Activity: Tie Dye

Summary
In this activity, students make tie-dye shirts and complete a worksheet about a reading from ChemMatters about how dyes work. It gives students the opportunity to apply chemistry to everyday life.

<table>
<thead>
<tr>
<th>Resource Type</th>
<th>Grade Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activity</td>
<td>Middle or high school</td>
</tr>
</tbody>
</table>

Objectives
By the end of this lesson, students should be able to
- Understand the basics of how dye works.
- Know more about the history of dyes.

Chemistry Topics
This lesson supports students’ understanding of
- History
- Chemical changes

Time
**Teacher Preparation:** 1 hour
**Lesson:** 45-60 minutes

Materials
- T-shirt (1/student)
- Dyes (available from Flinn)
- Rubber bands
- Jumbo pipets

Safety
- Always wear safety goggles when handling chemicals in the lab.
- Students should wash their hands thoroughly before leaving the lab.
- When students complete the lab, instruct them how to clean up their materials.

Teacher Notes
- The worksheet accompanies an article about dyes from a 1986 ChemMatters article.
- See teacher document for tips and chemistry about this activity.

FOR THE STUDENT

Student Activity Sheet: Worksheet on Dyes

Lesson
1. Dyes have been used for a long time. Neanderthals coated their dead with red ochre which was really ________________ (rust). Cave paintings used ______________ and ______________ iron ______________, black ______________ and white ______________. Humans got their coloring agents from ______________ and...
until weaving was invented. What is the difference between a dye and a pigment?

2. One of the most important animal dyes came from the ______________, which formed a ______________ color. The dye was extracted by ______________ the shellfish and boiling them in ______________ water for ____________ days. Cloth was dipped, placed in the sun, and the color changed to ____________ then to ____________. In the beginning only the ______________ could wear it. Later dyes were formed from ______________ and it was a ______________ color. Cochineal was an ______________ and used until 1954 to dye ______________.

3. Vegetable dyes can be made from plants. The three most important were ______________, ______________, and ______________. Madder is a ______________ color and the chemical it contains is ______________. Woad is a ______________ color and contains ______________ as its chemical.

4. What are chromophores? (Look on left of page 6)

When the light of certain colors strikes the chromophores, ______________ are energized and the light is ______________. A good dye must also be ______________ so the solution can penetrate the fabric. Once in the fibers it must become ______________ or attach itself to the fibers, so it does not wash out. The ______________ dyes that we will use for tie dye are fiber reactive. This means that the dye molecules react with the cellulose (cotton) molecules in the shirt.

5. Saxon green was a mixture of ______________ and ______________. Indigo is much richer in the ______________ molecule. It was called the ______________ and believed to harm both the ______________ and its ______________. The anti-indigo lobby kept the plant out for ______________ years. Finally it was chosen for the British naval uniform and it gave the world ______________ forever after. Today indigo has been largely replaced by other blues EXCEPT it is still used for dyeing ______________.

6. A mordant (page 7) is a ______________. It is usually an ion that attaches to both the ______________ and the ______________ and forms a ______________ between them. Most mordants are salts of ______________. Some mordants change the ______________. Alizarin (red) turns ______________ when reacted with ______________, or ______________ with calcium, and ______________ with ______________.

7. Indigo is not soluble in water so is applied by ______________. Indigo used to be treated by ______________ but today they use ______________. The cloth is soaked, then ______________ by hanging it in the air. Oxygen ______________ the indigo back to the ______________ form, which is ______________ and difficult to wash out.

8. A college student named ______________ made the first synthetic dye
named __________________ as it was a purplish color. In the beginning the ______________ were the leaders in the dye industry, but soon the __________________ took over.

9. Today more than ______________ synthetic dyes are available.

10. Levi Strauss started dyeing ______________ from tents with ______________ to make the first ______________. The heavy gold nuggets ripped out the pockets, so Levi reinforced them with ______________. The word denim came from ______________. Nowadays in denim mills, ______________ is unwound and passed quickly through ______________ (yellow) then exposed to air where it turns ______________. This process is repeated as many times as ______________ until the color is jeans blue. The back side of denim is ______________ blue and ______________ white. Roll up your jeans and take a look. Jeans get better with age as the color gets lights and softer. Right? However, stone washing makes them soft to begin with.

The dyes that you will use to tie dye are called PROCION MX and have been around since the 1950s. They are fiber reactive so have a chemical reaction with the cellulose (cotton) in your t-shirt. They became very popular in the ’60s and were worn by many hippies and young people. However, several times since then, tie dye has come back in style. Enjoy your tie dye!