Color Change Toys

Commercial Toy: Color Change Duck and Mood Mudd™

Other Stuff: ▸2 clear plastic tubs (cut-off 2-L soft drink bottles also work) ▸water ▸ice ▸tongs ▸hair dryer

What to Do:

1. Fill one container with very warm tap water and the second container with cold tap water. Add a few pieces of ice to the cold water.
2. Use tongs to dip the duck into the very warm water. What happens? Now dip the duck into ice water. What happens? Do the changes happen immediately or are they gradual?
3. Use a hair dryer to blow warm air onto the duck. What happens? Is the change immediate or gradual? What's causing the duck to change colors?
4. Now take the Mood Mudd out of its container and hold it in your hands. What does it feel like? What color is it?
5. Squeeze the Mood Mudd while switching it back and forth between your hands. What happens? Does the change happen immediately or is it gradual?

How It Works:

Both of the toys in this activity change color because of a temperature change. In general, items that change color in response to temperature work by one of two different mechanisms. Some color change toys, like color change cars, use liquid crystals. The molecules in liquid crystals have properties in between the solid and liquid state. At low temperatures, the materials are more like solids and, as they are heated, they change to the liquid crystal state. Liquid crystals reflect light differently than solids. As the wavelength of reflected light changes, so does the color of the toy. Other color change toys use a chemical that changes color in response to temperature changes. Heat-sensitive (thermochromic) paper also works in this way.

More Fun?

Learn about more color change toys and other items. Terrific Science Press offers the following book that includes an activity with color change objects:

▸▸ *Teaching Chemistry with TOYS*

The Joy of Toys
National Chemistry Week 2005

Find more toy-based activities at www.terrificscience.org.

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Wall Walkers

Commercial Toy: Wall Walker

Other Stuff: ▸removable adhesive putty or other substance safe to stick on walls ▸meterstick or tape measure ▸watch with a second hand or stopwatch

What to Do:

1. Check out your Wall Walker. What does it look, feel, and smell like?
2. Throw the Wall Walker against a blank wall and watch carefully. What does it do?
3. Throw your Wall Walker against the same wall and this time put a piece of adhesive putty (or other substance safe to stick on walls) where the Wall Walker initially lands. Then, use the second hand of your watch or a stopwatch to time how long it takes the Wall Walker to reach the floor.
4. How far did the Wall Walker travel? Measure the distance. What is the Wall Walker's speed? It's easy to figure out—just divide the distance the Wall Walker travels by the time it takes to reach the floor.
5. Test your Wall Walker on different walls and/or on different kinds of surfaces (such as metal file cabinets, wooden doors or cabinets, and tile walls). Is the Wall Walker's speed faster or slower on the other surfaces you tested?

How It Works:

Wall Walkers come in a variety of shapes, including spiders and other insects, bats, and skeletons. These toys are made of polymers, usually with a sticky substance added in. The kind of polymer varies based upon the manufacturer.

When Wall Walkers are thrown onto a smooth surface such as a wall, they initially stick to the surface because they are slightly attracted to the surface. Over time, gravity overcomes this attraction and the Wall Walker "crawls" down. The speed of the Wall Walker depends on the kind of surface and the cleanliness of that surface. In general, the smoother and cleaner the surface, the better the Wall Walker sticks to the surface and the slower it travels.

More Fun?

Learn how to make polymers such as Gluep and slime. Terrific Science Press offers the following books that include activities involving the science of polymers:

- *Polymers All Around You, 2nd Edition*
- *Teaching Chemistry with TOYS*
- *Classroom Science from A to Z*
- *Science Night Family Fun from A to Z*
- *Exploring Matter with TOYS: Using and Understanding the Senses*

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Diving Toys

Adapted from *Teaching Chemistry with TOYS*, published by Terrific Science Press, www.terrificscience.org

Commercial Toy: Diving submarine or other diving toy

Other Stuff: ▸baking powder ▸tub (at least 6–12 inches deep) ▸water

What to Do:

1. Prepare and operate the toy by following the package directions.
2. Watch your toy dive and surface several times. Can you explain the toy's behavior?

How It Works:

The toy "dives" (sinks) when you first place it in the water because it is more dense than water. Eventually, you observe the toy begin to surface. As the substances in the baking powder react because of the water, bubbles of carbon dioxide gas are slowly produced and are trapped beneath the bubble chamber. When enough gas is trapped, the toy with carbon dioxide gas becomes less dense than water and the toy rises to the surface. At the surface, the toy tips, the gas bubble escapes, and the toy sinks again because its density is once again greater than the density of water. This cycle is repeated as long as the substances in the baking powder react.

More Fun?

Learn ways to experiment with diving toys. Terrific Science Press offers the following book that includes a diving toy activity:

▸▸ *Teaching Chemistry with TOYS*

The Joy of Toys
National Chemistry Week 2005

Find more toy-based activities at www.terrificscience.org.

Glitter Wands

Adapted from *Teaching Chemistry with TOYS*, published by Terrific Science Press, www.terrificscience.org

Make-It-Yourself Toy: Glitter Wand

Stuff You'll Need: ▸12-inch length of ½-inch diameter, clear, rigid plastic tubing ▸2 end caps or corks that fit snuggly around/inside tubing ▸glitter and/or sequins (ultra-fine glitter is especially pretty) ▸measuring spoon ▸water ▸(optional) liquid soap or detergent ▸(optional) toothpick

What to Do:

1. Place a cap or cork on one end of the plastic tubing. Add about ¼–⅓ teaspoon of glitter and/or sequins to the tube. Fill the tube with water to about 2–3 cm below the rim.
2. With your finger over the open end of the tube, invert the tube and observe. Does your wand have enough glitter? Add more if needed. Does the glitter swirl freely? If you want to keep the glitter from clumping, dip the tip of a toothpick in liquid soap or detergent and then in the water within your wand.
3. When you are satisfied with your wand, place the other cap or cork on the open end of the tube. Invert your wand and observe. What can you infer about the densities of the different substances inside your wand?

How It Works:

Each kind of matter has its own characteristic density. Differing densities allow some things to sink while others float. Air is less dense than water; therefore, the air bubble in your tube always moves to the top of the tube. Some of the solids in your tube may be less dense than water while others may be more dense. The less dense solids will float in water. The more dense solids will sink in water.

You may have observed that some of the more dense substances move to the top of the wand. Why is this? As you invert the wand, the air bubble moves, agitating the solids. This movement of the air bubble may momentarily carry some of the more dense materials to the top of the wand. The surface tension of water may also be at work, allowing small pieces of denser solids to float. With time, these more dense solids will settle to the bottom of the tube.

More Fun?

Terrific Science Press offers the following books that include Glitter Wand activities:

▸▸*Teaching Chemistry with TOYS*
▸▸*Teaching Physical Science through Children's Literature*

The Joy of Toys
National Chemistry Week 2005

Find more toy-based activities at www.terrificscience.org.

Glow-in-the-Dark Vinyl

Adapted from *Teaching Chemistry with TOYS*, published by Terrific Science Press, www.terrificscience.org

Commercial Toy: sheet of glow-in-the-dark (phosphorescent) vinyl or other glow-in-the-dark vinyl shapes (such as stars)

Other Stuff: ▸room that can be darkened ▸assorted small objects

What to Do:

1. Before beginning, be sure that your glow-in-the-dark vinyl has not been exposed to light recently.
2. Put the vinyl face down. Place one hand—palm up—underneath the vinyl sheet. Place your other hand—palm down—on top of the vinyl. (If using a smaller vinyl shape, place just one finger above and one finger below the vinyl.)
3. Keeping both hands in place, flip the vinyl face up so it is exposed to the light. Keep your hands in place for about a minute.
4. Remove your hands from the vinyl. Turn off the light. What do you see?
5. Use other objects to create images on the vinyl.

How It Works:

The vinyl used in this activity glows after being exposed to light. The part of the vinyl covered by your hand is not exposed to light, so it does not glow (creating a dark handprint). Materials that glow in this way are phosphorescent.

So, how does phosphorescence work? When any object is exposed to light, it absorbs some of the light energy. Most objects release this energy immediately, but phosphorescent materials store the energy and release it over a period of time (even when the lights are turned off). Zinc sulfide and strontium aluminate are two phosphorescent materials found in many glow-in-the dark products such as vinyl, paint, and stickers.

More Fun?

Want to do more glow-in-the-dark experiments? Terrific Science Press offers the following books that include glow-in-the-dark activities:

- Teaching Chemistry with TOYS
- Classroom Science from A to Z

The Joy of Toys
National Chemistry Week 2005

Find more toy-based activities at www.terrificscience.org.

Grow Creatures

Commercial Toy: Grow Dino or other grow creature

Other Stuff: ▸paper ▸quart-size (or larger) zipper-type plastic bag ▸water ▸measuring cup ▸ruler

What to Do:

1. Use a ruler to measure the height or length of your grow creature and record the measurement. Younger scientists can trace the outline of the creature.
2. Place the grow creature into a zipper-type plastic bag and add about 2 cups of water. Seal the bag so that the water doesn't spill out.
3. Observe (and measure, if desired) your grow creature every few hours. Record your observations.
4. Once the creature seems to have stopped growing, remeasure or retrace it and record the results. Compare your beginning and ending observations.

How It Works:

Grow creatures are made of two different kinds of polymers, a "water loving" (hydrophilic) polymer and a "water hating" (hydrophobic) polymer. A mesh of hydrophobic polymer forms the outside of the grow creature and helps it maintain its shape while allowing water to reach the hydrophilic polymer at the creature's core. Because the hydrophilic polymer attracts water, the grow creature increases in size and volume as it absorbs water.

When the grow creature is removed from water, the water slowly evaporates and the grow creature shrinks back to its original size.

More Fun?

Now that you know how grow creatures act and why, can you design an experiment to see how different non-toxic solutions affect a grow creature's growth?

Terrific Science Press offers the following books that include activities with grow creatures:

- *Teaching Physical Science through Children's Literature*
- *Teaching Chemistry with TOYS*

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Find more toy-based activities at www.terrificscience.org.

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Hand Blasters

Commercial Toy: Hand Blasters

Other Stuff: ▸dark room ▸piece of paper

What to Do:

1. Put both of the balls into the same hand. Throw one of the balls a few feet into the air and catch it in the same hand that is holding the other ball. The two balls should collide as you catch. What happens? Make observations using all of your senses (except taste.)
2. Take the Hand Blasters into a dark room. Since you won't be able to see, put one ball in each hand and bring them together to make the collision. What results do you get this time? What additional observations can you add to your list?
3. Have a friend hold up a sheet of paper. Make the balls collide as you did in step 2, but this time put the sheet of paper between them. What happens to the paper?

How It Works:

Hand Blasters are ceramic balls that are coated with potassium chlorate, sulfur, glue, and powdered glass (silica). These are the same substances used to make caps for cap guns—that's why the sound and the smell may have been familiar to you.

When the two balls collide, the friction between the sand on the two balls causes a chemical reaction between the potassium chlorate and sulfur. This reaction gives off energy in the form of heat, light, and sound. The heat released is enough to burn a hole through paper!

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Find more toy-based activities at www.terrificscience.org.

Reference: Flinn Scientific Website. CHEM FAX™ on Hand Blasters. www.flinnsci.com (accessed July 20, 2005)

Hand Boilers

Commercial Toy: Hand Boiler/Love Meter

What to Do:

1. Place the bottom bulb of the Hand Boiler in the palm of your hand and wrap your fingers around it for a few moments. What happens? Do you think the liquid in the Hand Boiler is boiling?
2. How do you think the Hand Boiler works?

How It Works:

The liquid in the Hand Boiler has a low boiling point. The packaging will indicate the liquid used in your particular Hand Boiler. Even though the liquid looks like it's boiling when you grab the bottom bulb, it's really not. So what is happening to cause the bubbling you observe?

When you hold the bottom bulb in your hand, heat from your hand is transferred to the bulb and to the stuff inside of it (the liquid and vapor above it). The vapor that sits above the liquid becomes warmer and expands. This additional warmth causes more liquid to evaporate. These two factors cause the pressure in the bottom bulb to become greater than the pressure in the upper bulb, and the liquid is pushed up the tube to the upper bulb. When the level of the liquid in the bottom tube falls below the end of the tube, vapor can travel up the tube and rise through the liquid, giving the appearance of boiling.

More Fun?

Learn how to do a "cool" distillation with your Hand Boiler by visiting chemmovies.unl.edu/chemistry/beckerdemos/BD055 or by reading "Toys in the Classroom" by J.L. Sarquis and A.M. Sarquis in the October 2005 (Vol. 82 No. 10) issue of the *Journal of Chemistry Education*.

The Joy of Toys
National Chemistry Week 2005

Find more toy-based activities at www.terrificscience.org.

Magic Ink

Commercial Toy: Magic Ink

Other Stuff: ▸white piece of paper or white cloth

What to Do:

1. Pour a small amount of the Magic Ink on a white piece of paper or white cloth.
2. Blow on the colored portion of the paper. What's happening to the ink?

How It Works:

Most commercial Magic Inks are made of a solution of thymolphthalein, an acid-based indicator. Thymolphthalein is colorless if the pH is less than 9.4 and blue if the pH is greater than 10.6. Breathing on the blue Magic Ink results in a color change as the carbon dioxide you exhale lowers the pH. The colorless form of thymolphthalein can be changed back to its blue form if the pH is increased.

The Joy of Toys
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Find more toy-based activities at www.terrificscience.org.

Reference: "Disappearing Ink," *Fun with Chemistry: A Guidebook of K–12 Activities*; Sarquis, M., Sarquis, J., Eds.; Institute for Chemical Education: Madison, WI, 1991; Vol. 1, pp 91–94.

Magic Sand™

Adapted from *Teaching Chemistry with TOYS*, published by Terrific Science Press, www.terrificscience.org

Commercial Toy: Magic Sand

Other Stuff: ▸plastic spoon ▸clear plastic cup filled with water ▸paper towels

What to Do:

1. Feel the Magic Sand. Now pour a few spoonfuls of it into a cup of water. Look at it in different directions. What do you observe? Does the sand look like it's getting wet?
2. Sprinkle a little more sand on the surface of the water so it floats. Slowly and carefully push the tip of your finger slightly down on the sand so that you can see your finger in the water. What does it look like? Remove your finger. What does it feel like?
3. Carefully pour most of the water out of the cup. Try not to lose too much of the sand. Observe the sand as you pour off the water, then feel the sand. Did it get wet?
4. Dump the contents of the cup onto several layers of paper towel. Let it air dry. The Magic Sand can be put back into its original container and used again.

How It Works:

From your experience at the seashore or in a sandbox, you probably have seen that regular sand becomes wet in water. Magic Sand remains dry in water because the surfaces of the grains are coated with a water-repellent substance much like Scotchgard™ or silicone spray. These coatings are hydrophobic substances ("hydro" means "water" and "phobic" means "fearing") and therefore do not attract water. This hydrophobic coating also allows Magic Sand to form some unusual shapes and designs when poured into water. The coating keeps the Magic Sand dry even when it is totally submerged in water. When you push down on floating sand so the tip of your finger goes slightly under water, sand surrounds your finger and water is repelled. Your finger even stays dry if enough sand surrounds your finger.

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Find more toy-based activities at www.terrificscience.org.

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More Fun?

Want to make and investigate homemade Magic Sand and other water-repellent objects? Terrific Science Press offers the following book that includes an activity on hydrophobic materials:

▸▸ *Teaching Chemistry with TOYS*

Mystical Tree™

Adapted from *Investigating Solids, Liquids, and Gases with TOYS: States of Matter and Changes of State*, published by Terrific Science Press, www.terrificscience.org

Commercial Toy: Mystical Tree

What to Do:

1. Set up the Mystical Tree by following the directions on the back of the package.
2. Make observations of your tree once an hour for six hours. What do you observe happening right away? How much time does it take for crystals to begin to form? On what part of the tree do crystals appear first? What do your crystals look like?

How It Works:

The soft, fluffy, flower-like substance growing on the branches of your Mystical Tree is actually a formation of salt crystals that were once dissolved in the tree's growing solution. When the cardboard trunk and branches of the tree come in contact with the growing solution, the solution moves up the cardboard by capillary action. When the growing solution reaches the surface of the cardboard, the water in the solution begins to evaporate. As the water evaporates, the salts in the solution are left behind as soft, fluffy crystals.

More Fun?

Learn how to grow rock candy, crystal gardens and flowers, and homemade magic trees. Terrific Science Press (www.terrificscience.org/bookstore) offers the following book that includes activities with crystals:

- *Investigating Solids, Liquids, and Gases with TOYS: States of Matter and Changes of State*

The Joy of Toys
National Chemistry Week 2005

Find more toy-based activities at www.terrificscience.org.

Shrinky Dinks®

Adapted from *Polymers All Around You, 2nd edition,* published by Terrific Science Press, www.terrificscience.org

Commercial Toy: Shrinky Dinks Shrinkable Plastic

Other Stuff: ▸conventional or toaster oven (not a microwave) ▸permanent markers ▸aluminum foil ▸cookie sheet or toaster oven tray ▸oven mitt ▸spatula ▸(optional) clear container made from polystyrene plastic (recycle code #6)

What to Do:

1. Use permanent markers to create a design on a piece of Shrinky Dinks or polystyrene plastic. Place it on a cookie sheet or toaster oven tray lined with aluminum foil.
2. Heat the plastic in a preheated 325°F oven until it stops shrinking. It typically takes about 30 seconds and will curl and then reflatten in the process.
3. Use an oven mitt to remove the cookie sheet or tray from the oven. Use the spatula to remove the plastic from the foil and set it aside to cool.

How It Works:

Shrinky Dinks and containers with recycle code #6 are made of polystyrene, a common polymer that shrinks when heated because of how it is made. When the plastic is manufactured, it is heated, stretched, and then quickly cooled. The sudden cooling "freezes" the molecules of the polymer into their stretched-out position. When they are heated again, the polymer molecules return to their original positions, resulting in the observed shrinkage.

More Fun?

Terrific Science Press offers the following books that include activities with shrinking plastic:

- *Teaching Physical Science through Children's Literature*
- *Polymers All Around You, 2nd Edition*

The Joy of Toys
National Chemistry Week 2005

Find more toy-based activities at www.terrificscience.org.

Silly Putty®

Adapted from *Teaching Chemistry with TOYS*, published by Terrific Science Press, www.terrificscience.org

Commercial Toy: Silly Putty

Other Stuff:

▸page of newsprint ▸several other kinds of printed materials such as magazine pages, comic book pages, typewriter print, photocopies, and computer print

What to Do:

1. Test the ability of your Silly Putty to pick up different inks from the printed materials that you have gathered. Press your putty onto the paper, lift it, and then examine the surface of the Silly Putty that was in contact with the printed material. Which inks did the Silly Putty pick up?
2. Rub your fingers across your nose to collect skin oil and then rub your fingers across the newsprint. Were you able to pick up the newsprint ink? Try this with the other printed materials.

How It Works:

Silly Putty is well-known for its ability to pick up ink from the newspaper. But you probably observed that the Silly Putty does not pick up all inks that you tested. The reason it picks up some inks and not others is due to differences in solubility.

A rule of thumb for solubility of two substances is "like dissolves like." Polar substances (such as water or alcohol) will dissolve other polar substances. Likewise, nonpolar substances (such as oil and fat) will dissolve other nonpolar substances. However, polar and nonpolar substances (oil and water) do not dissolve in each other.

Newsprint ink is a pigment suspended in oil (a nonpolar substance) which is adsorbed by the paper. Since Silly Putty picks up the ink from the newsprint, we can infer that it must also be a nonpolar material. The pigment-oil suspension of the newsprint ink is readily adsorbed by Silly Putty. Our oily skin often picks up newsprint for the same reason.

From this activity, we can also infer that the inks the Silly Putty did not pick up are polar substances and therefore are not readily picked up by the nonpolar Silly Putty.

More Fun?

Want to investigate more properties of Silly Putty? Terrific Science Press offers the following book that includes a Silly Putty activity:

▸▸ *Teaching Chemistry with TOYS*

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Self-Inflating Balloons

Adapted from the "What a Gas!" Instant Science Kit, published by Terrific Science Press, www.terrificscience.org

Commercial Toy: Self-Inflating Balloon

What to Do:

1. Make some observations before inflating the balloon.
2. Place the balloon on the table and move the "mysterious" item inside to the center of the balloon.
3. Hit the center of the balloon with the bottom of your fist.
4. Shake the balloon. Make observations. What do you think causes the sounds? Feel the temperature of the balloon. Is it cooler or warmer than before? Squeeze the balloon. How does it feel? Shake the balloon until it stops inflating.

How It Works:

Self-Inflating Balloons contain a small bag with two chemicals inside. One chemical is a liquid while the other chemical is a solid powder. The liquid substance is an acid (many times, citric acid) and the powder is a base (many times, sodium bicarbonate, also called baking soda). Inside the balloon, the liquid is in a small bag which is surrounded by the larger bag containing the powder. This prevents the two substances from mixing. When you hit the balloon, you burst the bag of liquid inside the balloon, the two chemicals mix, and a chemical reaction occurs that produces carbon dioxide gas. The fizzing you may hear as you shake the balloon is from the gas production. As more gas is produced, the pressure on the larger bag inside the balloon increases until it bursts and you hear a pop. The pop is quite loud sometimes! The gas now fills the balloon and it inflates.

If the white powder inside your balloon is baking soda, you probably will notice the balloon getting cooler as it inflates. This occurs as the baking soda dissolves in water. In science, this cooling process is called "endothermic."

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Bubble Solutions

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Commercial Toy: Bubble Solution

Other Stuff: ▸clean Styrofoam® meat tray ▸black construction paper ▸scissors ▸straw ▸several other brands of bubble solution

What to Do:

1. Cut black construction paper to fit inside the tray and lay it on the bottom of the tray. Pour enough bubble solution into the tray to soak the paper and leave a few puddles.
2. Place your straw into one of the puddles. Blow gently through the straw to form a large bubble dome. Carefully remove the straw so that the bubble stays on the paper and does not pop. Time how long the bubbles lasts.
3. Use your straw to blow a second bubble and remove the straw just like you did in step 3. This time, observe the color of the bubble. Is the bubble all one color? Does it stay the same color from the time it forms until the time it pops? What color(s) do you see? Write down the bubble color pattern.
4. Try out different brands of bubble solution. Do the bubbles last any longer or shorter? What color patterns do you see?

How It Works:

Bubbles have air in the middle and a thin soap-film wall on the outside. The bubble will remain intact as long as the soap-film wall remains thick enough to hold the air in. Over time, the wall becomes thinner and thinner because gravity causes the soap film to flow away from the top of the bubble. Eventually, the wall becomes so thin that the bubble pops.

A bubble's change in color is caused by light waves reflecting off the bubble surfaces. When light hits the bubble, some waves are reflected off the outer surface while others are reflected off the inner surface. When the bubble's film is very thick (such as when the bubble first forms), the bubble will appear blue-green. As the film thins, the colors change to blue, magenta, and yellow/white. This color pattern will probably repeat several times. When the film is so thin that it is transparent, dark spots appear that let you know the bubble is about to pop.

More Fun?

Terrific Science Press offers the following books that include activities with bubbles:

- *Classroom Science from A to Z*
- *Science Night Family Fun from A to Z*