# Circuitry Unit

**Overview:** During this unit the students will review/learn the basics of circuits using a variety of programs and activities. Using the base understanding of circuits, students will learn types of electrical sources & currents, how to harness and utilize the power associated with each, ways that circuitry has been interwoven into every aspect of our lives, future possibilities of evolving skill and programs, and explore the endless career opportunities available that integrates the knowledge of circuitry. The students will create pre-planned projects to solidify the techniques and demonstrate a solid knowledge base but they will be also be challenged to create independent projects of their own interest.

**Goal:** Students will learn the basic principles of circuitry/ Apply this knowledge to create and improve circuitry related projects/ Explore the manufacturing and career opportunities associated with circuits

**Unit duration:** 5 – 7 weeks

**By the end of this unit, students will be able to:**

- Understand basic circuitry and the corresponding terminology
- Be able to describe and demonstrate the principals behind static electricity and lightning
- Draw schematics and descriptions using the correct electrical terminology
- Create and Identify different types of circuits and the purpose for each
- Use circuitry to create projects involved in the areas of light, sound, motion, and sensors
- Use circuitry to develop coding and programming skills to higher levels
- Create items with current marketable features and be able to describe how this area of the economic has impacted their lives directly
- Investigate career paths that incorporate the use of circuitry
- Invent their own projects using learned circuitry skills

**Materials**

Unit Specific Material List

- Snap Circuits
- Ladybird E-textiling
- Foil Tape
- Conductive Ink Pens
- LED lights
- Arduino Boards
- Multimeters
- Sensors (sound, motion, buzzers)
- Breadboards
- Resistors/ Motors/ Fan Blades
- Makey Makey kits

Everyday Item Material List

- Card Stock or Paper
- Pencils/Pens
- Index Cards
- Batteries various sizes (CR3032, AA, AAA, C)
- masking tape (scotch will work)
- pliers/ tweezers/needles
- alligator clips/ copper wire/ insulated wire
- flour/salt/cream of tartar/veg.oil/sugar/deionized water
- various materials (ex. Scarves, hats, felt, etc.)
- balloons/straws/glue
- computer/printer

**Resources**

- Links
  - www.Tryengineering.com
  - www.Instructables.com
  - www.BrainPop.com
  - https://chibitronics.com/project-tag/science/
  - www.exploratorium.edu/tinkering/projects/cardboard-automata
  - https://squishycircuits.com/pages/dough-recipes
  - https://cdn.shopify.com/s/files/1/2640/3158/files/Squishy-Circuits-NGSS-Curricula-and-Educators-Guide.pdf?10140376818392922586
  - https://ny.pbslearningmedia.org/favorites/
  - https://makeymakey.com/pages/educators#resources
  - https://pbskids.org/designsquad/pdf/parentseducators/DS_TG_full.pdf

- Lesson plans – the lesson plans are attached and are also included in the hard copy binder.

**Criteria for Projects:**

- Teams of 2-4
- Be creative and use the materials safely
- Collaborate and share your expertise with others
- Presentation Skills needed for each project- Projects will be shared with outside friends of the class
- Show that you planned, tested and re-adjusted your project

**Timeline**

Each topic is listed out as a one week lab session. Materials for all projects should be gathered at least one month prior to the start of the year. The ability of the students and the complexity of the projects will make the timeframe for each vary.

# Activity Overview

| Week | Activity | Activity outline | Guiding questions |
|---|---|---|---|
| 1 | **STEM Jobs- An Introduction to the world of STEM** | • Using BrainPop Analyze and discuss a slideshow of the 10 best careers of the future.<br>• Use BrainPOP and other internet resources to research one of these careers, or design their own career based upon the most pressing 21st century needs identified in the slideshow.<br>• Create an individual slide and description based on his or her selected career to create a collaborative slideshow about STEM careers of the future. | What do you know about STEM careers?<br><br>What areas of Science/Math/Technology interests you the most and why?<br><br>Where can you find out more information about that interest is used in careers? |
| 2 | **Electricity and Circuits- Basic Understanding**<br><br>**(Conductive Ink)** | • Explore basic principles related to electricity.<br>• Identify pertinent questions related to electricity, electromagnetism, and electric currents.<br>• Answer student-generated questions using BrainPOP resources.<br>• Share their research findings with the class.<br>• Use research to create a new BrainPOP movie<br>• Learn about alternatives to wiring in electrical circuitry.<br>• Learn about the electrical properties of different materials.<br>• Learn how conductors and insulators react to electric current. | How does electricity travel through certain materials?<br><br>What are ways we use electrical current and how do we harness the power for our benefit?<br><br>How are schematics for electrical currents drawn and what do the symbols mean?<br><br>What conducts electrical current and how can we discover new materials/ |
| 3 | **Understanding Batteries & Squishy Circuits** | • Label the parts of a battery.<br>• Order the steps to describe how a battery works.<br>• Demonstrate understanding of a battery's operation through a hands-on investigation and oral/written reflection.<br>• Create a battery using squishy materials- test voltage with a Multimeter<br>• Use measurements in recipe to make conductive and insulating doughs<br>• Create circuits, test resistance and investigate resistors, and begin coding- all incorporating the squishy circuits<br>• Instruct others how to use the squishy dough and create basic circuits (primary students/ other students in middle grades/ demonstrate to after school programs) | How can we create an electrical circuit using play dough?<br><br>What does it mean for a material to be conductive? Insulating?<br><br>When would it be beneficial to use a series vs. parallel circuit and vice versa?<br><br>How can we use schematics to show electrical circuits? |
| 4 | **Snap Circuitry & Sensor Introduction** | • Instructor explains how to build projects with the kit (Grid, Layers). | • What do all those little parts in an electronic gadget do? |

| | | | |
|---|---|---|---|
| 4(cont'd) | **(See Project List and Schematics)** | • Students construct an electric circuit in series with a motor and fan<br>• Students construct an electric circuit in series with a resistor, motor, and fan. Note and discuss the impact to the fan speed.<br>• Instructor demonstrates an electric circuit in series with two battery packs, motor, and fan. Note and discuss the impact to the fan speed.<br>• Students construct an electric circuit in parallel with a resistor, motor, and fan. Note and discuss the impact to the fan speed.<br>• Students construct an electric circuit using an integrated circuit plan. | • Can I predict what a circuit will do based on the parts that are present?<br>• Can I build a circuit that accomplishes a task that I want it to? |
| 5 | **Buzzers/ Switches/ Resistors**<br><br>**(Snap Circuits/ Lego EV3/ Makey Makey)** | • Students use breadboards to construct buzzers for games, alarms, and personal inventions.<br>• Use the breadboard to install switches and resistors to regulate electrical current going through the assembly.<br>• Create paper circuitry that incorporates switches<br>• Investigate the when and how much is needed for resistors<br>• Progression of understanding will lead to Arduino boards and initial programming | • Why would you need a buzzer and where would it be helpful in everyday life?<br>• How might an engineer determine if a material would make a safe housing for a switch?<br>• How would resistors and switches control sensors and be incorporated into the current technology? |
| 6 | **Radios/ Receivers & Transmitters/ Machine Usage** | • Students explore how advances in radio communications have impacted society.<br>• Students work in teams to build and test a working FM radio receiver and an FM transmitter.<br>• Review challenges encountered in the building and testing process, evaluate whether they are able to both send and receive radio transmission, and share observations with their class.<br>• Research the new demands for radio transmission/ music downloads and the circuitry needed for such demands. | • How does a circuitry systems and its components work together to create radios?<br>• What advancements and what circuitry systems are involved in the advancement of radio/ music?<br>• Where will the demands of advancing technology lead the needs of circuitry and in what way? |
| 7 | **E-textiling/ Manufaturing/ Genius Plans** | • Students design circuits to be infused into the textile industry.<br>• Students work in teams to create schematic drawings of circuitry for clothing(textile) | • How might a textile engineer use circuitry to boost business?<br>• How might you engineer a textile product that would be highly marketable? |

| | | | |
|---|---|---|---|
| 7 (cont'd) | **(LilyPad/ Arduino)** | • Use conductive thread, conductive ribbon and conductive material efficiently<br>• Create a variety of projects- bookmarks, stuffed toys, scarves, hats, etc | • Can you create an item for sale using textiles and electronics? |

# ACTIVITY RUBRIC

| ***PERFORMANCE INDICATORS*** | **EXEMPLARY 5 points** | **SATISFACTORY 3 points** | **NEEDS WORK 1 point** | **SCORE** |
|---|---|---|---|---|
| **Identify the problem(s) and brainstorming solutions** | Showed a clear understanding of the problem(s) to solve. Independently brainstormed solutions. | Needed some teacher direction to define the problem(s) and brainstorm possible solutions. | Needed lots of teacher direction to define the problem(s). Little if any independent brainstorming. | |
| **Working as a team member** | Worked well together. All team members participated and stayed on task. | Some team members were occasionally off task. | Most team members were often off task and not cooperating or participating fully. | |
| **Using the design process** | Team brainstormed many design ideas and tested and improved the design. Final design complete or nearly complete and shows creative problem solving. | Some team members were occasionally off task | Team brainstormed few design ideas and did little testing or redesigning. Final design lacks clear design idea(s). | |
| **Processing the science and engineering-- Presentation of STEM principles** | Team gave a strong presentation of its solution to the challenge and showed clear understanding of the science concepts. | Team gave a basic presentation of its solution to the challenge and showed basic understanding of the science concepts and design process. | Team gave a weak presentation of its solution to the challenge and showed little understanding of the science concepts and design process. | |
| **Correlation of STEM concepts with real-world manufacturing and future career opportunities** | Team investigated numerous career fields directly related to the activity and thoroughly connected the concepts to manufacturing opportunities. Great detail provided and shared out. | Team investigated a few career fields relating to the activity and generally connected to manufacturing, with limited details and average sharing proficiency. | Team either investigated no career fields, did not connect the activity to manufacturing, or details/sharing are missing. | |
| | | | ***Total*** | |