**ACTIVITY: Making a composite material container**

**Activity idea**

In this activity, students will make a container using a composite material made from fabric strips (the reinforcement) and a flour and water paste (the matrix). They will choose a function that they’d like their container to perform (for example, can hold water, can be used to grow a plant, can be composted, can hold a tealight candle). The finished container is then used to compare the properties of the composite material to the properties of the individual materials.

By the end of this activity, students should be able to:

* explain that a composite material is made out of two materials with different properties
* discuss the roles of the two key components of a composite – the matrix and the reinforcement
* discuss how the composite material has new and different properties when compared to the properties of the individual materials
* discuss how the choice of materials in the design of any product will affect how well the product functions/performs.

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**Introduction/background**

In recent years, there has been a huge increase in both the number of composite materials available and the number of products using them. Modern composites are often made from a plastic with another material like glass fibre, carbon fibre, ceramic or metal added to it. The physical and chemical properties of each of the constituent materials remain distinct in the new material. These constituent materials work synergistically to produce the composite material, which has new and different properties when compared with the individual constituent materials.

Composite materials are commonly used in sporting equipment, such as tennis racquets, bicycles, canoes, skateboards, surfboards, boats and fishing rods. When compared to the original materials, composite materials improve the performance and/or functionality of the sporting equipment. Commonly, the physical and functional requirements of the sporting equipment are matched with the properties of the composite material.

For example, up until the 1970s, tennis racquet frames were made of wood. They had a small head and a long handle. Today, most tennis racquets are made from graphite composites, and they have quite a different shape to the earlier wooden racquets. Graphite composite materials are used as they keep the frames lightweight and stiff for increased racquet head stability and performance. They also allow for more aerodynamic shapes to be made so that the speed at which the racquet can travel through the air increases.

In this activity, your students will make a container using a composite material made from fabric and a flour and water paste. They will choose a function that they’d like their container to meet (for example, can hold water, can be used to grow a plant, can be composted, can hold a tealight candle).

The finished container is then used to compare the properties of the composite material to the properties of the individual materials.

**What you need**

* Access to the articles [Composite materials](http://link.sciencelearn.org.nz/resources/1466-composite-materials) and [Radical bike redesign](http://link.sciencelearn.org.nz/resources/1467-radical-bike-redesign)
* Sporting equipment – old and new (such as an old wooden tennis racquet and a modern racquet)
* Copies of the student handout [Make your own composite material container](#Handout)
* Strips of fabric (calico, cotton or dishcloth)
* Flour
* Water
* Vaseline
* Mixing bowl and spoon (or a food processor)
* Small yoghurt pot/seedling pot (to use as a mould)
* Cling wrap
* Newspaper

**What to do**

1. Introduce your class to composite materials by showing them some examples of products that are made from composite materials. There may be examples in your classroom or you could discuss items that students are familiar with (such as tennis racquets, hockey sticks, skateboards, boats or car parts). If you can, find some examples that can be used to show the difference between old materials and composites (such as a wooden tennis racquet compared to a modern tennis racquet or a high-end racing bike compared to an average bike). Ask your class to compare the properties of the old and new equipment.
2. Read and discuss the article [Composite materials](http://link.sciencelearn.org.nz/resources/1466-composite-materials) and ensure that students are familiar with the terms ‘matrix’ and ‘reinforcement’.
3. Explain to your class that they are going to make a container from their own composite material. Hand out copies of the student handout [Make your own composite material container](#Handout) and assist students to gather the materials they need. Remind students to keep a sample of the individual materials – a piece of fabric and a dried out sample of the flour and water paste.
4. Discuss the results and the likely drawbacks and limitations of the composite material in relation to the intended function of their containers. Use the information your students provide to illustrate that:
* a composite material is made out of two materials with different properties – one material acts as the matrix, the other as the reinforcement
* the composite material has new and different properties compared to the individual materials
* the choice of materials in the design of a product will affect how well the product functions/performs.

**Extension activity**

Read the [Radical bike redesign](http://link.sciencelearn.org.nz/resources/1467-radical-bike-redesign) article. Then use the [YikeBike Carbon technical specifications](#spec)

to explore in more detail composite materials, their properties and why they are used.

**Student handout: Make your own composite material container**

1. Think of a function that your container will provide (for example, hold flowers, grow plants, hold a tealight candle, be used and then composted). This function will be important when you evaluate the properties of your composite container.

**Purpose of container:**

**Required properties to be fit for purpose (e.g. holds water, holds shape etc.):**

1. Begin by making some flour and water paste. Put some flour into the mixing bowl and slowly add an equal amount of water. Use additional water if necessary until the mixture is a thick pouring consistency. This paste can also be made in a food processor. (Make sure you keep a sample of the flour and water paste for comparison later.)
2. Use Vaseline to grease the outside of the pot you’re going to use as the product mould. This will make it easier to remove the composite product when it’s dry.
3. Dip a strip of fabric into the flour and water paste. Get it well coated, wipe off the excess liquid and then gently smooth it to the mould. Continue adding strips of fabric until the mould is covered. (Keep a sample of the fabric for comparison later.)
4. Add a second layer of flour and water-soaked fabric. Try to get the fabric strips lying in the opposite direction.
5. Add a third layer.
6. Give your product one last smooth, trying to push out any excess liquid.
7. Leave the container to dry out completely – 2–3 days on a windowsill in summer or near a heater in winter.
8. Once dry, carefully ease the composite container off the mould.
9. You should now have your container plus a fabric sample and a dried out sample of flour and water paste. Complete the following:
* Identify which of the starting materials is the matrix and which is the reinforcement and describe the properties of the individual materials.

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| --- | --- | --- |
| **Material** | **Matrix or reinforcement?** | **Properties** |
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* Look at your container and describe some of the properties of the composite material. Does your container keep its shape? What happens if you tap it? How strong is your container?
* Look at the purpose and properties for your container you wrote down in question 1. Does your container have the required properties and fit the purpose? Why or why not?

**YikeBike Carbon technical specifications**

