

# Directions

spectrUM Discovery Area is located on the Children's Floor of the new Missoula Public Library at 455 East Main Street, in downtown Missoula.



“Stare at spectrUM’s logo for 30 seconds and then look away to a blank wall. What do you see? The colors are reversed because of something called afterimage. **Pretty cool, huh?**”



**Science.** Try it.



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## Sensing for Science: Paper Chemistry

GRADES 3-8

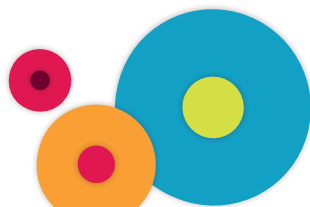
Use simple chemistry and special paper to make a work of art and explore acids and bases.



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# Paper Chemistry



## What You Need:

- Goldenrod paper
- Cotton Swabs
- pH Strips
- Baking Soda
- Cotton balls
- Bowls & Water
- Citric Acid
- Yellow Crayon (not included)

**WARNING:** We are using baking soda and citric acid in this experiment, which are safe to handle and only mildly acidic or basic. Do not eat them or drink the solutions you make, avoid inhaling the dust, and don't get either in your eyes. DON'T use any other household chemicals in this activity. Mixing some chemicals in your house can harm or kill you.

## Try it

**1. Pour** the baking soda powder into one small bowl or cup, and the citric acid powder into a separate bowl or cup.

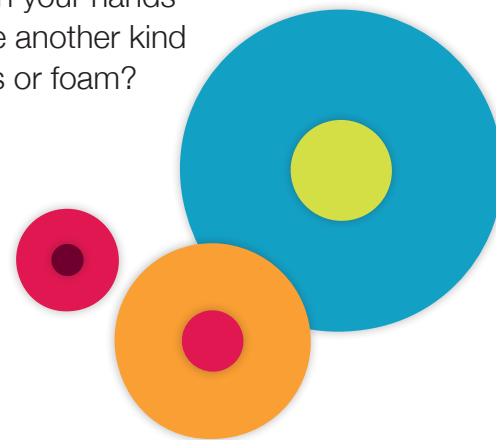


**2. Add** about 1/8 to 1/4 cup of water into each cup or bowl - you don't need too much, so don't fill up the whole bowl or cup! Swish around carefully to help the powders dissolve.



## Here are some ideas to ponder:

- Are there some other **safe** solutions you can think of to test? What about orange juice or tomato juice? Milk? How might the colors of those juices interact with the colors produced by the chemical reaction?
- How many times do you think this paper can switch back and forth between red and yellow?
- If you have test strips left over from this experiment, try them with some other foods in your fridge or cupboards - how basic or acidic are they?
- Can you fold the paper in an interesting pattern, then spread the basic solution onto it to create some interesting designs?
- You can easily make a “bloody handprint” by putting your hand in the baking soda solution and slapping it onto the paper (be sure to wash your hands afterward!). Can you make another kind of “stamp” out of sponges or foam?



For more information on the chemistry in this activity and ideas to explore see our Instructable at [tinyurl.com/paperchemistry](https://www.tinyurl.com/paperchemistry) or scan this QR code:



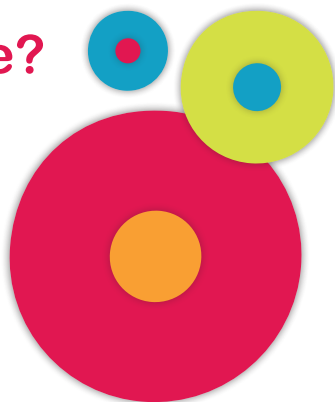
## What's going on here?

The special paper we are using here has a chemical in it that changes color depending on how **basic** or **acidic** of a solution it is exposed to. Even though both of the solutions are clear, they create very different colors on the paper. Bases, like our baking soda solution or things like soaps, turn the chemical a dark orange or red color. Acids, like our citric acid or things like lemon juice and vinegar, will turn the paper a yellow color.

When you color on the paper with your crayon, it prevents that part of the paper from soaking up the basic solution and turning red, so it stays yellow. In art, this is called the **wax resist method**.

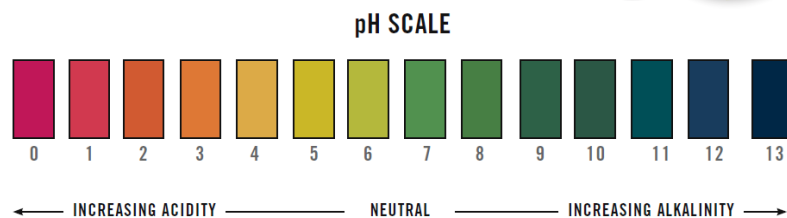
The little paper test strips are a **universal indicator**, meaning that they measure most or all of the full range of the **pH scale** from 0-14 and change through different colors of the rainbow based on how acidic or basic the solution is. pH stands for "power of Hydrogen" or "potential of Hydrogen" and refers to the concentration of free Hydrogen ions there are in a solution - more of them means a more acidic solution, fewer of them means more basic. Pure water is 7 on the scale, right in the middle between the range of 0-14, and is a **neutral pH**. The paper strips and the goldenrod paper we are using both react to acids and bases a bit differently - they change color based on how acidic or basic the solution is.

Scientists and chemists measure the pH of many different things to learn about what chemicals are contained within them and how they will react to things around them. Measuring the pH of things like soil and water in the environment can give a scientist a lot of information about how plants and animals will grow and survive.



3. **Test** each of the solutions with the pH paper by dipping one strip into the solution about halfway. Make sure to use a separate piece of paper for each different solution.

4. **Compare** the color of the strip to this color chart by holding it up to the closest matching color. The baking soda solution should turn the paper a brown or green color, meaning that it's basic or alkaline. The citric acid solution should turn the paper strip a reddish orange, indicating it's acidic. What number most closely matches the color that your paper turned to?

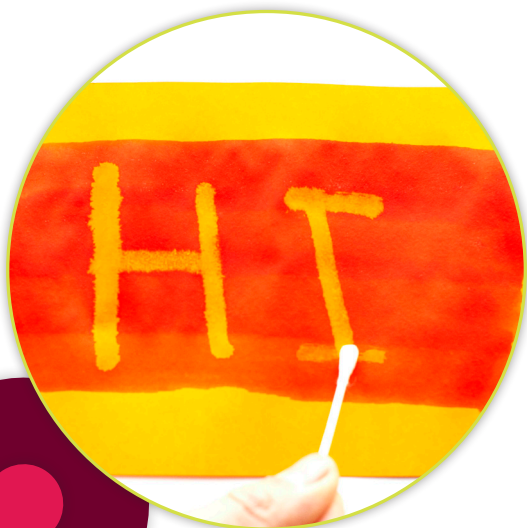




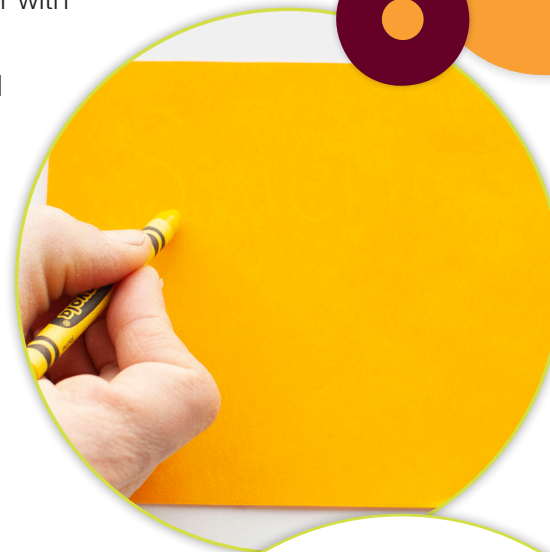
**5. Create** some chemistry art by dipping a cotton ball or swab in the baking soda solution and wiping it onto one of the sheets of goldenrod paper. This basic solution will turn the paper a dark orange or red color.



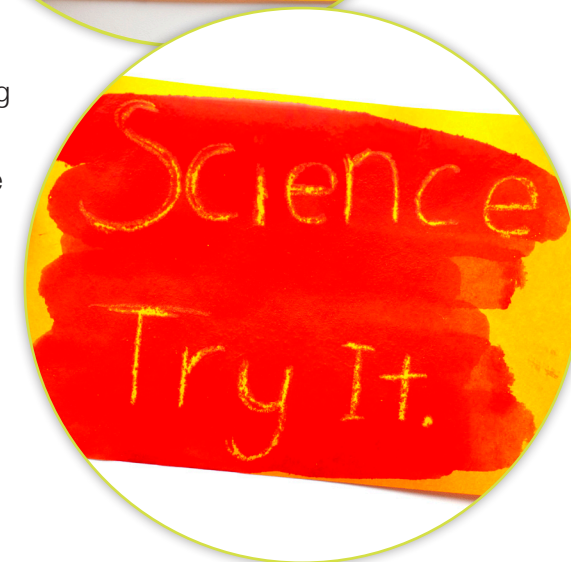
**6. Dip** a separate cotton ball or swab into the citric acid solution and paint it onto the paper. It will turn the dark orange color back to the original color of the paper.



**7. Draw** a secret message or drawing on the other sheet of orange paper with your yellow crayon. It will be hard or impossible to see!



**8. Paint** with the baking soda solution over your secret message to reveal it. The part you drew will stay the same color as the paper, and the rest that was painted will turn red!



**9. Wash** your hands after this activity.