

## TIME/SPEED - FRICTION

**SENSOR(S)** - Internal Light

**INVESTIGATE**

- Friction as a force which slows moving objects
- Describe the movement of objects (speed up, slow down etc.)
- Practice knowledge of the relation between distance and time (speed)



### INTRODUCTION TO THE INVESTIGATION

The movement of objects can be changed by applying different forces - pushing, pulling, dropping (gravity).

When designing a car it is important to take into account the forces that will effect how well it handles and how fast it can go. Two important forces that can change the speed of a car are air pressure and the friction of the tyres on the road. To demonstrate/experience friction get two shoe brushes, slide the backs together and then slide the brush parts together. Which was easier to do ? What you have experienced is the effect of one object slowing down another by rubbing together (friction).

This investigation tests the friction of different materials by testing the effect that the materials have on the time/speed of a 'vehicle' travelling down a ramp.

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).

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### **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 which can be raised to form a ramp
- Different materials to place on the track and a way of connecting them (e.g. tape)
- Ruler to measure the height of the track.

### **WHAT TO DO**

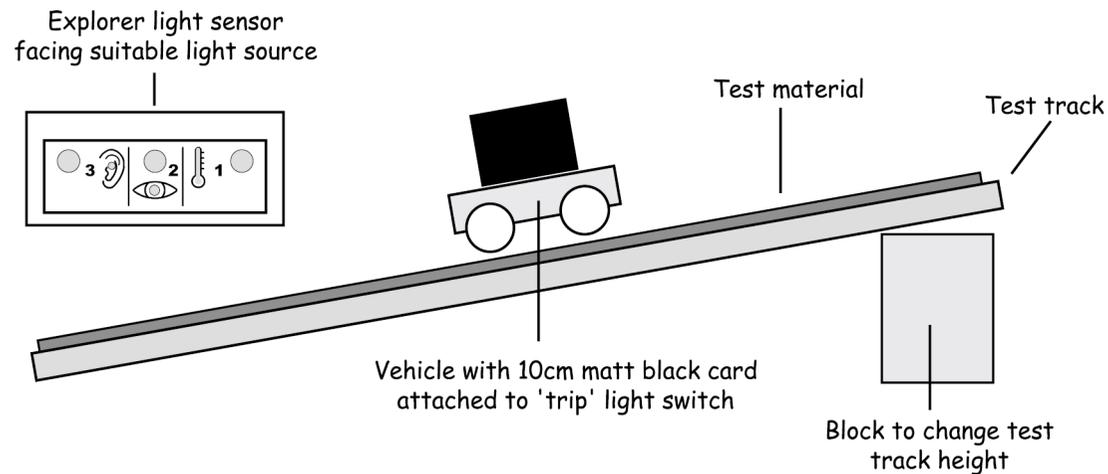
- Cut out a 10cm long piece of matt black card and attach it to the test vehicle.
- Place the Explorer about three quarters of the way down the track ensuring the black card on the vehicle will pass in front of the light sensor. Place the light source on the opposite side of the track so that it forms a type of light gate with the Explorer.
- Get the pupils to try to predict the results by feeling the materials.
- 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.
- Run the vehicle down the track passed the Explorer, recording either its speed or time and note down that the first reading was without material (although what the test track is made out of classes as a material).
- Choose a piece of material and write down its description so that when you come to view the graph you know which point on the graph refers to which piece of material.
- Stick the material securely to the track and note down its description.
- Run the vehicle down the track again.
- Repeat this for each piece of material you want to test.
- When finished, 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 findings and whether they matched the predictions.

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Fair testing is important with this experiment as it is possible to change a lot of different factors which might affect the test such as the height of the track, the starting point of the vehicle, whether the vehicle is pushed or just released - because of the number of variations it is worth spending time talking about fair testing with the pupils.

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 displayed result of each run and then manually display their results or enter them into a spreadsheet or database package (the Explorer does not record timing information, it simply displays it for the pupils to write down).

### DIAGRAM



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### **ABOUT THE RESULTS**

- Was it a fair test ? - where did you start the car from on the track, was the track always at the same height ? how big were the pieces of material ?
- Which material slowed the vehicle the most (largest friction) ?
- Which material slowed the vehicle the least (smallest friction) ?
- When would you want no friction (think about the engine itself) ?
- When would you want a lot of friction (think about stopping the vehicle) ?

### **EXTENSION ACTIVITIES**

- Try changing the tyres on the vehicle.
- Does the height of the slope change the results ?
- Does the weight of the vehicle change the results ?
- How could the pupils test the force of the air on the vehicle ? Think about the shape of cars, are they square at the front or rounded? Investigate the aerodynamics of different shapes.