

COPPER cleanup

Pennies become dull when their surface is exposed to oxygen. In this activity, kids use chemistry to explore whether acids or bases are better at restoring a penny's shine.

Prepare Ahead

- Try this penny-cleaning experiment yourself, so you can anticipate where kids may get stuck or need guidance.
- Gather pennies—each kid needs seven, though it's useful to have extras. Look for pennies with a dull, slightly darkened appearance. If possible, discard pennies with spots of black or green discoloration. All pennies should be about equally dull.
- Get pH paper, which indicates if something is an acid or a base. It can be found online and at some pharmacies. It comes in different pH ranges (1–14, 5–10, etc.) and is available as individual strips or on a roll. Any type should work, so buy what's affordable; costs range from \$5 to \$15.
- Photocopy the reproducible data sheet on p. 42; one copy per kid.
- Set up work areas: each table should have one bottle each of vinegar, lemon juice, ammonia-based cleaner, cola, ketchup; a box (or bowl) of baking soda (with a spoon); and a separate bowl of water. For each kid, provide a data sheet, pencil, spoon, six cups, six pH strips, and seven pennies.



See p. 42

Lead the Activity

- 1 Introduce Ruff's challenge.** (5 minutes)

 - Distribute an activity sheet, data sheet, spoon, and pencil to each kid. Tell them that they're going to try to shine up some dull pennies. They will also use special paper to find out which type of liquid shines pennies the best.
 - Ask kids what they think pennies are made of. (*Copper*) Hold up a shiny penny and a dull one. Ask kids to compare the two. Explain that a penny gets dull over time when it is exposed to oxygen in the air; oxygen combines with the copper to form a dull coating called copper oxide.
 - Tell kids that today's challenge is to test different liquids to find out which are the best penny polishers.
- 2 Set up the experiment** (10 minutes) as explained in steps 2 and 3 of the activity sheet. Encourage kids to put in just enough of each liquid to cover the bottom of the cup and the penny (about three tablespoons). For the baking soda cup, they should put in two spoonfuls of the powder plus enough water to make a paste for the penny to sit in.
- 3 Make a prediction.** (5 minutes) After everyone has their pennies and liquids in the cups, ask kids to predict which substance will shine the penny best.

Materials

- activity sheet for each kid
- data sheet (1 per kid; see p. 42)
- pencils (1 per kid)
- pH paper (6 strips per kid—see “Prepare Ahead”)
- dull pennies (7 per kid)
- cups (6 per kid)
- plastic spoons (several per kid)
- 1 bottle of white vinegar (per work area)
- 1 16-oz bottle of cola—not diet (per work area)
- 1 bottle of lemon juice (per work area)
- 1 box of baking soda (per work area)
- water
- 1 bottle of household cleaner with ammonia (per work area)
- 1 small bottle of ketchup (per work area)
- paper towels (1 roll per work area)

National Science Education Standards

Grades K–4

Science as Inquiry: abilities necessary to do scientific inquiry; understanding about scientific inquiry

Physical Science: properties of objects and materials

Grades 5–8

Science as Inquiry: abilities necessary to do scientific inquiry

Physical Science: properties and changes of properties in matter

4 Test the liquids. (5 minutes) Explain that while they wait for the liquids to work, they will use pH paper to learn whether each liquid is an acid or a base. Ask:

- What is an acid? (*Answers may include: a liquid that stings, burns, or is sour.*)
- What's a base? (*It's the opposite of an acid. Many cleaning products are bases.*)
- Have kids dip the pH paper strips in the cups, using a different strip for each liquid. Explain that acids will turn the paper reddish-orange, and bases will turn the paper bluish-green.

5 Penny Cleanup. (5 minutes) Have kids use a spoon to remove the pennies from each cup, then rinse each penny in water, dry it with a paper towel, and place it on the data sheet. When all the pennies are in place, encourage kids to compare them to the seventh one that was set aside as the control.

6 Discuss what happened. (10 minutes) Bring the group back together. Ask:

- Which liquid shined the penny best? (*Answers will vary, but should be one of the acids—vinegar, lemon juice, cola, or ketchup. Cola contains phosphoric and citric acid, and ketchup contains vinegar.*)
- Were you surprised by the results? If so, in what way? (*Answers will vary.*)
- Looking at your results, are acids or bases better at shining pennies? (*Acids*)
- Why was it useful to test the liquids with the pH paper? (*The paper helped to show that acidic liquids are the best penny polishers.*)
- Have kids read “Chew on This,” the science explanation on their activity sheet. Then ask: Why do you think the acids worked so well? (*The acids caused a chemical reaction that dissolved the copper oxide coating and left the penny shiny. Bases don't cause chemical reactions with copper, so they had no effect.*)

7 Award points. (5 minutes) Time to rack up some points! Review the activity's key ideas by asking the following questions, worth 50 points each.

1. What did the best penny polishers have in common? What about the worst? (*The best penny cleaners—cola, ketchup, vinegar, lemon juice—are acids. The worst are bases.*)
2. How do you know which liquids are acids and which are bases? (*By testing the liquids with pH paper.*)
3. Why was it helpful to have a penny that wasn't cleaned as a control? (*You can use it to compare to the shined pennies.*)
4. How was the copper oxide on the dull penny removed to make it shiny again? (*A chemical reaction occurred between the copper oxide and the acid.*)
5. Was the penny cleaned the same way that soap and water cleans your hands? (*No. Soap and water removes dirt from the surface of your hands. Copper oxide and acid cause a chemical reaction that changes the penny's surface.*)

Data Sheet Answer Key (see p. 42 for a reproducible copy)

	Vinegar	Baking Soda & Water	Cola	Lemon Juice	Household Cleaner	Ketchup
pH strip (put here)						
Acid or Base?	acid	base	acid	acid	base	acid
Penny (put here)						

Safety Tips

Tell kids to keep mixtures away from their clothes, eyes, and mouth. Have them wear protective goggles, if available.

COPPER cleanup



In this crazy cleaning experiment, can you make pennies sparkle with . . . ketchup? . . . baking soda? . . . or cola?

1 Get what You need.

- 7 dull pennies • 6 cups • a spoon • 3 spoonfuls of vinegar • 3 spoonfuls of cola • 3 spoonfuls of lemon juice • 2 spoonfuls of baking soda and some water • 3 spoonfuls of household cleaner with ammonia • 3 spoonfuls of ketchup • paper towels • bowl or cup of water for rinsing • 6 strips of pH paper • data sheet (see below)

2 Add Pennies.

Line up the cups in front of the data sheet and put a penny in each cup. Place the extra penny on the sheet—it's known as a "control." You'll use it later to compare with the others.

3 Add liquids.

In each cup, put enough of each liquid to cover the penny: household cleaner, baking soda and water, vinegar, lemon juice, cola, and ketchup.

4 Make a Prediction.

Let the pennies sit for at least five minutes. Which liquids do you think will shine the pennies the best?

5 Test for more information.

While you wait, find out more about your liquids. Using pH paper, discover if each is an acid or a base.

- Dip one end of a pH paper strip in the first cup: If it turns reddish, it's an acid; if it turns bluish-green, it's a base.
- Place the strip on your data sheet and write down whether the liquid is an acid or a base.
- Repeat these steps with each liquid and a fresh strip of pH paper.

6 Check Pennies.

Use a spoon to remove the penny from the first cup. Rinse it in water and dry it. Then place it on the data sheet. Repeat with the other pennies. Keep your hands as clean as possible.

7 Draw conclusions.

Look at your control penny and compare it to the others. How do the other pennies look in comparison? Which liquids shined the pennies the best? Can you tell if one type of liquid—acid or base—did the best job?

Chew on This!

Pennies are made with copper. After they've been exposed to air for a while, a dull coating of copper and oxygen, called copper oxide, forms on them. When some acids (like the ones you used) come in contact with copper, there's a chemical reaction that dissolves the copper oxide, making the penny shiny again. But the bases you tested left the pennies looking dull. Bases don't cause a chemical reaction with copper (or any metal), so they can't dissolve copper oxide.

safety Tip

Keep mixtures away from clothes, eyes, and mouth. No tasting!

	Control	Vinegar	Cola	Baking Soda & Water	Lemon Juice	Household Cleaner	Ketchup
pH of liquid							
Appearance of penny							
Time taken to shine							

Data sheet

Use separate data sheet to record your observations.

Dig Deeper

Speed cleaning. Want to shine your pennies even faster? Add a spoonful of salt to vinegar or lemon juice. Swirl a penny around in the mix and watch it shine up before your eyes.

Copper coating. Use copper from pennies to coat another object. Put about ten dull pennies in a cup with a vinegar and salt mix. After a few minutes, remove the pennies, but keep the liquid. Add a steel nail or paper clip. Wait about 10 minutes to a half hour. The copper oxide from the pennies will transfer to the nail or paper clip, changing its color.

Did You Know?

Pennies haven't been made of pure copper since 1857. Today, most are made of zinc with a copper coating. Since 2007, it has cost more than a penny to make a penny—\$1.00 in pennies is now made from \$1.67 in metals.



Watch **FETCH!** on PBS KIDS GO! (check local listings) and visit the **FETCH!** Web site at pbskidsgo.org/fetch.



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Fold

Fetch!

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Ahoy, mateys! I be wantin' to play pirate, but alas, me only treasure is a handful o' dull, pitiful pennies—an insult to a swashbuckling seadog like meself! Yer cap'n commands ye to shine 'em up to look like gold doubloons. Make haste, or I'll have ye walkin' the plank!

GOOO FETCH!





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Name: _____

	Vinegar	Baking Soda & Water	Cola	Lemon Juice	Household Cleaner	Ketchup
pH strip (put here)						
Acid or Base?						
Penny (put here)						

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Place dull penny here for comparison.
This is called the control.