



Drexel-SDP GK-12 ACTIVITY

Subject Area(s): Polymers

Associated Unit: None

Associated Lesson: None

Activity Title: Composites

Grade Level: 5 and 8 (7-9)

Activity Dependency: None

Time Required: 120 minutes

Group Size: 2-3 students

Expendable Cost per Group: US \$5

Summary

The students are given a basic introduction to the composite panel design and layout. They are also given the opportunity to see how the different resins used affect the material properties of the completed panels.

Engineering Connection

Composite are used in many engineering applications, from airplanes to baseball bats to bicycle frames. This lesson shows how different types of resins can be used to vary the mechanical properties of the composite panels.

Keywords resin, polymer, reinforcement, composite, stiffness, materials engineering

Educational Standards

- Science: 3.4.7
- Math: none

Learning Objectives

After this lesson, students should be able to:

- Understand the basic concept of composite materials
- Understand how the different resins affect the properties of the composites

Materials List

Each group needs:

- Fabric (4 or 6 plies)
- Resin (either Elmers glue, Gorilla Glue or Epoxy): 1/3 of the groups should have each type of glue so they can compare panels once they cure
- Glue spreader (either a glue spreader from the adhesive aisle at the hardware store or a plastic knife)
- Plastic bags or wax paper to work on
- Rubber gloves

To share with the entire class:

- Scale to measure completed panels

Vocabulary / Definitions

Word	Definition
Polymer	A chemical compound made up of a large number of identical components linked together like a chain. This substance is often referred to as a plastic.
Resin	
Reinforcement	
Elasticity	The tendency of a material to return to its original shape after it has been stretched or compressed

Procedure

Background

Composite materials are used in many engineering applications from airplanes to bicycles to baseball bats. This is a continually growing field as different types of materials are being mixed together. Some of the first composites were sticks and mud which were used to build houses now concrete and rebar are common construction composite materials. Epoxy and carbon fiber are used for aircrafts, but carbon nanotubes and epoxy are being for state of the art baseball bats. Nanodiamonds are also being added to epoxy to increase it's properties. Composite materials are all around us, in the engineering research and development labs and in our homes.

Before the Activity

- Cut 4"x4" (or 6"x6") panels of muslin or another cheap fabric

- If this fabric could be cut on the 45° to show different properties, this is an interesting material property to show student. (Similar to cutting the material on the Bias).
- Cut enough panels so that each group can have 4, 5 or 6 each, if you cut 45° panels make sure there are enough to make a symmetrical lay-up. (example: 0° panel, 45° panel, 0° panel, 45° panel, 0° panel)
- Make sure you make the 45° panels if using so you can easily tell them apart

With the Students

1. Explain why composites are used and why they are better than traditional engineering polymers for many applications. Explain some application where composite are used. If you have access to cut up tennis rackets, surf boards, etc... it can be helpful for the students to see what composite materials look like “on the inside”.
2. Give 1/3 of the students Elmer’s glue, 1/3 of the students Gorilla glue and 1/3 of the students epoxy.
3. Have the students make the panels using the appropriate glue, applying the glue to one side of the first fabric panel. Then apply the next fabric panel right on top of the glue side of the first panel. Continue until all of the fabric is used up.
4. Leave the panels to dry – do not press the Gorilla glue panels as they are drying it will prevent them from foaming up.
5. Once the panels are dry, weight them to see the difference the difference glues make on the weight of the panels.



Figure 1: A completed composite panel

Safety Issues

- The student can glue their skin together with the gorilla glue and the epoxy, which is why the gloves are necessary. Younger students were given the Elmer’s glue to work with.

Troubleshooting Tips

There are no common issues with this activity.

Investigating Questions

- What could you use a composite made with epoxy for? What could you use a composite made with Gorilla glue for? What could you use a composite made with Elmer's glue for?
- What are the main difference between the panels?

Assessment

Pre-Activity Assessment

Class Discussion:

- Composite materials are all around us, in the engineering research and development labs and in our homes.
 - Have the students explain what they know about composite materials
 - Ask where are some composite materials that they interact with everyday

Post-Activity Assessment

Class Discussion: This is a rather long activity, so the following we the panels we weighed and then passed around. We wrote the data and the students observation on the board and talked about what resin could be used for different applications.

Owner

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