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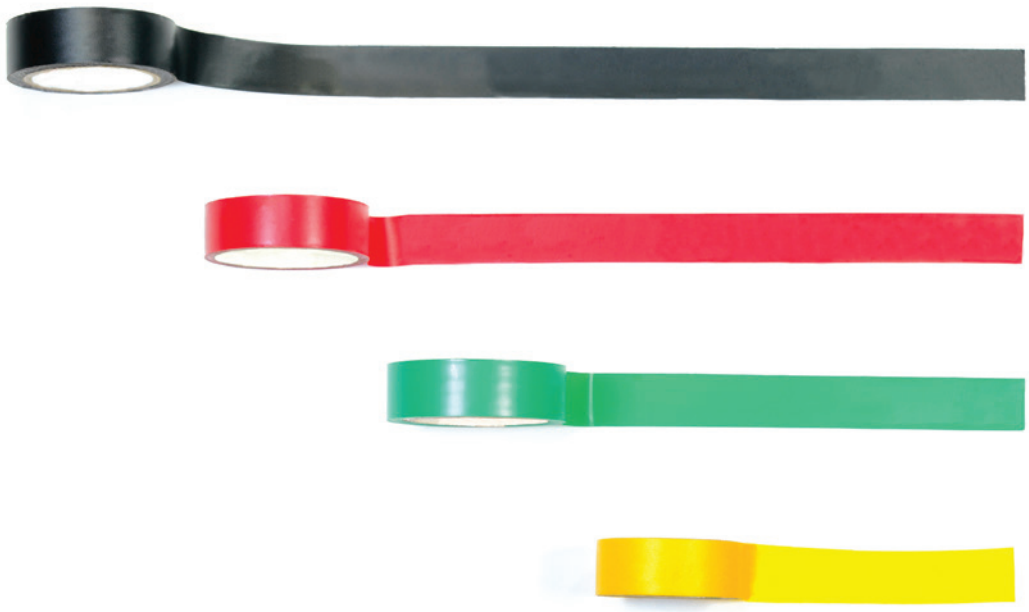
Sticky Buisness

Read the article about the science of sticky stuff:

https://education.australiascience.tv/sticky-business

In this, we learn about why substances are sticky.



Background Science.

Abstract
In this lesson, students will test the shear strength of different sticky tapes by performing tests in which they will take measurements, record data, and report their findings. They will explain how the usefulness of a manufactured product depends on its function for a particular purpose. Students will learn how scientists and engineers look to nature to invent products that are useful in our lives.

Objectives.

What students know upon completion of this lesson:

- Students will describe one way to test the shear strength of tapes meant to hold something to an upright surface, like a wall.
- Students will explain how the usefulness of a manufactured product depends on its function for a particular purpose.

What should the students be able to do upon completion of this lesson?

- Students will plan, conduct, and evaluate an experiment to test the shear strength of different adhesive tapes. Skills include obtaining and recording measurements, processing data, and reporting and communicating findings. In the elaboration activity, students will develop research and scientific literacy skills by conducting research of topics related to adhesives and product testing.

Apparatus.

Examples of various kinds of tapes to display in the opener and for testing:

- Masking tape
- Duct tape
- medical bandage tape
- clear packing tape
- cellophane tape,
- Post-it Notes™ *
- Cream sandwich biscuit, such as an Oreo *

*(These are for the opener discussion/ teacher demo to show everyday examples of adhesion)

Testing track for each group:

- Roller ball testing track
- Ruler
- Scissors for cutting tape
- A4 piece of cardboard (folded lengthways into a V shape) *
- carboard tubes e.g. inner tube from wrapping paper (cut in half lengthways) *
- marbles, ball bearings
- measuring tape
- books or blocks to increase ramp incline
- protractor or smartphone app to measure the angle of incline
- Wipes to clean the test marble
- Cloth/rag to dry marble

*(These are used to create the ramp/runway test track)

Other resources:

- Graph paper

Lesson Plan.

Engagement

1. Provide students with a sandwich cookie (two wafers with cream filling between e.g. Oreo). Ask students to twist the cookie layers and pull apart. Notice that the cream filling sticks to one cookie rather than falling off the cookie - the filling acts like a natural adhesive.

NB: If students conduct this demonstration, they can eat the cookie. Be sure, however, that in the experiment that follows, students are cautioned NOT to eat or drink anything else whilst carrying out the experiment.

2. Discuss how scientific observations of nature influence the manufacture and design of adhesive products. Show students the video below. In which graduate student Stephanie Lopez shows how Geckos have inspired polymer scientists at the University of Akron.

Watch the video: https://youtu.be/qSMZkc4kw6U

3. Link the research back to an everyday, real life example students can easily relate. Use the following scenario:

It's the day before the big end of term school dance and the committee is hurrying to finish hanging decorations all over the gym walls. Work is progressing when you notice that you're running out of tape to finish the job. So, you call together your helpers and ask them to look around for more tape and bring back whatever they find as soon as possible while you keep decorating. A few minutes later your helpers return - one has brought a roll of masking tape, another has some clear cellophane tape and some Duct tape, another has clear packaging tape, someone else has a package of Post-it Notes™, and somebody else went to the nurse's office to get medical bandage tape. Quite a selection, you think. There's not much time to waste wondering what tape to use - you're desperate - yet none of these choices were meant to stick decorations to the gym wall? You wish you knew how "sticky" these tapes are so that the decorations you put up, won't fall down in the middle of the dance.

Display the following list of adhesives mentioned in the scenario:

Cellophane tape

Masking tape

Duct tape

Packaging tape

medical bandage tape

Post-it Notes™

Display/ask the students the following questions:
How are these tapes alike? How are they different?
Some tapes might work OK if the surface is flat and laying down (like a tabletop) but might fail if you used them on an upright surface (like a wall).

Which of these would you choose:

- To hold a bandage in place on a wound?
- To secure the wrapping on a box you intended to mail?

Do all these tapes have the same function? Are they all made the same? Do they all have the same stickiness?

Assessment.

Checkpoint 1: Monitor students' answers to questions during planning and discussion to be sure everyone understands the aim of the lesson. Before proceeding, be sure that students understand the posed problem.

Exploration.

- Introduction (taken from **Student Activity**):

This article explained the science of why things are sticky.

We can describe stickiness in different ways. As you have already learned, adhesion describes how strongly the tape and the surface bond to each other. Cohesion describes how strongly the adhesive molecules on the tape attract and hold on to each other. Tack describes how quickly a bond forms between the tape and the surface.

Scientists customise tapes for specific uses by balancing adhesion, cohesion, and tack. For example, high-tack tape sticks quickly to a surface, but it may be difficult to move later.

How can we measure how sticky an adhesive tape is? This question is more complicated than it seems!
In this lesson you will be examining the stickiness on various kinds of tape by conducting a simple test, the kind of testing that inventors and manufacturers use when they are working with new products. You should be able to determine how well the tape performs if you wanted to use the tape to hang something on a wall.

- Demonstrate set up of the apparatus, including how to construct the ramp and testing track.

The video link below shows the procedure for a similar experiment:
How to make a Sticky Tape Testing Apparatus https://youtu.be/mYDCSIVxTGI

Watch the following video to gain an understanding of the experiment using a rolling ball test track.
Rolling Ball Test Track https://youtu.be/pSgD8E_J3Z0

Prior to the experiment, discuss the following points:

- Every group should test the 0° (control) elevation and approximately 10° and 20° elevations.
- Discuss how many angles of the incline (by number of books chosen to lift the board or the measurement of the incline of the ramp) should be tested. Ensure that each group uses the same angle of elevation and performs the same number of tests. This will allow for collation and comparison of class data.
- Before beginning the tests, have students create a **Hypothesis** (predict which tape will be the stickiest/least sticky and roll the greatest/shortest distance along the track.
- Have students identify the **dependent** and **independent variable**.
- Discuss the control of variables and the validity of the experimental procedure.

Ensure the students have formed the correct correlation (the farther the ball rolls down the test track, the weaker is the sticky tape or converse statement).

- Assist students to construct a data chart (sample table in **Student Activity**).

Experiment – have students carry out the experiment following the method in the **Student Activity**.

- Tests of the marble down the inclined tape-path should be repeated for a minimum of three tests per tape.
- Record distance marble travelled after each test; find the mean distance for each type of tape.

After the experiment:

Assessment
Checkpoint 2: Following completion of the experiment, have students report their findings using the **Evaluation** questions (see **Student Activity**) to assess their understanding of the scientific principles involved. Did their data support their predictions?

Explanation.

Discuss the theory behind the experiment (see **The Theory** in **Student Activity**)

In the discussion of the findings, highlight that their tests **only** examined the stickiness of the tape on a glass surface (the marble). Manufacturers of the tape would have to test **other** materials adherence to the tape before marketing the tape as effective on wood, plastic, paper, and other surfaces.

Elaboration.

To elaborate, read the label of the tapes chosen for the class tests to see what surfaces the manufacturer has determined the tape be used on effectively. Ask students how they think these surfaces were determined. (See **Want More?** in **Student Activity**)

Explain that there are many tests that products undergo before they come to our stores' shelves. For tape, there are basically two types of tests - one for **peel strength** and one for **shear strength** (see **The Theory** in **Student Activity**). Ask students how they might design a peel test for the tapes that they tested for shear. (See **Want More?** in **Student Activity**)

Student research project - searching for information on adhesives. Suggested topics include the following:

- History of adhesives
- Invention of Post-it Notes™
- Hot glue, "miracle" glue, "super" glue, specialty glues
- Glues used in surgery
- Glues used in making cars and other products
- Sticky substances in nature

Plenary.

Discuss the applications of adhesives:

Adhesive tapes are a commonly used product around the home, in school, at work, in hospitals, and in industry. Tapes are made for various purposes, so their stickiness varies.

Link to use of adhesives in space. How would the environment differ? What other factors would scientists designing and testing adhesive tapes for use in space need to consider?

Other Considerations.

Grouping Suggestions: Groups of four recommended, materials manager/waste disposer, product tester, data recorder, and results reporter.

Pacing/Suggested Time: Introduction, testing, reporting, discussion, and assessment. These stages could be carried out over several consecutive lessons as an Investigation or students could be given pre prepared materials to accommodate a shorter lesson.

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SCIENCE UNDERSTANDING TOPICS				
YEAR	BIOLOGICAL SCIENCES	CHEMICAL SCIENCES	EARTH AND SPACE SCIENCES	PHYSICAL SCIENCES
R				
1				
2				
3				
4				
5		ACSSU077		
6				
7	ACSSU112			
8		ACSSU152 ACSSU225		
9		ACSSU178		
10		ACSSU186		

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YEAR	LINKED TO SCIENCE AS A HUMAN ENDEAVOUR	CURRICULUM CODE
Yr 7	**Nature and development of science**	
	1. Scientific knowledge has changed peoples' understanding of the world and is refined as new evidence becomes available.	ACSHE119
	Use and influence of science	
	2. People use science understanding and skills in their occupations and these have influenced the development of practices in areas of human activity. **a.** *performance.*	ACSHE121
Yr 8	**Nature and development of science**	
	1. Scientific knowledge has changed peoples' understanding of the world and is refined as new evidence becomes available.	ACSHE134
	2. Science knowledge can develop through collaboration across the disciplines of science and the contributions of people from a range of cultures.	ACSHE226
	Use and influence of science	
	3. People use science understanding and skills in their occupations and these have influenced the development of practices in areas of human activity.	ACSHE136
Yr 9	**Nature and development of science**	
	1. Advances in scientific understanding often rely on developments in technology and technological advances are often linked to scientific discoveries.	ACSHE158
	Use and influence of science	
	1. People use scientific knowledge to evaluate whether they accept claims, explanations or predictions, and advances in science can affect people's lives, including generating new career opportunities.	ACSHE160
	2. Values and needs of contemporary society can influence the focus of scientific research.	ACSHE228
Yr 10	**Nature and development of science**	
	1. Scientific understanding, including models and theories, is contestable and is refined over time through a process of review by the scientific community.	ACSHE191
	2. Advances in scientific understanding often rely on technological advances and are often linked to scientific discoveries.	ACSHE192
	Use and influence of science	
	1. People use scientific knowledge to evaluate whether they accept claims, explanations or predictions, and advances in science can affect people's lives, including generating new career opportunities.	ACSHE194