Name _____ Date _____ Period _____

**Zorn**Science
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# Metals, Nonmetals and Metalloids Virtual Lab

Chemistry

Open **activities.zornscience.org/metals-lab/** and follow each step. Record what the simulation shows.

## Objective

Test the physical and chemical properties of three unknown elements and use the evidence to classify each one as a **metal**, **nonmetal**, or **metalloid**.

**NGSS alignment:** HS-PS1-1. Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.

**Practices and concepts:** Planning and carrying out investigations; Analyzing and interpreting data; Engaging in argument from evidence; Patterns.

## Meet the simulation

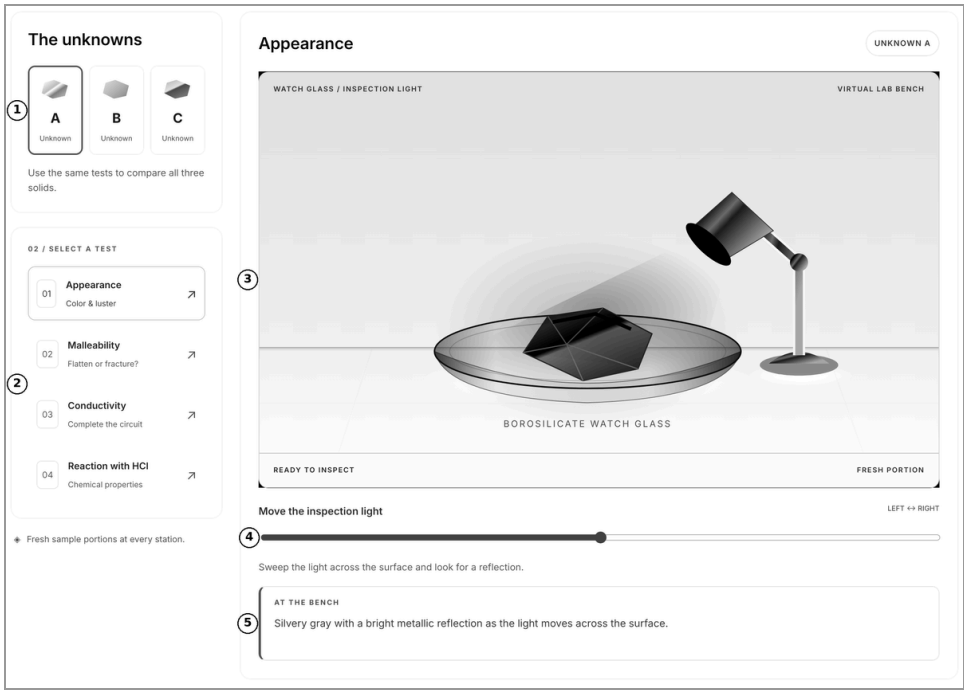



Figure 1. The Metals, Nonmetals and Metalloids lab. The dark lab bench is shown inverted for printing.

(1) Choose Unknown A, B, or C.

(2) Choose one of the four tests.

(3) The lab bench for the test you chose.

(4) Test controls (here, a slider that moves the light).

(5) "At the bench" describes what you observe. Every test uses a fresh portion.

## Pre-lab

**1.** Classify each description as a metal, nonmetal, or metalloid.
(a) Shiny, malleable, and conducts electricity well. (b) Dull, brittle, and does not conduct electricity. (c) Shiny, brittle, and conducts electricity weakly.


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**2.** Use the periodic table to predict three properties of zinc and three properties of phosphorus. Explain how the location of each element helped you.

**3.** List the four signs that a chemical reaction has happened.

## Part A. Physical properties

1. Select **Unknown A** and the **Appearance** test. Drag the light slider back and forth. Record the color and whether the surface is **lustrous** (shiny) or **dull**.
2. Select **Malleability** and click **Press with pestle**. Record whether the solid **flattens** (malleable) or **breaks** (brittle).
3. Select **Conductivity** and click **Touch probes to solid**. Record the tester reading: STRONG, WEAK, or NONE (Figure 2).
4. Repeat steps 1 to 3 for Unknowns B and C.

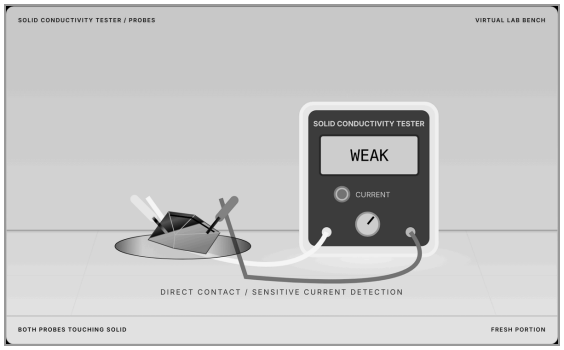



Figure 2. Conductivity test with both probes touching the solid. The reading appears on the tester screen.

OPEN means the probes are not touching the solid, so the circuit is not complete. NONE means the probes are touching, but no current flows.

| Unknown | Appearance (color and luster) | Malleability | Conductivity |
|---|---|---|---|
| A | | | |
| B | | | |
| C | | | |

Table 1. Physical properties of the unknown elements.

**4.** Which unknown has a mix of metal and nonmetal properties? Name one metal property and one nonmetal property it shows.

**5.** Unknown C looks shiny like a metal. Why is appearance alone not enough to classify an element?


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## Part B. Chemical property: reaction with HCl

1. Select **Unknown A** and **Reaction with HCl**. Click **1. Pipette 3 mL HCl**, then **2. Add solid**.
2. Watch the full five simulated minutes (the clock runs at 20× speed, so it takes 15 seconds). Record the starting and final temperature and every sign of a reaction you see.
3. Click **3. Pour into HCl Waste** before you change unknowns. Repeat for Unknowns B and C.

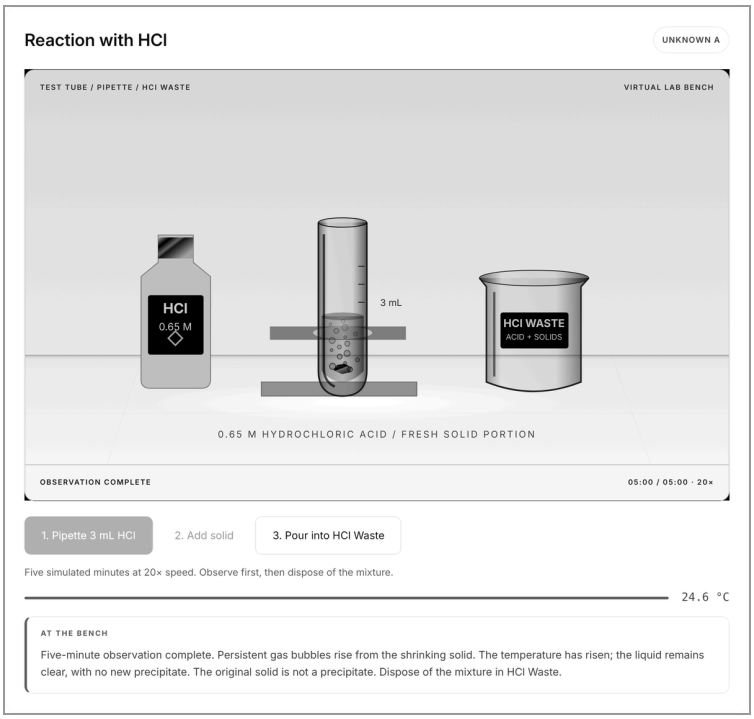



Figure 3. Unknown A after five simulated minutes in 0.65 M HCl. The thermometer reading is at the right of the timer bar.

| Unknown | Starting temp. (°C) | Final temp. (°C) | Observations with 0.65 M HCl | Reaction? (yes or no) |
|---|---|---|---|---|
| A | | | | |
| B | | | | |
| C | | | | |

Table 2. Reaction of each unknown with 0.65 M hydrochloric acid.

**6.** Calculate the temperature change for Unknown A. Which two signs of a chemical reaction did Unknown A show?

**7.** For the first part of the test, Unknown A shows almost no change. Why is it important to watch the full five minutes?


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## Analysis

**8.** Many metals react with acids to make hydrogen gas. Write the balanced equation for aluminum reacting with hydrochloric acid to make aluminum chloride and hydrogen gas. Include states.

**9.** How well a real metalloid conducts electricity depends on how pure it is and what is added to it. How could this affect a real version of this lab?

## Conclusion

**10.** Classify Unknowns A, B, and C as a metal, nonmetal, or metalloid. For each one, give evidence from Tables 1 and 2 and explain your reasoning.

| Unknown | Classification | Evidence and reasoning |
|---|---|---|
| A | | |
| B | | |
| C | | |

**11.** Where on the periodic table would you expect to find each type of element? Use the staircase line in your answer.


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