Kids' Science Challenge

Activity Kit Instructions

Sports on Mars

Detective Science

Bio-Inspired Designs

Pressented by
the award-winning radio series,
Pulse of the Planet

Watch the movie

We filmed our KSC scientists doing most of the activities that you're about to try. Check out **kidsciencechallenge.com** for an online demonstration. Click the tab of the science field (Bio-Inspired Designs, Sports on Mars, Detective Science) related to the activity you want to see. Scroll through the videos listed on the player to find the one you want.

Safety Guidelines

⚠ WARNING:
CHOKING HAZARD–Small parts. Not for children under 3 yrs.

⚠ WARNING:
CHOKING HAZARD–Children under 8 yrs. can choke or suffocate on uninflated or broken balloons. Adult supervision required. Keep uninflated balloons from children. Discard broken balloons at once.

Participants in the Kids' Science Challenge are encouraged to carry out any experimentation under supervision of a parent or teacher. Activities that call for scissors or other sharp objects should be approached with care, and with the assistance of an adult. Recommended science activities may include small parts and balloons, both of which can be a choking hazard. Keep small parts and uninflated balloons away from children under 8 years. Do not engage in any experimentation that is harmful to other persons or animals, or damaging to the environment.

Kids' Science Challenge

Activity Kit Instructions

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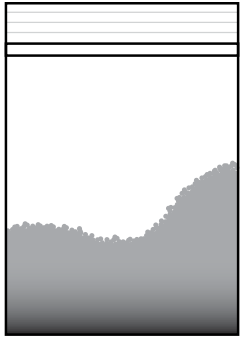
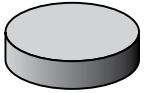
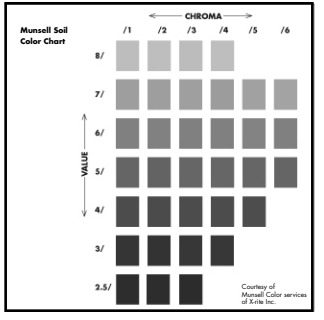


Simulated Mars soil packet



Magnet



Munsell Soil Color Chart

Located on the back cover of this instruction booklet.

Sports on Mars

Be A Mars Soil Sleuth

Find What You Need

In the Kit: Mars soil packet; magnet; Munsell color chart, located on the back cover of this booklet.

On your Shelf: soil sample (about 1 teaspoon) in sandwich bag, index card, magnifying glass (optional)

Do all planets have the same type of soil?

A very long time ago – four billion years – a giant cloud of dust and gas formed our solar system. Rocky planets, like Earth and Mars, were formed from the same raw materials.

Now flash forward to today. A lot can change on a planet's surface in four billion years. What could change the type of soil on a planet? Soil is made from rocks that slowly break down over hundreds of years. Different kinds of rocks make different kinds of soil. Volcanic eruptions on Mars and Earth create special kinds of rocks that eventually crumble and mix with soil.

Other environmental conditions also affect soil. Water, wind, and meteor strikes can change the surface layer of a planet. And on Earth, living things like plants and animals decay and become part of the soil. Studying an area's soil gives scientists lots of information about that environment.

The soil in your activity kit is similar to Martian soil! We know a lot about the surface of Mars, because scientists and engineers designed robotic Rovers that have actually landed on the "Red Planet" and examined its soil. They discovered that Martian soil has many nutrients found in Earth soil, but it's also very different from your home-town dirt.

Like Martian soil, your activity kit soil is made of weathered volcanic material, including minerals that rusted and developed a reddish color. The soil was collected on the island of Hawaii, from a volcano called Mauna Kea. Scientists experiment with it as they develop new Mars Rovers and plan experiments for future Mars missions.

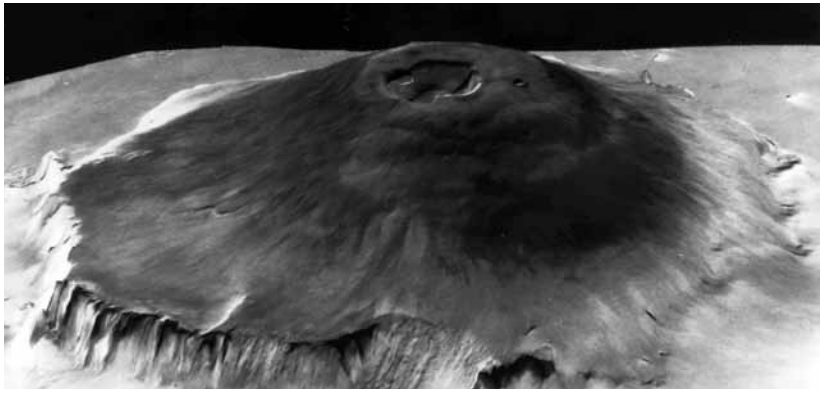
One property that scientists pay attention to is a soil's color. The color gives clues about what rocks the soil came from, what minerals are in it, and how much water or decayed organisms the soil holds. Colors are hard to describe, so scientists use a Munsell color chart, which

you'll find on the back of this booklet. Scientists look for the square on the chart that best matches a soil's color. You'll see that moving left to right on the chart gives you different colors, and moving down the chart gives you darker versions of the same color.

Are you ready to start observing? This activity will let you examine the properties of "Mars Soil" and compare it to soil here on Earth!

Volcano eurption on earth

Courtesy NASA



Martian Crater

Fact:

Mars is much smaller than Earth but its volcanoes are much larger. One Martian volcano, *Olympus Mons*, is about 24 km (15 miles) high. *Can you think of a reason why volcanoes on Mars are higher than those on Earth?*

Activity: Compare Mars and Earth Soils

1. Put about 1 teaspoon of soil – from a yard, park, or houseplant – into a baggie and seal it. Now put your plastic bag of "Mars" soil alongside it.
2. Keeping the soil in the bags, compare them by looking at and feeling them. View them through a magnifying glass if you have one. What's the smallest particle you can see? See if you can answer the first two rows of questions in the Soil Property Notes on page 9.
3. Compare each sample to the Munsell color chart on the back cover of this booklet. Find the color that is the closest match to each sample. Number your color by finding the number at the left-hand side of the row, then the number at the bottom of the column, and putting a / in between. For example, the color at the upper-left would be 8/1, the color next to that would be 8/2, etc. List the number of the matching color on row three of your Soil Property Notes.*

*Scientists also list the number of the chart. This chart is number 7.5 YR. It was especially selected to match our Mars soil by Munsell Color services of X-rite Inc.

4. To test the magnetism, pour one soil type onto an index card. Drag the magnet along the bottom of the card. Try it with each soil type and complete the chart.

   (Try not to touch the Mars soil to the magnet, unless your idea of fun is picking tiny particles off a strong magnet with tweezers!)

   Tip: *Put the magnet in a plastic bag before doing this experiment.*

   Important: *Wash your hands after touching soil. All earth soil contains microbes which may include germs!*

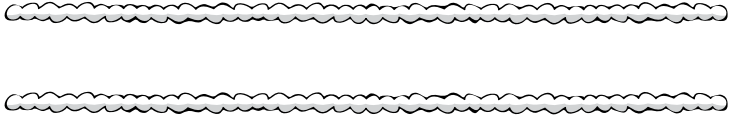
Conclusion:

How were the two soils the same? What were some of the biggest differences? What do you think would happen if you poured water onto a pot of Mars soil? (Hint: Mars soil resembles sand. Which "grabs" water better, sand or soil in a flower pot?) Why is it important to wash your hands after touching Earth soil? Would be same be true of Mars soil? The magnetic particles in Mars' soil are a clue as to why Mars is the RED planet. Can you solve this riddle?

Soil Property Notes

Soil Property	Mars Soil Observations	Your Soil Observations
1. Consistency: Squeeze a little soil between your fingertips. Does it hold together?		
2. Draw particle size and shape: Draw the size – and shape if you can see it – of the largest and smallest particles.		
3. Color: Find the closest match to the soil on the Munsell Color Chart,	_____ / _____	_____ / _____
4. How many of the particles are magnetic? (circle one)	None Some All	None Some All
5. Do you see any signs that living things were in the soil (roots, twigs, etc.)?		
6. Other observations:		

3 UV beads



2 pipe cleaners

Sports on Mars

Make a UV Man

Find What You Need..

In the Kit: 3 UV beads; pipe cleaners

On your Shelf: Scraps of material: plastic cup; cardboard; sunblock or sunscreen lotion; whatever else you think might block the sun's UV rays.

Outside: A sunny day and a place to go outside. A party cloudy day is fine, but the beads will need more time to change when the sky is really overcast.

What's the best protection from the sun's harmful rays?

Unless you were hiding under a rock all summer, you probably saw some sunshine. What you couldn't see is that light from the sun is made of many types of energy. One type of energy is called *UV, or ultraviolet,* light and it can burn your skin if you don't protect yourself. UV light is what causes a sunburn!

If you think you need to wear a lot of sunblock on Earth, think about this: We'd need a great deal more UV radiation protection on Mars. That's because the Earth's atmosphere deflects or soaks up much of the Sun's energy. Mars' atmosphere is thinner than Earth's.

Any mission to Mars needs to protect spaceships, equipment – and, someday, maybe people – from UV energy. In this activity, you'll find some ways to block sunburn, without risking your skin.

Fact:

Some scientists hope to build a human colony on Mars by using technology to create a thicker atmosphere on the planet. This atmosphere would both block some of the harmful UV energy and help warm up the planet.

Activity: Protect UV Man!

1. Make the shape of a person with a pipe cleaner and string UV beads in three different spots.

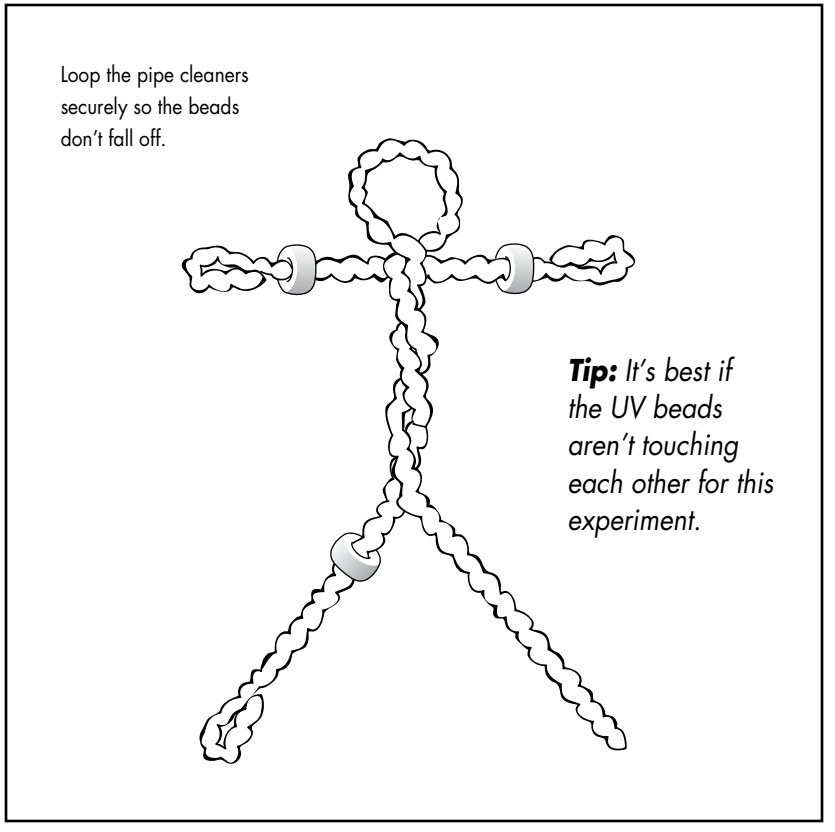
   Tip: *It's best if the UV beads aren't touching each other for this experiment.*

2. Place UV man (or woman) in the sun for about 10 seconds. Notice the color change in the beads! Then bring it inside. It may take a minute for the beads to turn white again.

   Tip: *If there are a lots of clouds, you may need to wait 20 seconds to see the beads turn color.*

3. Think about things that might protect the beads from UV energy. First, find three types of "clothes": different types of cloth, paper, or other materials. Cover each bead with a different material and place your person outside for 10 seconds. Record your results on the chart on page 17.

4. Think of three ways to provide shelter for your beads: foil, plastic, glass, etc. Cover each bead with a different "home" and place outside for 10 seconds. Record your results.



5. Now, test your sunblock. Find one or two types of sunblock, and some hand lotion that doesn't offer sun protection as well. Try different *SPF* (Sun Protection Factor) levels if you have them – and regular hand lotion. Grease up each bead with a light coat of the lotion, noting the beads' location on the chart so you don't mix them up. Place UV Man in the sun again and record results. Then wipe off the lotion with a damp paper towel.
6. Find out more about what makes your beads change color. Does the light from a light bulb make your beads colorful? How about the heat from a hair dryer?
7. Optional: Try out other ideas that might keep the beads from turning colors. Will they turn color if they're underwater? In a car?
9. A Fun Challenge: Why do you need sunblock even when it's cloudy? Let UV man help you answer that question!

Conclusion:

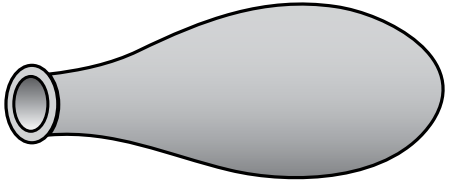
Did you find more than one way to keep your beads from turning color? Did anything surprise you about your results? Does sunblock work? Why did a normal lightbulb have the effect it did? Do you think a light bulb at a tanning salon would make the beads turn color? How are the beads like your skin? How are they different? One important difference: While UV light has no lasting effect on the beads, it can leave you with a painful sunburn and, more importantly, damage your skin cells.

Brain Squeezer:

Take the Ultimate UV challenge: Based on what you learned, can you choose ONE solution that will keep UV man from changing color for a full day in the sun?

Category of Protection	Material Used	Bead Location	Did the Color Change?
Clothes			YES / NO
			YES / NO
			YES / NO
Shelter			YES / NO
			YES / NO
			YES / NO
Chemical Protection			YES / NO
			YES / NO
			YES / NO
Your Idea			YES / NO
Your Idea			YES / NO

Ink Strip



Balloon

Detective Science

Blow Up Your Fingerprints

Find What You Need..

In the Kit: A balloon; ink strip

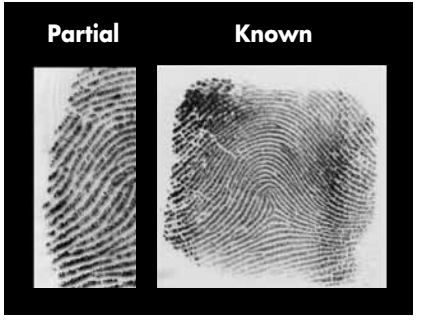
On your Shelf: Newspaper or scrap paper to cover your work surface

How can you match a fingerprint to a person?

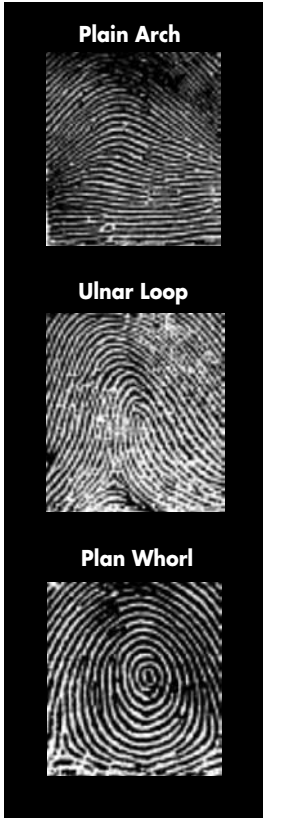
You've heard that police use fingerprints to solve crimes. Here's why: fingerprints are one of the best and easiest ways to identify a person. Fingers have slightly raised lines that form patterns, and every finger has its own unique pattern. Forensic scientists study fingerprint patterns to match them to a particular person.

Sometimes their work is made harder because they only have part of a fingerprint to study. Look at the partial print on page 21. That's a "Latent" or unknown print. If you were a forensic scientist working in a lab, you would use a "Latent" print to try to find a match among thousands of "Known" prints in the police's computer files.

Mo Lupia, Forensics Investigator – Wallie Howard Jr. Center for Forensic Sciences



How do scientists – with the help of computers – search for matches? They look for basic types of patterns in the fingerprint lines. Three of the basic patterns are shown at right. In this activity, you'll take your own fingerprints. Then you'll use a balloon to blow them up and make their images larger so you can study your fingerprint patterns.



Activity: Print, and Enlarge

1. Prepare your balloon by stretching it out in all directions. This will help make it inflate more easily.

   Tip: *Balloons are also a lot easier to inflate if you first cool them in the freezer.*

2. Cover the table with scrap paper. Then open the ink strip.

3. Choose a finger. Press the finger onto the ink strip, but don't move it around.

   Tip: *Make sure you press firmly to get as much ink on your finger as you can.*

4. Press and gently roll your inked finger onto the balloon. Don't slide it around or the print will smear!

5. Wait a few minutes for the first print to dry. Then repeat steps 3 and 4 with a different finger and make another print on a clean part of the balloon. Try one more finger if there's room on the balloon.

6. Blow up the balloon slightly so the prints get larger. If they look blurry, let out some air until they are clearer.

7. Compare your prints to the patterns in the illustration on page 21. Do you have a loop, whirl, or arch at the center of your print? Are both prints the same?

8. A Fun Challenge: Get together with some friends and their fingerprint balloons. Each of you leave a print on a scrap of paper. Then put all of your papers in a pile. Pick one at random and see if you can identify it by comparing it to the balloons.

   Tip: *If you run out of ink from your fingerprint strips, you can use an ink stamp pad or use ink from a water soluble marker.*

Fact:

The raised lines of your fingerprints help your fingers to grip objects better.

Brain Squeezer:

If you had a machine that could scan fingerprints to identify people, what would you use it for?

Conclusion:

Could you see the patterns on your fingerprints? How did the balloon help? What would happen to the print if you blew up the balloon too much? Are the prints on your different fingers all the same or different? Can you think of any other uses for fingerprints besides crime detection? How might a fingerprint expert choose from thousands of prints to find a match for a latent print? Watch the videos on KidScienceChallenge.com to see how a fingerprint expert works with a latent print in the lab.

Test tube, 3 round density pellets

Detective Science

Solve the "Sink or Float" Mystery!

Find What You Need..

In the Kit: Test tube; 3 round density beads

On your Shelf: Honey; water; cooking oil

Why would detectives care whether a material floats or sinks in water?

Forensic detectives often have to figure out what happened by using tiny clues. For example, a sliver of glass found on a street may give clues about a traffic accident. Scientists can test the glass to see if it came from a windshield. How do they test glass and other materials? They study properties such as color, mass, and *density*.

Objects with high density have lots of material packed into a small space. Objects with low density have much less material in the same space. Density determines whether an object floats or sinks. If an object has greater density than the liquid it's in, it sinks. If its density is lower than the liquid's, it floats on or near the surface.

Look at the three plastic pellets found in the activity kit. All three pellets are the same size. Do you think they have the same density? Try this activity and find out!

Tip: *You might have a lot less mess to clean up if you ask a grown-up to help you pour the liquids into the tube.*

Fact:

Most materials are denser as solids than as liquids. But not water! When water is in its solid form - ice - it becomes less dense, That's why ice cubes float.

Activity: Test Pellets in a Density Column

1. Pour honey into the test tube until the tube is about ¼ full of water.
2. Tilt the tube and gently pour a little water down the side. Straighten the tube when it's about ½ full.
3. Tilt the tube again and pour cooking oil down the side. The tube should be about ¾ full.
4. Holding the tube straight up, gently drop in the beads one by one. Look to see where they land.

Instructor Tyna Gaylord, with Allision Strang of Emerson J. Dillon Middle School and Derenique Barnes of Liverpool MIddle School at Syracuse University's Forensic Science lab.

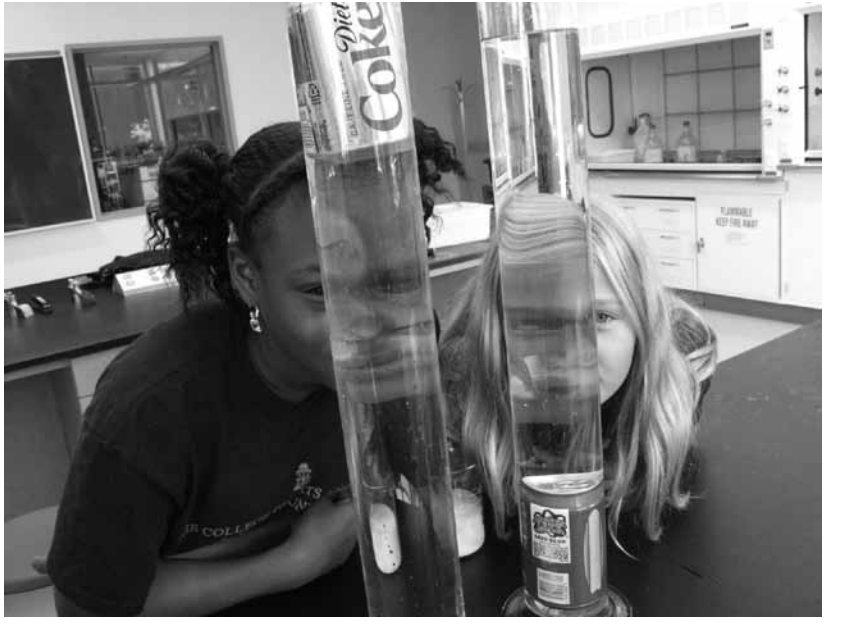
Conclusion:

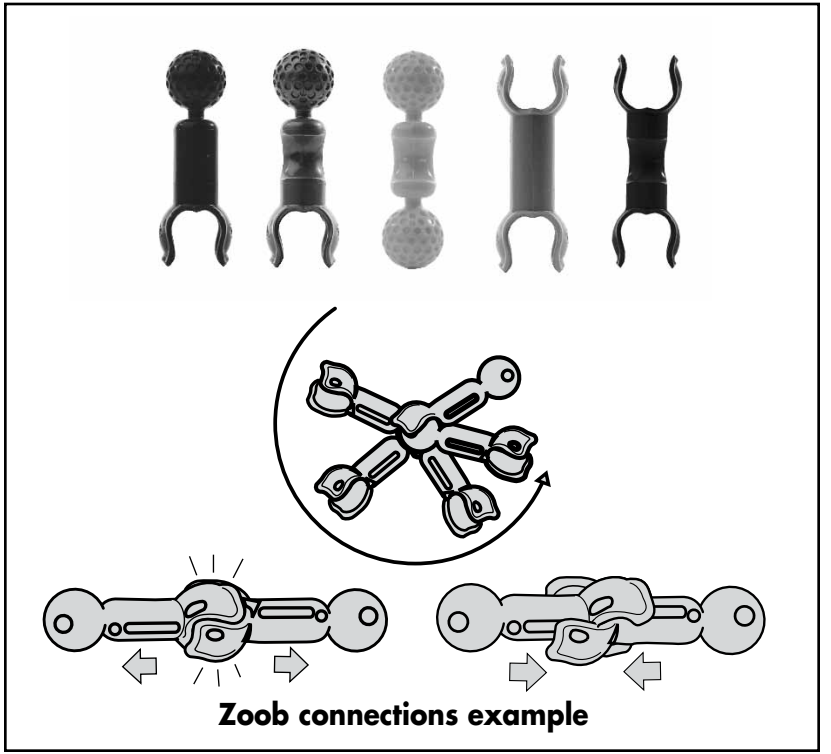
Which bead has the lowest density? Which liquid is its density most similar to? Can you tell which bead has the highest density? If not, how might you find out? What's denser – a bowling ball or the same size ball of cotton candy? A tennis ball or a billiard ball (the kind you play pool with)?

Different types of plastic can be identified by their densities. Check out our downloadable density experiment to see how you can test for different kinds of recycled plastic. Watch the videos on kidsciencechallenge.com to see how a forensic scientist does a density test in the lab.

Brain Squeezer:

If an object changes shape, does it change density? *A chunk of metal sinks into water. But a huge ship made of metal can float. Why?*





Zoob connections example

Bio-Inspired Designs

Move Some Zoobs!

Find What You Need.

In the Kit: 20 Zoob pieces; Zoob connections examples

Do you move like a machine?

Zoobs were designed to connect – in almost any imaginable way. Many of the "joints" where two pieces connect are moveable. Zoob creations can imitate the movements of living things: a human neck, shoulder, knee or thumb joints; an ant's legs with three bendable joints; a monkey's tail that can curl around a branch; lobster claws; and a clam shell's "hinge," for example. Zoobs can also recreate human-made items, many of which are modeled after living things. Hinges work a lot like knee joints for example. And there's a reason that fast-food sandwich containers are called "clamshell" packages.

In this activity, you'll use your Zoobs to mimic some biological movements. Then you might even design a machine based on the same type of movement to do a job.

Activity: Make a Zoob-ersaurs!

1. Start connecting your Zoobs and see what they can do. Try out the types of connections.
2. See if your connections can imitate the movements of living things. Try the joints mentioned in the paragraphs above (leg, claw, tail, neck, etc.), and some of your own ideas.
3. Build a Zoob creature. If you can, take a picture of it!
4. A Fun Challenge: Look at the ways your creature moves. Can you design a machine that would use that type of movement to do some useful work (e.g. can opener, doorstop, machine that throws a ball for a dog..)? Use your Zoobs to build a simple model of your machine.

Brain Squeezer:

Design a new element for a Zoob Kit: a new shape, a base to build on, a power source, or something else . . . Think of something you could build if you had this extra element.

Conclusion:

About how many kinds of motion could you get from your Zoobs? What were you able to build? Was there anything they couldn't do that you wanted them to do? Why do you think the Zoob designers created so many types of connections? How is this different from other building sets you've used? How could a building set like this be helpful to scientists?

Bionic Hand

Fact:

Some types of human joints have the same names as machine parts: Elbow joints are "hinge" joints, while hips are "ball and socket" joints.

Nano Cloth

Bio-Inspired Designs

Take The Nano Cloth Challenge

Find What You Need..

In the Kit: Two fabric samples
On your Shelf: An eyedropper or a spoon; food coloring (optional), a leaf (still on the plant is fine)

How would you keep cloth from getting soaked in water?

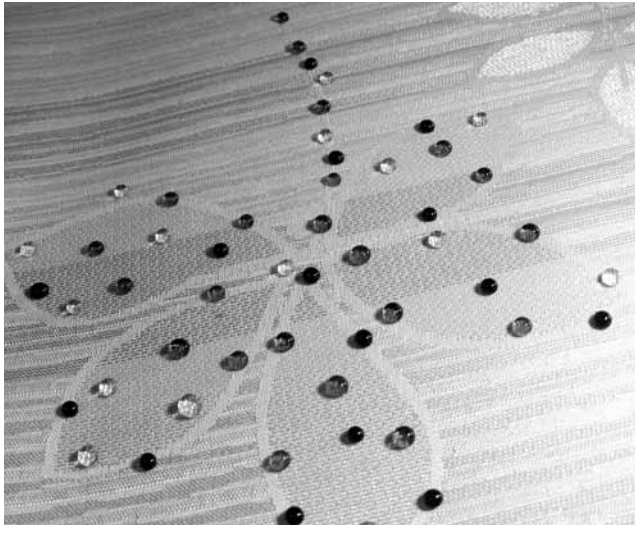
If you're sitting on a couch, you may be sitting on a waterproof covering. Material that covers furniture – along with curtains, surgical gowns, and other fabrics – is often protected in this way. Most protective coatings are made from chemicals that are harmful to the environment. A new technology may allow companies to cut down on the amount of these chemicals needed to make protective coatings. Scientists developed this technology by imitating the water-repellent coating on the leaves of plants.

How did the scientists create their fabric coating? With *nanotechnology.* Nanotechnology means working with materials on the level of atoms

or molecules – particles so tiny they're measured in something called *nanometers*. Scientists have arranged molecules in these protective coatings in a way that's similar to the protective layer of leaves.

One of the two fabric samples in your kit is coated with Greenshield – a new kind of protective coating. Which one? You're the scientist! Do the activity and find out!

Greenshield



The bumpy surface of a lotus leaf has inspired scientists to copy it to make water-resistant surfaces.

Activity: Find the Nano Fabric

1. Put a couple inches of water into a glass. If you like, add a drop of food coloring. Using a dropper or a spoon, drop a few drops of water onto each of the fabric samples.
2. Observe the drops of water on the cloth, then look at the back of the cloth. Which sample had the protective coating?
3. Let's see where the scientists got the idea for Greenshield: Drop a few drops of water onto the top of a leaf. You can test a houseplant leaf without removing it from the plant. Can you see why scientists wanted to imitate plants?

   One way that plants resist water is through microscopic bumps on their surface that cause water to bead up and roll off. Greenshield's protective coating is made of these tiny bumps.

Conclusion:

Was it easy to spot the waterproof fabric? Did the fabric seem to resist water as well as – or better than – a leaf? Why is it good for a plant to prevent water from sticking to it? What other material – in addition to fabric – might be helped by a waterproof coating? What would you use this waterproof material for?

Brain Squeezer:

Can you think of another property of a plant that could inspire a design? How about a building with a foundation that imitates a root system? Or a hurricane-proof flagpole that could bend in the wind and not break, like a plant stem? What else can *you* think of?

Made possible by the National Science Foundation

Presented by the award-winning radio series, Pulse of the Planet

Thank you to those who have contributed to the Kids' Science Challenge Activity Kit

Biomimicry Institute
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