New Jersey 4-H
National 4-H Youth Science Day Experiment

Can diapers "*help*" the environment?

The global landscape is changing… as population increases so do the needs to develop land and demands for clean water for drinking and sustaining our crops. New Jersey, as the most populated state in the country is working to conserve and protect our water resources. So…can diapers help us protect the environment? Well…. Not really diapers but maybe the stuff in them!

The Experiment:
4-H is providing and easy to perform activity that helps youth discuss environmental issues relating to wetlands protection, water conservation and groundwater contamination. Specifically we will look at the potential impact of superabsorbent polymers called hydrogels. In a follow-up experiment, youth are invited to explore the properties of these polymers and test their effectiveness to absorb liquid in an easy-to-administer soil and water experiment and then post their findings online to engage in dialogue with fellow youth nationwide.

Time Allotment:
45 –60 minutes

Materials:
- Disposable diaper
- Measuring cup and measuring spoons
- Water
- Zipper-lock bag; 1-gallon size
- Newspaper
- 9 oz. plastic cup
- Scissors

Background:
Discuss with the group the importance of water and the water cycle. Where does water go? What happens if we use too much? How can we protect it? Work into the concept of wetlands and the importance they have in holding water and slowing letting it seep into the ground. Discuss how wetlands can help reduce flooding because of its ability to hold so much more water than other areas. Explain to them that we are going to see how a diaper can act in a similar manner to wetlands – and then try figure out how that knowledge can help us protect the environment.

Procedure:

1. Divide youth into groups of 3-5 children. Put newspaper on the tables.

2. Give each group a diaper. Ask them to predict (or hypothesize) how much water the diaper will hold until it is saturated (starts to leak when turned upside down). Have them write down their predictions.

3. Have the group open the diaper so it is spread out on the newspaper on the table. Have them take turns adding ½ cup water to the diaper at a time. After each ½ cup is added, they should put a hash mark on their paper. One hash mark is equal to ½ cup water.

4. After a ½ cup of water is added they should wait about 10 seconds and then turn the diaper upside down to see if water drips out.

5. Continue to repeat steps 3 and 4 until the diaper leaks water when upside down. They should record their final count and calculate how many cups of water the diaper held. Remind them that it takes 2 ½ cups to equal 1 cup of water.

6. Have the class share their findings. Ask them why they think the diaper held so much water.

7. Have them gently push on the filled (saturated) diaper. What happens?

This next section can either be done by the individual groups (depending on available time and age of students) or as a demonstration by the leader/teacher.

Tell them they will be dissecting a diaper to see what causes it to hold so much liquid. They should put the saturated diaper to the side, and put down fresh newspaper on the table.

1. Place a new diaper on the piece of newspaper. Carefully cut off the legs, and cut through the inside lining and remove all the cotton-like material. Put all the stuffing material and plastic lining into a clean, 1-gallon zipper-lock bag.

2. Scoop up any of the powdery material that may have spilled onto the paper and pour it into the bag with the stuffing. Blow a little air into the bag to make it puff up like a pillow, then seal the bag.

3. Shake the bag for a few minutes to remove the powdery stuff from the stuffing. Notice how much powder falls to the bottom of the bag. (This powdery stuff is the hydrogel polymer).

4. Carefully remove the stuffing and the plastic lining from the bag, and measure out the powdery polymer left in the bag. Place that powdery material into a 9 oz. plastic cup. Place the diaper back into the back and repeat steps 3 and 4 with the same diaper until you get 1 teaspoon of the hydrogel powder in the cup.

5. Now it's time to mix the powder with water to see what happens. Pour ½ cup of water into the 9 oz. plastic cup with the 1 teaspoon of hydrogel powder.

6. After about 30 seconds, observe that the water has changed — it's no longer a liquid… it's a gooey solid!

7. Take a closer look at the gel by scooping up some of the gel with your fingers. You can poke holes in it and even tear it into smaller pieces. This hydrogel is safe and non-toxic, so you can touch it, but remember: even safe chemicals never go into your mouth, ears, eyes, or nose!

8. Take some of the cotton stuffing and place it in a child's hand. It has some of the powdery hygrogel still in it. Slowly add water. You will notice it absorbs water and the child's hand does not get wet.

9. Have the children gently cut open their filled diaper. Notice what it looks like – the same gel that was in the cup.

10. Ask them – was there a lot of powder in the diaper? How much water did the powder hold? What conclusions can you make about the powdery hygrogel?

Things to think about...

• How does this water-slurping powder work? Does it only absorb water?

• How much water will the average diaper absorb?

• What would happen if you let the gel dry out? Is this powder reusable?

• Besides diapers, how else could this powder be used?

• How does the absorbency of the hydrogel compare with other materials that are absorbent: cotton balls, paper towels, sponges?

• How could adding other ingredients (like salt) affect a hydrogel's water-absorbing properties?

So what's next?

Hydrogel technology, of which there are many different types, lends itself well to an unlimited number of agricultural and domestic applications. For example, certain growers have learned that by adding hydrogels to the soil in the right proportions, crops easily survive on sixty to eighty percent less water. Today, hydrogels are widely used in such applications as forestry, gardening, and landscaping as a means of conserving water.

Wetlands are like a natural hydrogel. They hold much more water than other areas. By destroying wetlands due to building and expanding, we are risking flooding. A prime example is what happened in New Orleans after Hurricane Katrina. New Orleans is built below sea level – much of it on wetlands. Because there is less wetland, the soil can no longer hold the water. The combination of broken levees and lack of wetlands caused massive flooding and destruction during the hurricane.

Hydrogels are used for lots of things!
Scientists from the University of Delaware are using nano hydrogels in biomedical research. Regenerating healthy tissue in a cancer-ridden liver, healing a biopsy site and providing wounded soldiers in battle with pain-killing, infection-fighting medical treatment are among the myriad uses the scientists foresee for the new technology. http://www.udel.edu/PR/UDaily/2008/jul/gels071807.html

"Now Diaper Technology Takes on a Desert" New York Times Article (July 2004)
http://query.nytimes.com/gst/fullpage.html?res=9C07E1DD103AF933A15754C0A9629C8B63

This is a great article describing how chemical manufacturers are developing hydrogels as soil amendments to help sandy soils grow lush green plants. There is even an artificial island in Dubai called Palm Island made of this stuff!

Focus on Land and Climate
Scientists in the United Nations are focusing on how soil is a key issue to climate change. And are using hydrogels to prevent desertification. Read more about soil and climate change at
http://www.unccd.int/science/soilandclimate/menu.php

How is New Jersey's Landscape Changing? Check out Dr. Rick Lathrop's research on land use changes in New Jersey. http://www.crssa.rutgers.edu/projects/lc/newjersey/nj_frame.html

Try this at Home: Gather up some friends and make a rain garden in your community. Click here to learn how to do it. http://www.water.rutgers.edu/Rain_Gardens/RGWebsite/rginfo.html

*Go to **www.4-H.org** to share your thoughts, find more information, try the expanded student version of the National Science Experiment, and join a discussion on the potential impact of hydrogels as well as environmental issues relating to water conservation and groundwater contamination. 4-H, part of the Cooperative Extension System of the United States Department of Agriculture and the 106 Land Grant Universities across the country, has been educating youth on agriculture and the sciences for over 100 years—and we have lots of ways for youth to explore, engage, and get inspired by science!*

Adapted by lsr and jm 9.08