



Lemons are examples of an acid



Soap is an example of a base

## Acids and Bases

### Background Information

**Acids** are a large group of chemicals that taste sour and can dissolve certain metals to form salts. Familiar acids include lemon juice and vinegar. One of the most important acids for use in industry is sulfuric acid. It is used in making fertilizer, detergent, plastic, explosives, and other products. Strong acids can burn the skin if they contact it. Weak acids such as lemon juice and vinegar do not burn the skin, but their acidity can still be felt should they get into a small cut or the eye.

**Bases** are substances that taste bitter and have a slippery feel, like soap. Familiar bases include laundry detergent, most bath soaps, and many household cleansers. Another word for base is **alkali**. Two of the most important bases used in industry are

lime (calcium oxide,  $\text{CaO}$ ) and lye (sodium hydroxide,  $\text{NaOH}$ ).

Because many acids and bases are poisonous or cause chemical burns, scientists do not taste them or feel them to find what they are like. Instead, they use specially treated paper called **litmus paper** to test for acids and bases. Litmus paper is available from hobby stores or scientific supply stores. Blue litmus paper turns red if an acid touches it. Red litmus paper turns blue if a base touches it.

### Did You Know?

Litmus is a natural pink dye produced from **lichen**, a primitive plant. Because litmus changes color in the presence of acids and bases, it is used as a test for both.

## ACTIVITY 1

# Investigating Acids and Bases

### Purpose

To learn about acids and bases and the differences between them.

### Material

Four lemons.

Sharp knife for cutting lemon(s).

Lemon juicer (optional).

Vinegar.

Small spoons; one per student.

Hand soap.

Liquid dishwashing detergent.

Laundry detergent.

Household floor cleaner.

Water.

Paper towels for drying hands.

Four small bowls.

Red litmus paper, four per Year 6 student only.

Blue litmus paper, four per Year 6 student only.

Matter and Energy journals and pencils.



### Presentation

- Most Montessori teachers present this concept in Year 4 and explore it in more detail in Year 6.
- Announce to the students that they will have an opportunity to investigate acids and bases.

### Year 4: Common Acids and Bases

- Cut a lemon, and invite each student to squeeze a small amount of juice onto a spoon and then taste it. Pour a small amount of vinegar onto each student's spoon, and invite the students to taste the vinegar.
- Invite the students to describe the tastes of the lemon juice and vinegar. (Sour.)
- Encourage the students to rub a little vinegar between their fingers and to say how it feels. (Not slippery.) Invite them to do the same with the lemon juice. (Not slippery.)

- Invite the students to wet their fingertips and rub them on the bar of hand soap. Encourage them to rub their fingers together as they rinse the soap off and to describe how it feels. (Slippery.)
- Introduce the scientific word for sour. (Acid.) Ask the students which of the substances in front of them are acids. (The vinegar and lemon juice.)
- Introduce the scientific word for a slippery substance like the liquid dishwashing soap. (Base.) Explain that the other cleaning products on display are also bases but that they are irritating to the skin and should not be touched with bare hands.
- Tell the students that bases taste bitter, but that most bases are not safe to taste.
- Ask the students to write in their journals two examples of acids and two examples of bases, then to summarize how an acid differs from a base. (Acids are sour and not slippery, and bases are bitter and slippery.)

### Year 6: Testing for Acids and Bases

- Review common acids and bases and their characteristics, including that acids are sour and not slippery, and bases are bitter and slippery.
- Invite each student to take four pieces of red litmus paper and four pieces of blue litmus paper.

- Invite the students to pour small amounts of the four liquids provided into the four bowls, then to test the liquids by dipping a piece of red and a piece of blue litmus paper into each.
- Ask the students to use their journals to write down their observations. (Acids turn blue litmus paper to red, and bases turn red litmus paper to blue.)

### Extensions

- Year 6: Repeat this activity as an experiment, with a control and at least one variable defined, then write up the experiment.
- Test several other substances (e.g., milk, orange juice, plain water, shampoo, floor-cleaner, and window spray) to see whether they are acids or bases, then write a report describing findings. Try to predict first whether each will be an acid or a base based on what you already know about it.
- Research some of the industrial uses of acids and bases and write a short report about them.
- Refer to library books or the Internet to learn how to make a homemade acid-base indicator from purple cabbage. Make the indicator, try it out with some substances, and write a report summarizing the results.