WHAT TO DO

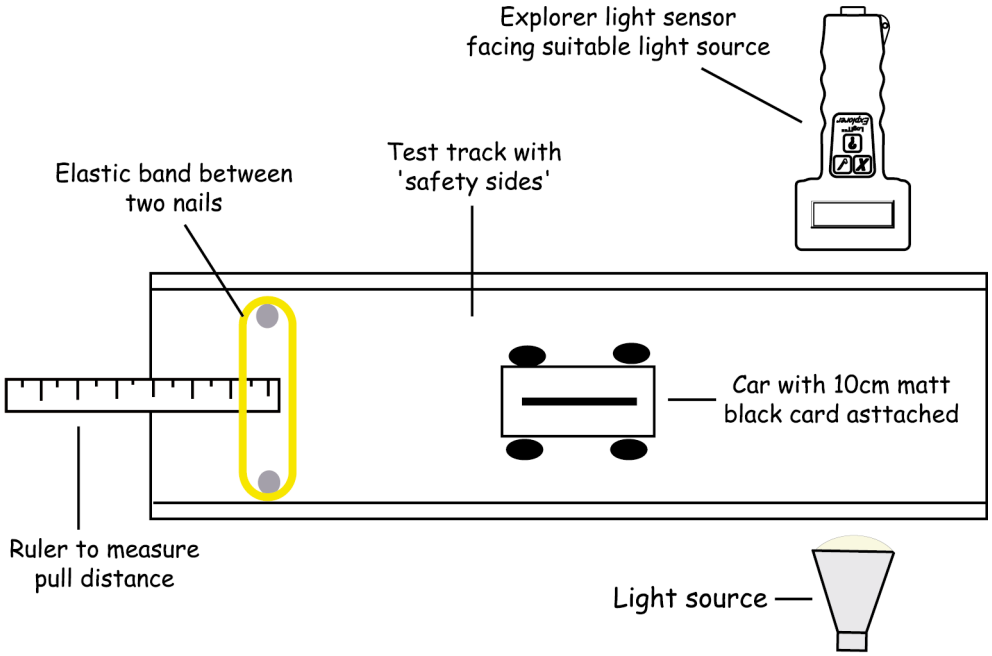
- Set up the test track as shown in the diagram (pupils could create/design the track depending on abilities).
- Cut out a 10cm long piece of matt black card and attach it to the test vehicle.
- Place the Explorer about three quarters of the way down the track ensuring the black card on the vehicle will pass in front of the light sensor. Place the light source on the opposite side of the track so that it forms a light gate with the Explorer.
- Before each run get the pupils to predict the results compared to the previous run e.g. 'it will go faster, it will go slower'.
- Connect the Explorer to the computer. Run the datalogging software and select the timing function (this may either be an option in the software or a separate program). Set up the timing software so that it knows you are using a single light switch and that you wish to measure speed or time. Start the software.
- Pull the elastic band back and write down how far the pull was using the ruler – a discussion will be needed as to how to measure correctly and in particular the 'at rest' position or start position of the band before it is pulled.
- Place the vehicle in front of the band and release the vehicle down the track passed the Explorer, recording either its speed or time – this brings up another issue of fair testing, how close the car is placed to the band before release.
- Repeat the run for different amount of pull, making sure that each time you note down the length of pull.
- When Ţnished, the results should be saved and printed - the pupils can then decide on the best way to show the results. The data could be transferred to a third party product such as a spreadsheet.
- Discuss the Ţndings, whether they matched the predictions and how the force produced by the elastic band is changed.

If computers are limited the same investigation can be carried out using the Explorer's built in time or speed facility which is selected by using the blue button. The pupils can manually record the results then enter them into a spreadsheet or database package.

SAFETY

- Care must be taken with elastic bands as injuries can result from bands breaking or being ticked at a person.
- Test the elastic bands before use as it is surprising how fast a small car can travel if enough force is applied to it !
- Make sure that there is something to stop the car at the end of the track rather than pupils using parts of their anatomy !

DIAGRAM



TIME/SPEED – ELASTIC FORCE

ABOUT THE RESULTS

- Was it a fair test ? – how close was the vehicle to the elastic band, was the track level, did the vehicle go straight ?
- Which length of pull produced the fastest speed/time (largest force) ?
- Which length of pull produced the slowest speed/time (smallest force) ?
- Did the results match the prediction ?
- What conclusion can be drawn from the results ?

EXTENSION ACTIVITIES

- Keep the length of pull the same but change how close the car is to the elastic band before release – why does this effect the result ?
- What other forces are affecting the car ?
- The same test track can be used to test different shapes and masses of cars. Extra card can be added to the front of the vehicle in different shapes to see the effect of air resistance – take care that the extra card does not pass in front of the Explorer light sensor/switch as this will cause false readings.
- It is possible to test the pull of the band, instead of the push, by attaching the elastic band to the front of the vehicle.
- Instead of an elastic band a spring can be used.
- Pupils could use their knowledge to create a pinball like game with a spring or elastic band launcher for the ball or could make a car game for shooting vehicles along a track.