Creating Science – Friction Climbers

Friction helps us, but can we get it to do work for us? ***#CreatingScienceFrictionClimbers***

Suggested Outcomes

(NOTE: This is by no means an exhaustive list of possible outcomes, neither is it intended that ONLY these outcomes can or should be met. Science is a deeply interrelated activity, and you may find cross curriculum links you can and should use.)

Science understanding

- Physical sciences 2: A push or a pull affects how an object moves or changes shape.
- Physical sciences 4: Forces can be exerted by one object on another through direct contact or from a distance.

Also

- Physical sciences 3: Heat can be produced in many ways and can move from one object to another.

Science inquiry skills

- Processing and analysing data and information 4: Compare results with predictions, suggesting possible reasons for findings (ACSIS216)
- Communicating 4: Represent and communicate observations, ideas and findings using formal and informal representations (ACSIS071)

Science as a human endeavour

- Use and influence of science 4: Science knowledge helps people to understand the effect of their actions (ACSHE062)

Science vocabulary words

Tier 3 (Specialised vocabulary)

- Force – a push, pull, or twist that can cause a change in motion or reshape an object.
- Friction – a force that opposes motion and heats things up. It is usually caused by rubbing object together, sometimes due to the lumps and bumps there, but at other times due to nanoscopic electrostatic forces pulling against each other.

Warning

- Be careful with scissors.

Preparation

- A picture - of a superhero, Pokémon, or even a relative!
- A stiff piece of cardboard - not too thick or it'll be too heavy, or too thin and it'll be too bendy!
- Straws. Normal plastic ones are fine, though thicker ones (i.e., McDonalds) can be easier to work with for younger people.
- String, lots of it. It's helpful if it is easy to pass through the straws, and then to tie in a stable knot.
- Sticky tape and glue, and scissors for cutting things.

Learning Intent (student friendly)

'We are learning to' (WALT) – understand friction.

Success criteria

'What I'm looking for' (WILF) – a working friction climber and clear description of how it works.

Student learning goals

Help students make a self-monitored learning goal for this lesson, such as put friction to work.

Evidence of learning

How will you know when the learning goal is achieved? What EVIDENCE do you have that your students have met or exceeded the learning expectations?

Suggestions for other year levels

As always, more material is presented here than can be used by the average class during the average lesson time. However, since the students' questions can and should guide student learning, more material is presented for your convenience. Remember, it is not uncommon for students to only remember those points which answered their personal questions.

Younger:

This activity is well suited to this age group.

Children at this age can have difficulty with focus. Avoid tangents if you're attempting to make a key point.

Middle:

This activity is very well suited to this age group, enhancing gross motor skills of manipulating the climber, to find motor skills of colouring it in. Friction is an important concept in middle school

Teen:

Extend the learning by researching friction further – it's a VERY complex topic, including dry friction, lubricated friction, drag and resistance.

Engage

Explain: According to science, something that is moving will keep moving forever unless something stops it.

- ⇨ Push a toy car, it will eventually stop.

Ask: Why, then, didn't that toy car go forever?

Ask: Maybe something invisible is getting in the way?

Explore

Yes, the air is.

But maybe there's something else as well?

- ⇨ Turn the car upside down. Give it a push, ask why it didn't go as far.

Explain: the wheels stop the bottom of the car from rubbing on the ground. All that rubbing slows the car down very quickly!

- ⇨ But the wheels are still rubbing on the car, can you find where? [On the axle.]

Ask: So rubbing slows things down? What about a balloon powered CD hovercraft (see below)? Riding on a cushion of air, will it go further?

Explain

Explain: This rubbing is called FRICTION by motion scientists. Friction is a force that pushes against the direction of motion, and turns that motion into heat instead. You can feel it when you rub your hands together to warm them up.

Slippery things have very little friction.

Things with a lot of friction can get stuck.

But **friction can also be our friend**. Would you like to see friction at work?

- ⇨ Build the friction climber from Creating Science, and set it in motion.

Elaborate

Research, with the students, different ways in which friction can help.

- Without friction we'd slide all over the floor like hockey pucks on ice. Friction keeps us in place.
- Friction is what makes breaks work. Without friction how would we stop? We could still bounce off things and change direction, but friction helps to slow us down to a stop.
- Sometimes, of course, we don't want things to stop, so we have to lower friction. Oil and grease help lubricate a car's moving parts so that they work more effectively instead of turning their energy into heat. Some estimates claim a third of a car's energy is used up as friction of various kinds (but are these claims from sources we can trust, or are they financially motivated to produce high numbers? Comparing and contrasting the two sources is very informative…).

So who invented the concept of friction? Many ancient cultures had an intuitive and possibly quite detailed concept, for example, the ancient Egyptians and Mayan cultures probably used rolling logs to lower the friction of heavy stone blocks to build their pyramids.

In modern times, the first recorded instance ended up being UNPUBLISHED in the Italian scholar Leonardo DaVinci's note books. Many scientists over many years had much to contribute, as briefly outlined here.

Evaluate

⇨ Review the Learning Intentions of this lesson with students. Were they met?

At the end of each class, review the learning objective and see how we did. Ask:

- Did you achieve your learning goal?
- What worked to help you achieve it?
- What might you do better next time?
- (If needed) where can you go for extra help or information?

Assessment

Prior learning:

Try a game of hangman with the word "Friction" to start the topic.

Find out what students already know about friction, by asking

- What is friction?
- Why do bikes need brakes?
- What makes things stop?

Be sure to watch out for the following common alternative conceptions (Gilbert & Watts, 1985[1]):

- Forces are a property of living things, such as people, not objects. [anything with mass, any many things without mass, can emit a force]
- Constant motion requires a constant force [not so, inertia requires that we keep going UNLESS something forces us not to. The planet will keep spinning to make day and night, for instance, and unless something stops it it'll just keep going. In a very real sense, we only need a force to prevent stopping, not to keep moving!]

Formative:

As students are learning, help them self-monitor their own learning and achievements.

While students are building the device, walk around and ask teaching questions such as:

- Why do you think the straws need to be on an angle like that? What happens if you change the angle?
- What job does the string do? Why does the string need to be tight, and not lose?
- Do you think it would work better with thicker string?
- What job does the picture do?

Summative:

Build a friction climber, and give an oral presentation on how it works to a small group of parents or peers.

So what?

The friction climber can teach us many things:

- Changes in motion can be caused by invisible forces, such as wind resistance and friction.
- Contributions from many people across many cultures helped to create the scientific knowledge we use today.

[1] Gilbert, J. & Watts, M. 1985. Force and motion. In R. Driver, E. Guesne & A. Tiberghien (eds) *Children's Ideas in Science*. Milton Keynes, UK: Open University Press, pp. 85-104.

Q: Who created the idea called 'friction'?

A: Leonardo DaVinci, but he didn't tell anyone!

⇨ Review with students what they felt they learnt from this lesson. Did they have any questions at the start that they feel were answered?

Creating science

Science understanding

As we learnt about the motion of the friction climber, we saw that;

- Physical sciences 2: A push or a pull affects how an object moves or changes shape.
- Physical sciences 4: Forces can be exerted by one object on another through direct contact or from a distance.

Also

- Physical sciences 3: Heat can be produced in many ways and can move from one object to another.

Science inquiry skills

As we tested ideas about motion with out climber, we had the chance to:

- Processing and analysing data and information 4: Compare results with predictions, suggesting possible reasons for findings (ACSIS216)
- Communicating 4: Represent and communicate observations, ideas and findings using formal and informal representations (ACSIS071)

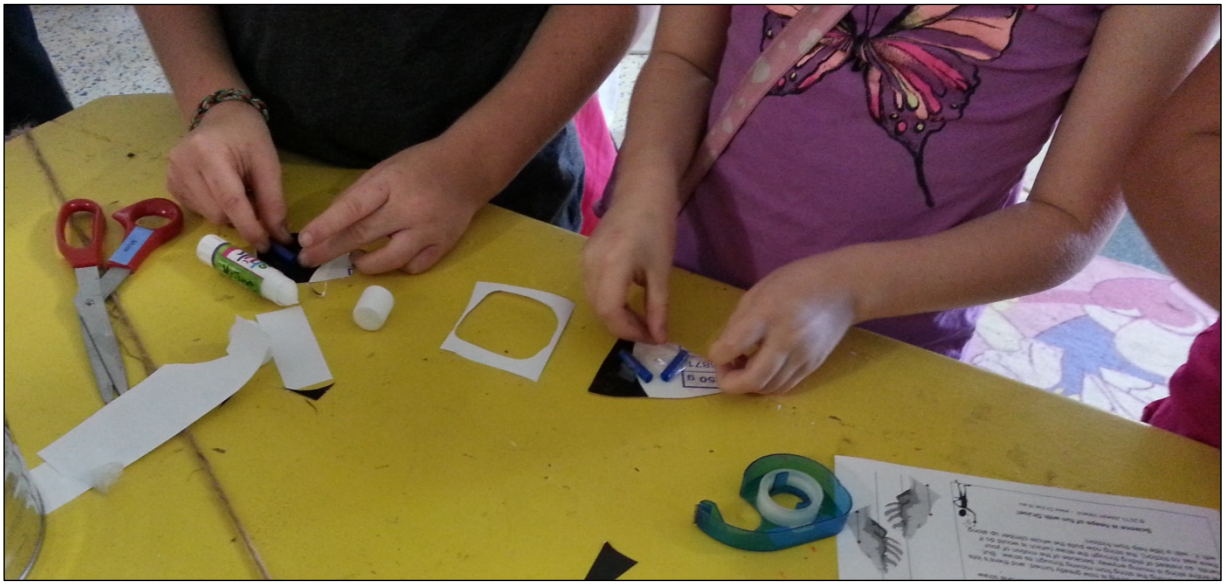
Science as a human endeavour

As we learnt how friction is our "frenemy", helping and hindering us, we learnt that;

- Use and influence of science 4: Science knowledge helps people to understand the effect of their actions (ACSHE062)

Tips from the masters to make it work:

Straws at almost 90 degree angle please!



Friction climber masters hard at work!