Cloudy with a Chance of Clear Color

Milk of magnesia is a medicine used to help people with stomach aches feel better. Citric acid is an ingredient in sour candies. Add a special liquid called an indicator to see a repeating rainbow of colors as these milk of magnesia reacts with citric acid.

Question to investigate

What color pattern do you notice each time you add citric acid?

Chemistry content

- Milk of magnesia is medicine for stomach aches.
- Citric acid gives sour fruits and candies their sour taste.
- Solutions called indicators change color to help chemists determine what is happening in a chemical reaction.
- Scientists look for patterns and use evidence to make predictions.

Special considerations

- Reuse the medicine cups between participants.
    - When working with young children and to keep things moving the presenter should pour water in first and then the milk of magnesia in one medicine cup.
    - Participants will pour the citric acid in a separate medicine cup.
- Use a fresh tall clear plastic cup between participants. Cups may be reused if cleaned well in a sink with detergent and running water.
- Participants must wear splash goggles during this activity.
- Neutralize used solutions before pouring down the drain of a sink.

Time required	Age range	Group size
Preparation 30 minutes Activity 8-10 minutes	4 – 10 years	• One participant per station • 1 presenter per 2 stations • 4 stations can fit along one edge of a 6- or 8-foot-long table to serve up to 24 participants per hour

Materials

For 4 stations operating continuously for one hour

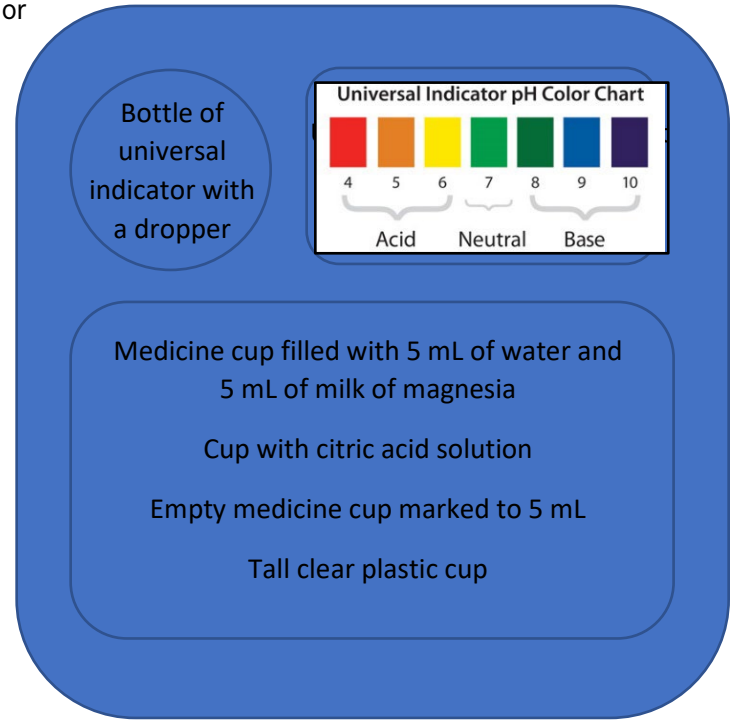
- 2 bottles of milk of magnesia
- 2 squirt bottles filled with water
- 4 250 mL bottles of citric acid solution, 5%
- 4 60 mL bottles of universal indicator
- 4 Universal indicator cards
- 8 Medicine cups
- 4 droppers
- 4 small clear plastic cups labeled citric acid
- 4 tall clear plastic cups
- 4 stirring rods
- Permanent marker
- Small clear plastic cups labeled citric acid
- Paper towels
- Splash goggles, one per participant
- Divided spill tray

Prior to the activity

1. Add 50 grams of citric acid to 1 liter of water and portion into 4 250 mL bottles.
2. Print copies of the universal indicator color chart. Cut along the dotted lines.

Prepare on site

1. Use a permanent marker to mark 5 and 10 mL on four medicine cups. Then mark 5 mL on four other medicine cups. Each station will need a pair of cups.
2. Label clear plastic cups, “citric acid” solution. Place one dropper in each
3. Arrange four trays along the front of the table close to participants.
4. Place items on each tray as shown.



Procedure

Onsite activity		
Step	**Details**	**Ask participants**
Introduce the reactants	• Explain that milk of magnesia is a medicine to make people take when they have a stomachache. • Add 5 mL of water to a medicine cup. Then pour 5 mL of milk of magnesia into this same cup. • Citric acid is used to make give candies a sour taste.	• Have you ever seen or tasted these chemicals before?
Introduce the colors on the chart	• Explain that scientists look for patterns so that they can make predictions. • Tell participants that they will look for colors during the chemical reaction and look for patterns.	• What color is universal indicator solution when it is in the bottle? • Find the color on the chart. • What does this tell you about universal indicator?
Add universal indicator to dilute milk of magnesia	**Direct participants to:** • Pour the milk of magnesia (and water) cup into their tall clear plastic cup. • Use a graduated dropper to transfer about 0.5 mL of universal indicator into the tall clear plastic cup. • Use a stirring rod to mix or swirl the cup until the liquid is all one color.	• What color do you notice when you first add the green liquid to the milk of magnesia? • How does the color change when you mix it?
Have participants pour citric acid from a small labeled source cup	**Direct participants to:** • Pour 5 mL of citric acid into a medicine cup (that is only used for citric acid in this activity. • Add 1 drop of universal indicator to the citric acid. • Pour the citric acid into the milk of magnesia. • Use a stirring rod to mix or swirl the cup until the liquid is all one color.	• What color do you notice when you add 1 drop of universal indicator to citric acid? • What colors do you notice as you mix citric acid and milk of magnesia? • Can you spot these colors on the chart?
Repeat three times	**Direct participants to:** • Pour and add 5 mL of citric acid, stir, and name the colors! • After a total of 4 iterations, notice that the liquid is clear and pink.	• What colors do you notice? • Do you notice a pattern ? • How has the liquid changed? • What does this color change mean?

How does this work?

The main ingredient in milk of magnesia is magnesium hydroxide. The liquid looks cloudy because only a small amount of the magnesium hydroxide dissolves in water. The rest stays suspended in the liquid or sinks to the bottom of the bottle. When you mix citric acid (an acid) with magnesium hydroxide

When you mix citric acid with alkaline magnesium hydroxide, a chemical reaction happens. The universal indicator changes color as the pH changes during the reaction. When the pink citric acid is added, the mixture quickly turns orange, yellow, green, blue, and purple as the acid is used up and more magnesium hydroxide dissolves into the water. Each addition of citric acid repeats this cycle until finally all of the magnesium hydroxide is used, and the solution turns clear and a color indicating that the solution is acidic.

Milk of magnesia is used to calm stomachs that have produced too much acid. Stomachs need to be acidic to digest food properly. However, too much acid is irritating, especially to the esophagus and intestines. Milk of magnesia uses up some of this acid. It has another helpful property. It speeds up the digestive process by pulling water into the stool. Soon the offending stomach contents are on their way out bringing relief.