

## Activity 1: Producing Circuit Boards

Guiding Question: What happens when chemical processes are used to produce electronic devices?

Key Words: *circuit board, etch, evidence, trade-off*

### **Get Started:**

1. What are circuit boards, and why are they important?

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2. Watch the LABsent video (found here: <https://labaid.s3.us-east-2.amazonaws.com/labsent-videos/Chemical+Reactions+3e+1+Teacher+Demo+R.mp4>), to see a demonstration of an electrical circuit.

Notice that when the two metal clips were touching, the light bulb lit up. If a piece of plastic had been inserted between the clips, the bulb would not have lit up because certain materials do not conduct electricity. However, if a piece of copper-coated plastic had been placed between the two clips, the bulb *would* have lit up. The copper plating on the plastic conducts electricity and creates a circuit that lights the light bulb. A circuit board directs energy within a computer in a similar way to a network of electrical wires.

3. Most metals are excellent conductors of electricity, and this is one reason that metals such as copper are used in circuit boards. Read the introduction and Guiding Question to Activity 1, “Producing Circuit Boards,” in your Student Book.

### **Do the Activity:**

#### Part A: Designing and Etching a Circuit Board

1. Read Procedure Steps 1-4 in your Student Book.

2. Watch the LABsent video (found here: <https://labaid.s3.us-east-2.amazonaws.com/labsent-videos/Chemical+Reactions+3e+1+Part+A+R.mp4>), and record your data. Each time the video says to record, you may want to pause the video to give you ample time to complete your observations.

*Procedure Step 4a: First, make a table, in the space provided on the next page, to record the properties of the copper on the circuit board and the copper chloride etching solution before and after you place the board in the solution for etching.*

Name \_\_\_\_\_

Date \_\_\_\_\_

Data:

Part B: Examining the Circuit Board

3. Read Procedure Steps 5-8 in your Student Book.

4. Watch the LABsent video (found here: <https://labaid.s3.us-east-2.amazonaws.com/labsent-videos/Chemical+Reactions+3e+1+Part+B+R.mp4>), and record your data. Each time the video says to record, you may want to pause the video to give you ample time to complete your observations.

Part C: Reading

5. Read the *Make Products, Make Waste* reading in your Student Book. Refer to Student Sheet 1.1, "Three-level Reading Guide: Etching Circuit Boards," which is attached to this packet, to guide you as you complete the following reading. Be sure to pay attention to the illustrations and relate them to the text and your experience producing a circuit board.

**Build Understanding:**

1. Based on your data, do you think the substances after the etching are the same as or different from those before the etching?

Name \_\_\_\_\_

Date \_\_\_\_\_

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2. The disappearance of one or more starting substances and the appearance of one or more new substances means that a chemical change, or chemical reaction, has taken place. Changes in properties indicate that starting substances have changed and new substances have formed.

The pattern of change at the observable level during a chemical reaction reflects patterns of change at the atomic/molecular (particle) level.

Copper's characteristic chemical properties are used for two key steps in preparing circuit boards: isolating copper metal from copper ore and then etching the metal coating on the circuit board to produce pathways. How does the process that you used compare with the process for etching circuit boards in the reading?

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3. What should be done with the used copper chloride etching solution?

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**Analysis:**

1. Describe the changes that occurred to the properties of the following during the etching process:
  - a. Your circuit board
  - b. The copper chloride etching solution

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Name \_\_\_\_\_

Date \_\_\_\_\_

2. **Evidence** is factual information or data that support or refute a claim. How does your answer to item 1 provide evidence about whether the starting and final substances change during the etching process?

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3. **Revisit the issue:** The etching process produced waste etching solution.

a. What do you think should be done with this waste?

b. A **trade-off** is an exchange of one outcome for another— giving up something that is a benefit or advantage in exchange for something that may be more desirable. What is one trade-off of your suggestion in 3a?

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4. **Revisit the issue:** Etching circuit boards creates large amounts of copper-containing toxic waste. What ways can you think of to reduce the amount of copper-containing waste produced?

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Name \_\_\_\_\_

Date \_\_\_\_\_

5. **Revisit the issue:** The phenomena you are investigating relate to what happens when chemicals are used to make products and solve problems. Think about what you know about how chemicals are used to produce circuit boards and other products. What questions do you have about chemicals and the wastes from using them?

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**STUDENT SHEET 1.1****THREE-LEVEL READING GUIDE: ETCHING CIRCUIT BOARDS**

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1. Put an X next to the statements below that you believe agree with what the reading says. Sometimes the exact words found in the reading are used. At other times, other words may be used to communicate the same meaning.

Under each statement, either quote the text from the reading that is the same or agrees with the statement OR explain why the statement is incorrect.

\_\_\_\_\_ a. The waste from etching circuit boards is toxic.

\_\_\_\_\_ b. Government agencies have stopped the production of toxic waste from computer manufacturing.

\_\_\_\_\_ c. At each stage in the life of a product, from making it to using it to disposing of it, waste is produced.

\_\_\_\_\_ d. Etching involves a chemical reaction.

2. Put an X next to the statements below that you believe represent the intended meaning of the reading. Under each statement, quote the text from the reading that supports or contradicts the statement.

\_\_\_\_\_ a. Copper can have many effects on human health.

\_\_\_\_\_ b. The raw materials needed to manufacture circuit boards can be used in their natural form.

**STUDENT SHEET 1.1****THREE-LEVEL READING GUIDE: ETCHING CIRCUIT BOARDS (continued)**

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\_\_\_\_\_ c. In circuit board etching, one of the starting substances is copper chloride solution.

\_\_\_\_\_ d. The toxic effects of copper are not yet known.

\_\_\_\_\_ e. The etching solution is different after etching than it was before etching.

3. Put an X next to the statements below that you agree with, and under each statement support your choices with ideas from the reading and from your own knowledge and experience.

\_\_\_\_\_ a. The toxic wastes generated from etching circuit boards are worth the hazards they pose to humans.

\_\_\_\_\_ b. People should be willing to pay more for products that are manufactured in ways that do less damage to the environment.

\_\_\_\_\_ c. It is better to use recycled copper chloride etching solution for making circuit boards than it is to mine new copper ore from Earth's surface.