GOALS
In this activity you will:
• Make modeling dough from common kitchen materials.
• Adjust the properties of the modeling dough by adding another material to it.
• Compare the properties of an emulsion to those of a composite material.
• Recommend whether an emulsion or a composite would be best for certain applications.
• Consider the advantages and disadvantages of using composites for industrial applications.

What Do You Think?
Frequently in movies, models of characters or sets are built to achieve specific effects. A character might be flattened by a falling object or bounced off a wall when tossed.
• What properties would materials that can be flattened or that can bounce have?

Record your ideas about this question in your Active Chemistry log. Be prepared to discuss your responses with your small group and the class.

Investigate
1. Use the following ingredients and directions to prepare a batch of modeling dough.

Ingredients:
1 cup flour
\( \frac{1}{2} \) cup salt
3 tablespoons cooking oil
2 tablespoons cream of tartar
1 cup water
Directions:

1. Warm the oil in a saucepan or large beaker on a hot plate set at medium-low.
2. Add the other ingredients and cook 3 to 5 min while stirring constantly.
3. Using tongs, drop the mixture onto waxed paper or aluminum foil.
4. Cool until the modeling dough is easy to handle.
5. Knead the dough until the texture is consistent.
6. Add a drop of food coloring, if desired.

2. Divide the dough into two samples. Set aside one sample.

Add a new material (tissue paper or paper towel strips, sand, gravel, pieces of twine, marbles) to the other sample, as directed by your teacher. Knead the mixture well until the new material is well incorporated into the dough.

3. You will now observe and compare the properties of the original sample and the new sample that you made.

In your group, discuss how you will test for each of the following properties: texture, elasticity, uniformity, bounce, strength, and malleability.

If you are not sure what characteristics you should be testing for, each property is explained in the Chem Talk reading section.

a) Record in your log the procedure you will use to test for each property.

b) Make a table in your Active Chemistry log to record your observations.

4. When your teacher has approved your procedure, test each property.

a) Record your observations in your log.

b) In a few sentences, describe the differences between the two kinds of mixtures.

c) Speculate on why your new mixture behaved differently from the original modeling dough.

5. Compare the properties of your new mixture with the mixtures of other groups.

a) What new or useful properties did each mixture have?

6. Dispose of materials and return all equipment as directed by your teacher. Clean up your station.
In this activity you examined a variety of physical properties of a mixture. In addition to the state and color of the mixture, you also observed the **texture** of the material. Texture is defined as the feel or appearance of a surface or substance. For example, if you were looking at a photograph, you may be interested in the texture of the surface of the paper used, or if you were looking at cloth, you might be interested in how the material is woven together. **Uniformity** describes how consistent a material is throughout. Does everything in the material seem to be evenly distributed? **Strength** determines how durable the material is. How well the material withstands the application of a force establishes how strong it is. **Elasticity** determines how well the material will resist deformation and return to its normal size or shape after a force has been applied to it. **Bounce** refers to the material’s ability to return to its original position when dropped from a given height. Another way to think about bounce is to consider how much it behaves like a ball. **Malleability** determines how easy it is to roll or hammer out the material without breaking it apart. Can the material be reshaped without breaking it apart? Lead is an example of a metal that can easily be shaped into other forms without breaking. Brittle objects shatter easily.
COMPOSITE MATERIALS

The properties of a mixture can be changed by adding different materials. The modeling dough you made in this activity was an **emulsion**. When you added one of the other materials, you made a **composite**. Composites are heterogeneous mixtures that use the characteristics of the components to make useful substances. Another example of a composite is papier-mâché.

The composite industry has been growing at a very rapid pace. Think about it. Composites are used as the skin on jets, rotor blades of a helicopter, bulletproof clothing for law enforcement officers, and special armor for tanks. Buildings, cars, boats, trains, and planes all take advantage of different types of composites. If you were trying to define what a composite is, you would probably say that it is a solid that consists of two or more materials. Some composites are made by a process in which fibers are embedded within another material. Usually, this will lead to a stronger material and provide the best qualities of both materials. Composites not only help make stronger and lighter materials but they also help in extending the life of materials.

For example, composites are used for materials that cover and protect electrical cables.

A major drawback to composites is the initial cost of research and the use of special raw materials in fabricating the composite. However, overall composites are materials of the future and their manufacture could be a great career choice.

### Checking Up

1. Two pieces of cloth have the same color and texture. Name another property of cloth that you might use to distinguish between the two materials.
2. Provide a situation in which each of the following properties of a material might be important:
   a) elasticity
   b) uniformity
   c) strength
   d) bounce
3. What is a composite material?
4. Give an advantage and a disadvantage of using a composite material.

**Chem Words**

- **emulsion**: a colloid or colloidal dispersion of one liquid suspended in another.
- **composite**: a solid heterogeneous mixture of two or more substances that makes use of the properties of each component.

### What Do You Think Now?

At the beginning of this activity you were asked:

- What properties would materials that can be flattened or that can bounce have?

Select two of the physical properties that have been discussed in this activity. For each property, suggest one additional ingredient that would enhance the property. For example, to increase bounce you could add pieces of rubber bands.
Chem Essential Questions

What does it mean?
Chemistry explains a macroscopic phenomenon (what you observe) with a description of what happens at the nanoscopic level (atoms and molecules) using symbolic structures as a way to communicate.

Complete the chart below in your Active Chemistry log.

<table>
<thead>
<tr>
<th>MACRO</th>
<th>NANO</th>
<th>SYMBOLIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Describe what you observed when you added</td>
<td>In words, compare the uniformity of the</td>
<td>Draw a picture to illustrate the</td>
</tr>
<tr>
<td>the new material to the dough.</td>
<td>emulsion (the original dough) and the</td>
<td>difference between homogeneous</td>
</tr>
<tr>
<td></td>
<td>composite at the molecular</td>
<td>and heterogeneous mixtures.</td>
</tr>
<tr>
<td></td>
<td>level.</td>
<td></td>
</tr>
</tbody>
</table>

How do you know?
Refer to the observations on uniformity. Explain how to distinguish between homogeneous and heterogeneous mixtures.

Why do you believe?
Sometimes when roads or driveways are repaved, the builders choose between cement and concrete. Cement is a mixture of clay, lime, and water used to bind substances together. Concrete is cement with sand or rocks added. Builders often choose concrete over cement. Why do you think they do this?

Why should you care?
You will be writing a movie scene for your challenge in this unit. You may choose to have dangerous scenes for your characters in which you could use models. By adding materials to your dough, you can create the effect for the scene.

Reflecting on the Activity and the Challenge
One part of making a special effect for a movie is finding materials that could be used for making models. In this activity you learned to make a material that has many characteristics that make it ideal for making models. Consider how each of the properties you investigated is important to a special effect. A malleable material is easy to shape. To construct a large building, you will want to use a composite that is strong. You could also construct a small model of a tall building, and then make a model of a character that can bounce 10 stories high.
1. A composite when tested bounces half as high as the original material. How can you create another composite that bounces only one-quarter as high?

2. Pure, 24-K gold is very malleable. By mixing gold with other metals it becomes harder and less malleable. In what situations would you want to use gold that is not as malleable?

3. Plastics are made of one type of material. Why are they not classified as a composite?

4. When road contractors are laying cement, they first place a series of steel rods in a specific pattern. Then they pour the cement on the rods and allow it to cure. The composite is called reinforced concrete. What is the purpose of the steel rods?

5. Give two examples of special effects in movies where each of the following properties is important: strength, elasticity, bounce, uniformity, malleability.

6. Preparing for the Chapter Challenge

   Each kind of modeling dough that you made in this activity could be used in making sets for a movie special effect. In your log list the kinds of structures each might be useful in constructing.

Inquiring Further

1. Other modeling materials

   Many other types of modeling materials, such as plaster of Paris or polymer clay, are available in crafts and art stores. Research these substances and consider their usefulness as modeling materials for your movie special effect.

2. Different composites

   Investigate different composites. Learn about the special properties of these materials. List the items of products that are constructed from composites.

3. Investigating other techniques with modeling dough

   Color and appearance of models are crucial to making them look authentic in a movie scene. With the supervision of an adult, try some alternative means of coloring your modeling dough. Try painting the surface of the dough, or using other substances to add color and texture. How do the various techniques affect the characteristics of the dough?