

Adhesives - Worksheet

By: Louise Lopes based on the Workshop Investigation of Ian Bentley

Introduction:

This is one sticky situation! Glues and adhesives are a common part of everyday life. We use them to stick things in a book, on a wall, or to repair a broken item.

The desk you are sitting at probably has a plastic laminate surface glued to a particleboard plank. If you are in a room with plaster walls, the plaster board has probably been glued to the building frame.



Figure 1

An important component of composite materials such as carbon-fibre and fibre-glass use glue, usually called a resin. When the resin dries (cures), the fibres stick together making a very hard and strong material. Even particleboard is a composite material made of woodchips and a glue called formaldehyde resin.

Carbon fibre is a potential replacement for metal parts in many products. It is strong and light but currently it is expensive and slow to manufacture. Material scientists are trying to make carbon fibre cheaper, stronger and faster to make. One of the keys to improving carbon fibre production is an understanding of how adhesives work.

In this activity, you are going to investigate how adhesives stick things together. You will be able to give a scientific explanation of the problems that material scientists are trying to solve in their research on carbon fibre manufacture.



Figure 2

Part A – Strength of Adhesion to Different Surfaces

Question:

In this activity, you will investigate the question: *“To which surface does Blu-Tack stick best, wood or plastic?”*

Write an Aim and Hypothesis based on this question:

Plan:

Materials List:

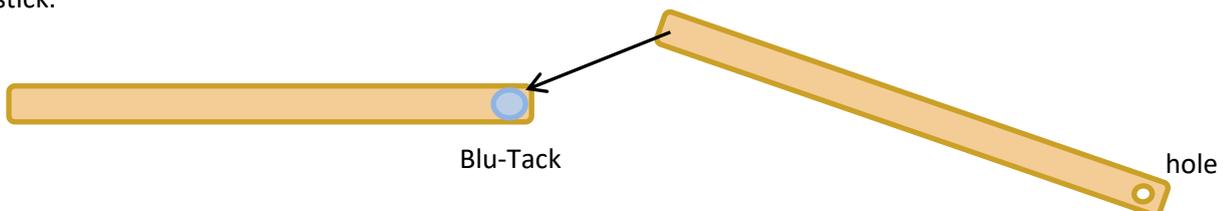
- A small piece of Blu-Tack about 6 mm in diameter.
- 2 paddle-pop sticks (one with a hole in one end)
- 2 plastic strips (one with a hole in the end)
- Slotted brass weights – about 500g
- Sand-paper

Instructions have been provided to you in the Conduct section, however they aren't thorough. You will need to think of more detailed steps. Read the instructions and try to identify what you can do to make the experiment a **fair test** (you may also set-up the equipment to help with this).

Write your answer below:

Conduct:

1. Stick two icy pole sticks together as shown so that they overlap by a distance equal to the width of the stick.



stick two paddle-pop sticks together
with Blu-Tack end to end

Hint: It is important that you use only a VERY small piece of Blu-Tack otherwise it will spread around the sides gripping the edges. A sphere of about 2-3mm in diameter is enough.

- 2. Hang glued icy pole sticks from clamp on a stand as shown in the diagram to the right.
- 3. Hang a 50-gram brass weight through hole in icy pole stick. Progressively add weight until the joint breaks. Record in the Results table the load at which the joint fails.
- 4. Closely observe the fractured Blu-Tack surface. Describe or draw the result in the Observations section below.

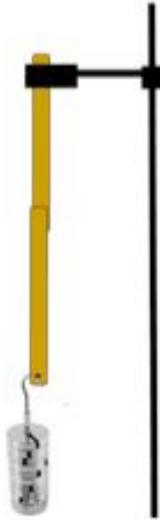


Figure 3

- 5. Repeat the tests with the icy pole sticks and record your results.
- 6. Repeat the tests using the plastic strips. Record your results and observations.
- 7. Using the sand-paper, roughen the surface on the end of one piece of plastic and repeat the tests. Record your results and note your observations.

Record your results in the below table:

Test	Suspended Mass (g) – Shear Strength		
	Wood	Smooth Plastic	Rough Plastic
1			
2			
3			

Draw or describe in words the broken Blu Tack joint:

Problem-Solving:

Key Ideas:

Adhesion (force) – adhesion is the name given to the tendency of one substance to stick to another substance such as glue to paper or water to glass. A rain droplet sticks to a window by adhesive forces.



Figure 2

Cohesion (force) – cohesion is the tendency of a material to hold together and not fall apart. Cohesive forces are the pulling forces between the particles of the material that hold it together. Cohesion between water molecules holds a drop of water together.

Surface – in this activity the word surface is used to refer to the part of the object or material to which the glue is applied.

Surface area – is the total area of the surface of an object. When thinking about glues we are interested in the total surface to which the glue is attached. If a surface is roughened up, its surface area increases.

Force – we know that forces are pushes or pulls. Forces can be seen at the level of people’s actions such as when a person pushes a trolley. But forces also operate at the level of the particles inside materials. Forces between the particles attract them to one another; the stronger the forces, the stronger and harder the material.

Load – the force applied to an object.

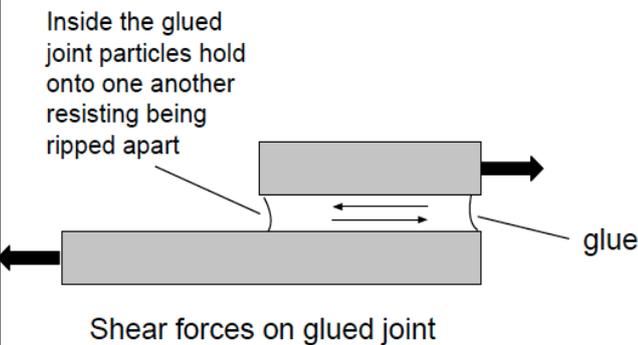


Figure 3

Shear – two adjacent pushing or pulling forces, acting close together but in opposing directions, causing a shearing load.

Shear strength – the shear load required to break an object or joint.

Failure – the breaking of a material exposed to external force such as when a rope being used to tow a car breaks, or when you bend a stick till it breaks.

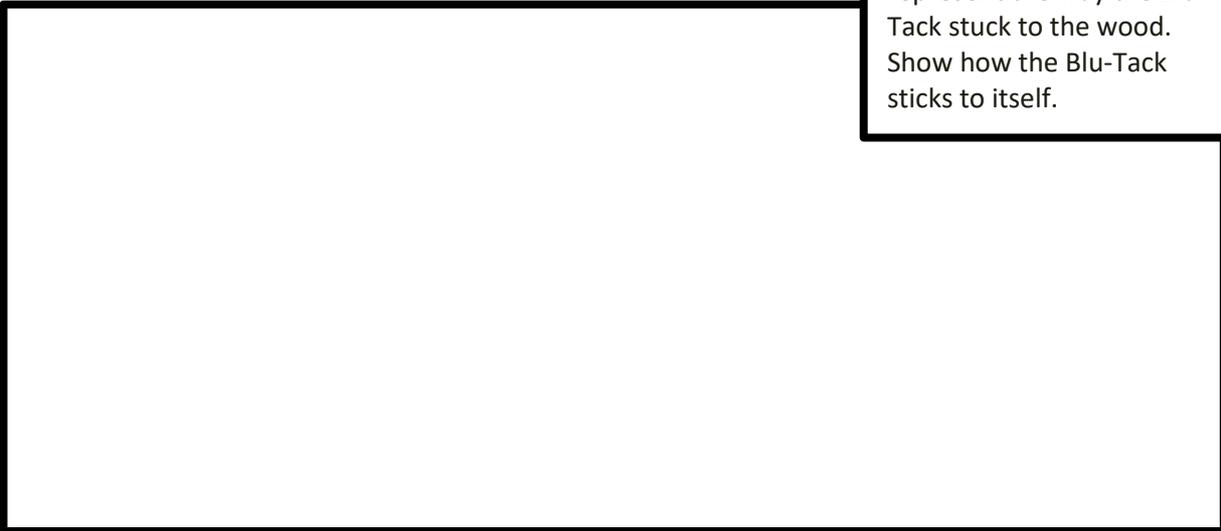
From looking at your results, what can you say about the tensile strength of Blu Tack compared with its shear strength?

Use labelled diagrams to represent what happened in this experiment.



Draw a labelled diagram to show how the particles inside the Blu-Tack stuck the two icy pole sticks together. Use the terms adhesive forces and cohesive forces.

Hint: In your drawings represent the way the Blu-Tack stuck to the wood. Show how the Blu-Tack sticks to itself.



Draw a labelled diagram to explain the effect of roughening the surface of the plastic.



Part B – Comparing Blu Tack with Tuff Tacks

Question:

An office supplies chain has produced a cheaper form of Blu-Tack. Devise and carry out a test to determine whether the new and cheaper product is as good as the original adhesive.

Write an Aim and Hypothesis based on this activity:

Plan:

What variables are important in your test? What will you measure? What will you keep the same?

Describe your Procedure:

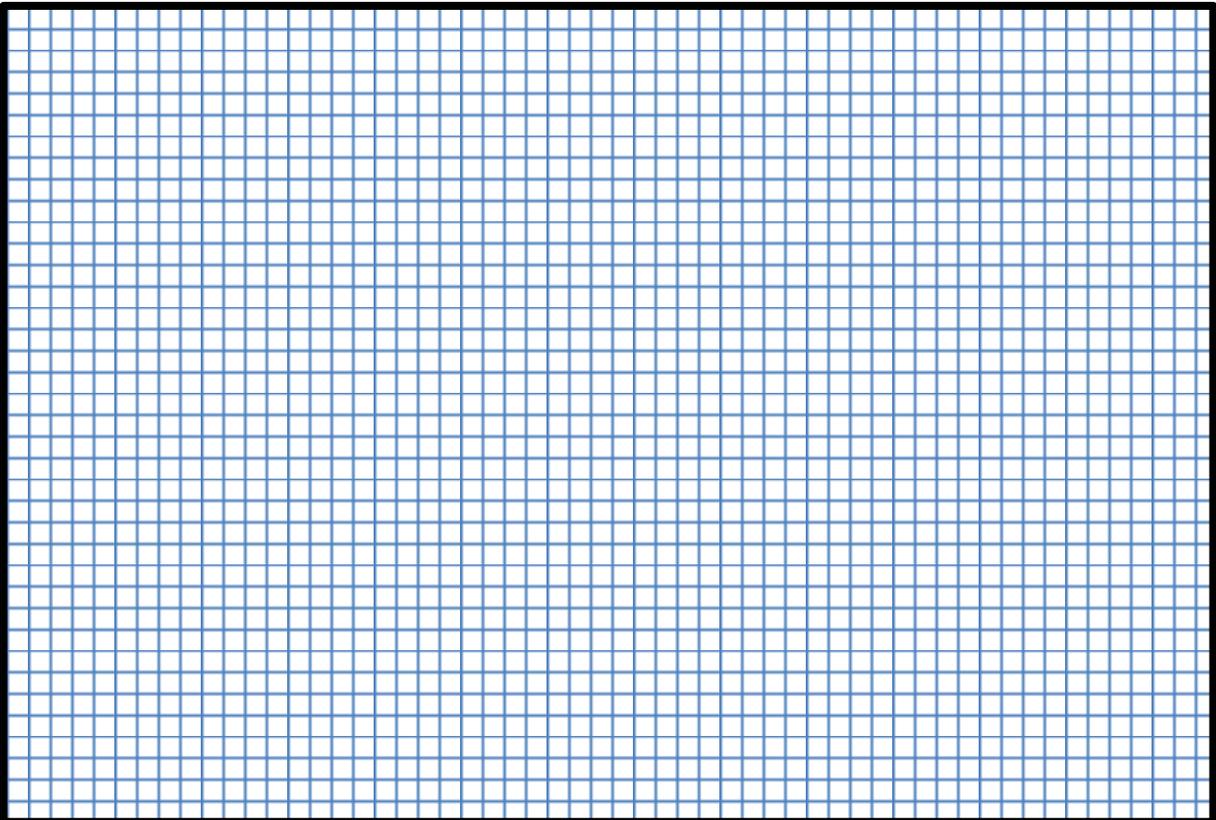
Conduct:

Record your results:

A large, empty rectangular box with a thick black border, intended for recording experimental results.

Analyse:

Draw a graph in order to present your findings visually:

A large rectangular area filled with a light blue grid pattern, intended for drawing a graph to present findings visually.

Problem-Solving:

Discuss any scientific theories that support your findings:

Assess the reliability of your experiment. Where there any sources of error? How would you improve your investigation?

Conclusion:

What is your conclusion? Were you able to achieve your Aim? Were your predictions correct?

References:

Figure 1 – stevepb, <pixabay.com/en/repair-glue-fix-adhesive-891422/>
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Figure 2 – skeeze, <pixabay.com/en/koenigsegg-agera-luxury-sports-car-2087797/>
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Figure 3 – Ian Bentley, ReMSTEP (Deakin University)

Figure 4 – dzordzo, <pixabay.com/en/drops-pane-rain-rain-drops-906019/>
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Figure 5 – Based on <teachengineering.org/lessons/view/wpi_lesson_1>
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