

MIT Edgerton Center QUIZBOARD Teacher's Guide

***Please have your students come on the day of the activity **with questions drafted in pencil on the templates provided** for their Quizboards. Instructions appear later in this guide (pages 5 & 6).

The Quizboard activity can serve many purposes in your curriculum:

- as an enrichment activity after the students have an initial understanding of circuits.
- as a culminating activity after students have mastered the concepts of circuits.
- as a review activity when beginning a unit which uses previous knowledge of circuits.

The material that follows is to provide background on this activity for you as a teacher. We do not expect that students come to the Edgerton Center knowing this procedure and the material. Use this information with your students to prepare them for their visit and to follow up in class after the visit. We do encourage you to conduct an introductory lesson with a class before they come for a visit. We have found that even a brief lesson helps to maximize the class' time during the visit and to further their level of understanding.

During Quizboard building, students are introduced to circuits, electronic components, and skills such as soldering and wire stripping. If students have studied circuits or electronics, you may find it appropriate to interrupt explanations provided by the Edgerton Center Staff with questions relating this activity back to materials the students have studied. In addition to providing a small lesson and supervision, we also give each student a handout to work from, complete with diagrams and instructions.

Electronic components introduced during the activity:

- Dry cell batteries provide the electrical energy to drive the circuit.
- Resistors reduce the voltage traveling through the circuit from 9V to 3V.
- LED's (light emitting diodes) give off light when current flows through them in the correct direction.

Physical concepts:

- open and closed circuits.
- current as the flow of electricity.
- voltage as the force that causes the flow of electricity.
- resistance as a method of dissipating electrical energy.

Schedule:

- 10 minutes Introduction to Edgerton Center and Quizboard Building.
- 50 minutes Students build probes as a group led by Edgerton Center staff.
This is when most of the electrical concepts are explained.
- 15 minutes Students break for snack.
- 75 minutes Students create the faces of their Quizboards, solder their probes, wire the back of the Quizboards, connect the probes to the battery, and clean up.
- 30 minutes Students eat their brown bag lunch.

(For start times of 10:00, snack is replaced by a mid-activity lunch break. Other times are shifted accordingly.)

Step-by-Step Overview of Quizboard Building

1. Drafting questions:

Each student in your class should draft 3-6 written questions for the face of their Quizboard **before** coming to the Center. We have found that younger students do better with only 3-4 questions for their boards. Older or more advanced students may wish to come with 5-6 questions. These questions can come from any subject (math, history, a recent science lesson) and should be matching or multiple choice. Questions should present one clear question with one definite answer. Included at the end of this guide are samples of questions used on Quizboard faces. These questions should be filled into the templates for the face of the Quizboard that will be sent to you by an Edgerton Staff member. (Ask students to use pencil.)

2. Introduction to Quizboard Building:

When the students arrive one of our staff will present a small lesson on circuits and electricity. This person will talk about these concepts as they relate to the Quizboard. She or he will also name and explain the parts on the Quizboards.

3. Assembling probes:

The completed Quizboard is a simple circuit powered by a 9-V battery. The board uses two probes to complete the circuit. One of these probes has an LED that lights to indicate a right answer. Here each student will be cutting wire and stripping the ends and joining small electrical parts together to make two working probes. We provide hands-on instruction for each student as well as a guide containing written step by step instructions for probe assembly.

For all remaining steps, students proceed individually as they are ready.

4. Designing the face of a Quizboard:

The students will now glue their question sheets to the front of a box top (about the size of the top of a Xerox paper box).

5. Soldering:

In order to provide the best safety and supervision, a few students at a time will be taken to a separate room to solder their probes together while the rest of the class is working on the faces of their board. Solder is used to connect the electric joints on the probes so that electricity flows through them. Solder is a soft metallic substance that liquefies when gently heated and bonds to the metal parts. Because the soldering irons are very hot, we require the students to wear safety glasses and closely supervise this part of the activity. The soldering itself is easy once you get started; but student's small hands often have a little trouble and have to try a few times to get the hang of how to do it. Once the soldering is completed each child covers all the exposed wires with electrical tape. The group then returns to the other room and a new group is brought in.

6. Wiring:

Each child will poke a hole through the box in front of each question and each answer. These holes are then filled with brass brads, which are locked in place. On the inside of the box each student identifies the path from a question to the right answer. Then he or she cuts and strips a wire and places it on the inside of the board over each path. Each question is now wired to its

correct answer. The final steps involve connecting the probes to the battery by stripping the wires and twisting them together. The battery is then taped to the box.

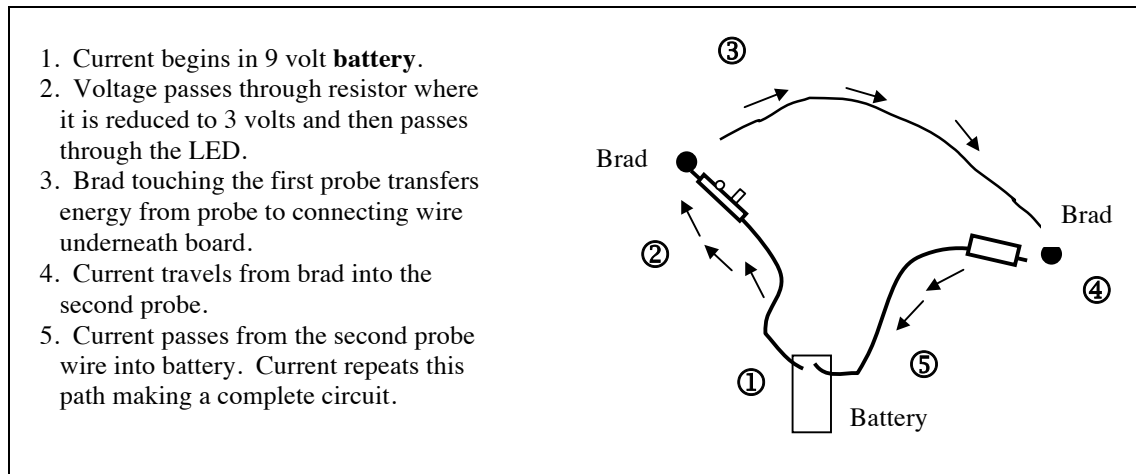
7. Trouble shooting and cleaning-up

Students now test their Quizboards to make sure the LED lights only for each correct answer. Often students have wired their boards so the probes light up for a wrong answer. Other students may not have wired their batteries in properly. The staff helps the students to trouble shoot these problems. The Quizboards are now complete. The students will be supplied with magic markers and crayons to make the final touches to their Quizboards. The students usually break at this point and test each other's Quizboards. After a few minutes of this we ask the students to help us clean up the materials. This is the end of the Quizboard activity.

Answers to questions commonly asked about Quizboards

- How does a Quizboard work?

This can best be explained in the diagram below.



- What is solder and why do the students use solder to connect the electric joints on the probes?

Solder is made up of 44% lead and ~55% tin. There is also flux in it to help the solder bond to the metal. The solder helps to physically hold the connecting wire together. The solder also helps to insure a reliable electrical connection is made; the solder bonds to the metal parts when the wire on the probe is heated properly during soldering.

- What does the resistor do?

The resistor is used to absorb excess power from the 9 volt battery. By itself, the LED can only handle 3 volts. If we were to connect the battery to the LED without the resistor, the 9 volt current would burn out the LED and we would have a *smoke* emitting diode.

- Why don't the wrong answers work?

Only the correct answers are wired to the questions. With the wrong answers there is no wire connecting the brads for the current to flow through and you do not make a closed circuit.

- When you put tape on the resistor how does the energy still flow through it?

The current flows *through* the resistor, it does not flow around the resistor. Also the tape only touches the *coating* on the resistor (the tan plastic looking material with colored stripes on it). The material in the resistor that reduces the voltage is inside this coating and the tape never touches it.

- What if a student's board stops working?

Check to see that none of the brads are touching. If the prongs touch this may result in a short circuit and the battery will be run down. Also check to see that none of the connections underneath the board have come apart. Finally, if the student has been using the board for a long time, the battery may be dead.

- Where did the Edgerton Center get the idea for the Quizboard building activity?

The activity was developed by Kathy Vandiver, a sixth grade teacher in Lexington's William Diamond Middle School.

Suggestions for using the Quizboards in your classroom

Post one or a few of the Quizboards on a bulletin board outside your room. Have a student(s) write up a description of how the board works and post it next to the board. The class might work together on what points needed to be included in the explanation and decide on the best one.

Have students make new faces for their boards. The students can use the same places for the brads on their boards. The original connecting wire can simply be moved to new connection points or you can have students make new connecting wires.

Students can use the boards to test whether an item conducts electricity or not. If they put both probes on an item that is a conductor, a closed circuit will be made and the LED will light. This idea came from one student who finished early and started testing which items on her work table could make the LED light. She began by testing the plastic handle of the scissors and also the metal end. This is a clear way to illustrate materials as conductors of electricity.

State Abbreviations

<i>Missouri</i> •	<i>MT</i> •
<i>Montana</i> •	<i>MI</i> •
<i>Massachusetts</i> •	<i>MO</i> •
<i>Minnesota</i> •	<i>MN</i> •
<i>Michigan</i> •	<i>MS</i> •
<i>Mississippi</i> •	<i>MA</i> •

ANIMALS

<p>Which one is a mammal?</p> <ul style="list-style-type: none">•	<ul style="list-style-type: none">• turtle• gorilla• robin
<p>Which one is an amphibian?</p> <ul style="list-style-type: none">•	<ul style="list-style-type: none">• toad• fish• snake
<p>Which one lays eggs?</p> <ul style="list-style-type: none">•	<ul style="list-style-type: none">• mammal• reptile• marsupial
<p>Which one is not a fish?</p> <ul style="list-style-type: none">•	<ul style="list-style-type: none">• goldfish• shark• whale