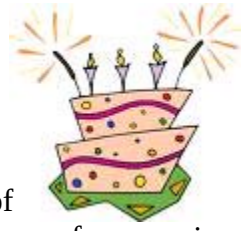
Cake Science



Introduction

Zeolites have a large amount of **surface area** because of their large number of holes throughout the structure. Normally a surface area is only the outside of an object. An apple's surface area is what the skin covers. A doughnut has a hole in the middle, and the surface area is where the glaze goes. If you made a donut with a lot of holes in it or a really big hole in it, you would need much more glaze to cover it, meaning it has more surface area.

Because of their large amount of surface area, zeolites are good **absorbers**. Something that is a good absorber is able to take in a lot of a material. Sponges are good absorbers of liquids which is why we use them to clean up spills. In this activity, we are going model how adding bigger holes to a zeolite allows it to absorb more molecules using a cake to model the zeolite and gelatin to model the molecules.

In this activity we will:

- Make a model of a zeolite using cake and gelatin. You will see how having bigger holes means more absorbability. You can also make a cake adding more increasing amounts of holes with the same tool to see how adding more holes increase absorbability. You can then tailor-make a cake to your specifications of taste just like a materials engineer would tailor-make a zeolite to have specific absorbability properties.

Safety

This activity involves the use of an oven and stove. Be careful when baking the cake in the oven and always use potholders. When dealing with hot water or hot gelatin, be careful not to spill it on anyone. Steam coming off of boiling water is also very hot and can burn. Parents should help out or do parts of the activity for children when dealing with hot items.

Materials

- Box of white cake mix with the ingredients necessary to bake a cake (typically egg whites, oil, and water)
- 9"x13" baking dish
- Butter knife
- Two small boxes (3 oz size) of gelatin (contrasting colors are good, cherry and lime flavoring is a good tasting option)
- Water
- Pyrex liquid measuring cup

- Three different sized hole making utensils (toothpick, straw, and large handle of a wooden spoon work well)
- Four plates
- Whipped topping (optional for frosting)

Pre-Activity

Talk to children about surface area and why adding bigger holes increases surface area. Ask if there could be too much surface area. Try to think of things like sponges that have a larger surface area than their outside size. Anything that is meant to "suck up" water or with tiny holes in it has a large surface area.

Activity

In this activity you will bake a cake, poke holes in it, and see how surface area affects absorbability. This models how different sized holes in zeolite can absorb more or less material.

- Begin by making the box cake according to the directions on the back of the box. Bake the cake in a 9"x13" pan.
- Bake the cake the recommended amount of time on the back of the box.
- Take the cake out of the oven and allow it to cool.
- Divide the cake into four sections (still in the pan).
- In the first section, you are not going to poke any holes. This is the **control** for the experiment, meaning you are not going to affect the cake in any way other than adding the gelatin to it.
- The second section, poke holes with your largest utensil. Make sure to count the number of holes! Each section will get the same number of holes.
- In the next section, poke holes with your second largest utensil. Poke the same number of holes as the second section as evenly spaced as you can.
- In the last section, poke holes with your smallest utensil. Again, make sure to poke the same number of holes.
- Your cake now has different sizes of holes in each section, but the same number of holes.

- You will be putting the same amount of gelatin into each section of the cake to see how it absorbs into the cake.

- Make liquid gelatin by mixing one pouch of gelatin with one cup of boiling water. Stir the gelatin into the water.
- Pour equal amounts of the liquid gelatin into each section. Try to pour the gelatin evenly over the cake sections.

- Make the other pouch of gelatin by mixing another cup of boiling water. Again, pour equal amounts of the gelatin into each section of the cake evenly. The gelatin can mix with gelatin from the previous step.

- Place the cake into the refrigerator and allow it to chill for at least four hours or overnight.
- After chilling the cake, take the cake out of the refrigerator. Remove each section and place them on a plate.
- Cut each section in half on the diagonal. Try to cut through some of the holes!

- Examine how much gelatin has absorbed into the cake. The more color is in the cake, the more gelatin has been absorbed.
- Which section has the most amount of color in it? You can cut up the cake to examine holes. The one with the most color was the section that absorbed the most gelatin.
- Next you can put whipped topping on top of your cake if you would like.

- Try a small piece of each section of cake. Which piece tastes the best? Is the one that absorbed the most gelatin or one of the others?
- What else could you do to increase the absorbability of the cake?
- What would you do to make the perfect tasting gelatin cake?

Summary

This cake is a model of a zeolite with different sized pours. The gelatin is a model of the molecules that are absorbed by the zeolite. The bigger the holes are, the more surface area there is. This increases the absorbability of the cake. You can see that having bigger holes increases the amount of gelatin in the cake. Models are used by scientists to simplify things or make things able to be seen. This model simplifies what is happening in zeolites (other factors such as charge matter) and also makes it large enough to see. You cannot see tiny molecules getting into the holes of the zeolite, but you can see gelatin in a cake. It also has the added benefit that you can eat your experiment!

Extensions

Hole size matters when it comes to surface area, but so does the amount of holes. Try making a cake with different amounts of the same sized holes in each section. (A straw is a good tool for poking the same sized holes.) The sections with smaller numbers of holes will absorb less gelatin than the sections with more holes.

You can also try tailor-make the perfect gelatin cake! This is what materials engineers do when they make zeolites. The engineers try to get the zeolite to absorb the right amount of molecules to have certain properties. You can engineer a gelatin cake to have the perfect property of taste that you enjoy.