

LOCATION:	TARGET AGE GROUP:
Classroom	KS2
TARGET GROUP SIZE:	DURATION:
10-20 (scale resources for larger group)	Min. 1 hour (ideally 1.5 hrs)

# PLPS CITY SCIENCE STARS

## Fixture 4: Get a Grip

### SUMMARY:

Pupils will learn about the applications of friction in the physical world. Pupils will identify how friction acts and conduct their own investigations into how friction is affected by different footwear and surfaces. Pupils will then analyse their results and draw conclusions about how friction is used advantageously in football. Pupils will then discuss when a lack of friction is useful and race their own hovercraft to demonstrate the effects of reduced friction.

### LEARNING OBJECTIVES:

1. To learn how friction is generated and how different types of footwear affect friction
2. To learn about applications of low and high friction surfaces
3. To take measurements accurately using a newtonmeter
4. To understand the importance of repeating measurements to improve accuracy
5. To use test results to make predictions and set up further comparative tests
6. To report and present findings from enquiries

### PRIOR LEARNING AND LINKS TO KS2 NATIONAL CURRICULUM:

- ✓ Pupils will be learning about friction.
- ✓ Pupils may be learning about calculating averages.

### PREPARATION AND RESOURCES:

- ✓ This workshop works best with the use of a computer and projector or a computer-linked smartboard to display the 'GET A GRIP' PowerPoint slides. If none are available, printouts could be used instead, but these will be less engaging and less environmentally friendly.
- ✓ Get A Grip report sheet inside their lab book.
- ✓ Selection of footwear in various styles, ideally with a wide range of 'grip' (e.g. flat sandals, walking boots, astroturf boots). The children can also use their own shoes.
- ✓ 5N newtonmeters (forcemeters).
- ✓ Weights or beanbags for weighing down shoes.
- ✓ Hovercraft (CD with bottleneck attached using a glue-gun and balloon to provide air)

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## ACTIVITY PLAN:

### Introductory activity 1

1. Show the pupils the slide containing images of people in different situations such as ice skating, playing football, skydiving or floating in space. Ask them which one they think is the 'odd one out'. There is no one correct answer, and the pupils are free to explain which one (or more) they think is unlike the rest. Further the question by asking about the forces acting on the people.
2. Explain that all of the images show people interacting with surfaces or fluids through friction, except the astronaut as they are floating in a vacuum with no friction.
3. Discuss what friction is, how it is generated and give some examples of how it is applied in the modern world, such as being required for cars and footballers to move and turn.

### Main activity (small groups of 3/4)

1. Explain that the pupils will be designing and conducting their own experiments to investigate friction. Ask them leading questions about when we might experience friction in everyday situations so that they are able to identify a good experiment to test friction that involves footwear and surfaces.
2. Introduce them to the newtonmeters and explain how they are used to measure force and mass. Demonstrate how to properly use them to find the mass of the footwear and to measure friction by dragging the newtonmeter while attached to the shoe.
3. Allow the pupils to pick which variable they are going to change, whether it is the type of footwear or the type of surface on which the footwear is dragged. Remind them that they will need to keep all other variables the same to make sure it is a fair test.
4. First, the pupils will need to find the mass of the heaviest piece of footwear (likely to be a boot) and note down this mass in grams. If the students choose to vary footwear, they will need to maintain a similar mass between shoes in order to assess the effect of the shoe's bottom on friction generation. This can be achieved by adding masses or beanbags to the lighter shoes to bring them up to a similar mass.

5. Ask pupils to measure the friction generated from a number of different shoes or surfaces (can vary depending on time or ability). Ask them to take three measurements so that they can see if it changes or stays the same each time, and then can calculate a median average.
6. Discuss what the pupils found from their results and talk about the deliberate application of friction in football boots, gloves and pitches.

### Plenary activity

1. Show the clip of Dr Suzie Imber using a supercollider. Explain that certain materials can create magnetic levitation when cooled down using liquid nitrogen. This allows the disc to be pushed around above the track without dropping off while also never actually touching it, making the movement friction-less.
2. Discuss when it might be beneficial to reduce friction, using the examples of air hockey and hovercraft racing as sports where friction is massively reduced.
3. Demonstrate how a reduction in friction affects movement by producing a hovercraft (without balloon) and pushing it across a flat surface, and then repeating it with an inflated balloon attached to the top of the hovercraft, allowing it to create a layer of air under the CD when released and pushed. Emphasise the fact that these balloons will be reused for other experiments and won't be thrown away (to demonstrate sustainable practice).
  - a. Prior to the session, remove the screw-top or (preferably) pull-top from a used plastic bottle and attach around the hole in the centre of a CD using a glue-gun.
  - b. (Optional) Provide hovercrafts for each pupil to try themselves. Allow the children to inflate the balloons themselves if possible or help them out if needed.
4. Review the learning objectives and propose the take-home challenges.

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## TAKE HOME CHALLENGE IDEAS:

- Prompt pupils to make their own hovercraft at home with the help of their parents.
- Also suggest other friction experiments that they could try, e.g. picking up a small plastic bottle full of dry rice by putting a chopstick inside and lifting it, due to the friction between the chopstick and rice.
- Prompt them to research about the achievements of polymaths Isaac Newton and Leonardo Da Vinci with their parents/family, focusing on their work exploring forces and other science projects.

## TASK/ASSESSMENT DIFFERENTIATION:

### ✓ Minimum student goals:

- Measure the friction generated by two very different shoes/surfaces

### ✓ Target student goals:

- Measure the friction generated by three or four different shoes/surfaces

### ✓ Further goals:

- Calculate the mean average instead of the median (may require a calculator)

## PUPIL MONITORING AND EVALUATION:

- During the main activity, monitor the friction investigations and offer help if needed.
- As this is a team investigation, ensure that all pupils in the team are getting involved and understand the rationale and goals of the experiment.

## DELIVERY NOTES AND ADDITIONAL SCIENTIFIC INFORMATION::

- You may need to explain that the difference between weight and mass: **weight is a force** and changes with different gravities; **mass is the amount of matter** in a material and always stays the same.

### Vocabulary

- Friction, weight, mass, gravity, newtonmeter/forcemeter, vacuum, momentum.