Squishy Circuit  Grades 3-8  45-90 minutes

LEARNING GOALS: After the completion of this workshop, students will understand:

1. How electronic circuits work
2. How various substances are conductive

CONCEIVE – What do I wish to accomplish through this project?

This stage involves guiding students in defining the goals of the project, then helping them develop conceptual, technical and action plans to meet those goals while considering the technology, knowledge, and skills that apply. This guidance is provided in the form of Essential Questions that use student’s preconceptions, and misperceptions then move them toward a deeper and more realistic understanding of the process and skills needed to complete the project.

ESSENTIAL QUESTIONS:

1. How can a working circuit be built from homemade play dough?
2. How does the soft circuit function?
3. How can the squishy circuit be used to power various components like LED’s, motors, and speakers?

NOTES:

DESIGN - How will I accomplish the project?

This stage focuses on creating the plans, drawings and algorithms that describe the product, process or system that will be implemented.

1. The overall explanation of squishy circuits can be found at:
   http://courseweb.stthomas.edu/apthomas/SquishyCircuits/howTo.htm
2. After making the dough, students will begin by constructing the Basic Circuit followed by the Series/Parallel
3. Students may choose which project to construct next from the website
4. Remind students of safety policies of your institution before they test their circuit
5. More information on the basics of electronic circuits can be found at:
   http://science.howstuffworks.com/environmental/energy/circuit1.htm
IMPLEMENT - From an idea to a product!

This stage refers to the transformation of the design into a product. It includes hardware, manufacturing, software coding, testing and validation.

Students are encouraged to tinker with their squishy circuit. Tinkering can be encouraged by laying out challenges to the students for them to accomplish then build upon. Challenges may include:

1. Try making a squishy buzzer. Have students brainstorm and experiment with how to do this without showing them the powerpoint slide
2. Try making a kinetic (moving) squishy creature using the DC motors provided
3. Are there other designs students can make?

Advanced Options: (information on using Arduino boards can be found on the Arudino CDIO)

2. Students may experiment with their squishy sound build to determine how resistance effects the sound generated

NOTES:

OPERATE – Does it work the way I planned?

Students should experiment with various configurations of conductive dough and insulating dough to determine how the circuit can be shorted. Students are encouraged to troubleshoot their designs to determine how the circuit works. They should understand that a short circuit is created when the conductive dough touches and creates a pathway for the current to travel around the LED. To avoid this, the layer of insulating dough must be placed between the two layers of conductive dough. Also, students will need to be sure that their positive LED leg is matched with the red wire from the battery pack to function correctly. Encourage students to discover these issues on their own as troubleshooting is an important problem solving skill

Reflection Questions (ask the students these questions in the few minutes before they leave the workshop):

1. Why do you need 2 different types of dough?
2. Most LED’s require a resistor, why doesn’t this one?
3. How did you change the pitch of your squishy buzzer? Why did it change?
4. How did Ohm’s law describe your squishy circuit? Could you make your own demonstration?
5. What did you find interesting? Why?

RESOURCES NEEDED – What equipment and supplies do I need?

1 per student team:

- Conductive dough (recipe at: http://courseweb.stthomas.edu/apthomas/SquishyCircuits/conductiveDough.htm)
- Insulating dough (recipe at: http://courseweb.stthomas.edu/apthomas/SquishyCircuits/insulatingDough.htm)
- 1 9V or 1 4 AA battery pack
- Various colored large (10mm) LED’s (can be purchased in bulk at: http://www.sparkfun.com/products/10635)
- DC motors (can be purchased at: http://www.allelectronics.com/make-a-store/item/DCM-374/8-16-VDC-MOTOR/1.html)
- Wires (2 per team) http://www.allelectronics.com/make-a-store/category/825/Wire/Cable/1.html
- Wire stripper http://www.allelectronics.com/index.php?page=seek&id%5Bm%5D=pattern&id%5Bq%5D=wire+stripper&x=0&y=0

Arduino Option:

- Arduino UNO board
- USB cable
- Computer with Arduino software installed
- Arduino source code

SET-UP
Colorado State Standards – High School | 21st Century Skills
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1. Physical Science | Concepts and skills students master:
5. Energy exists in many forms such as mechanical, chemical, electrical, radiant, thermal, and nuclear, that can be quantified and experimentally determined
6. When energy changes form, it is neither created nor destroyed; however, because some is necessarily lost as heat, the amount of energy available to do work decreases

Evidence Outcomes
Students can:
b. Evaluate the energy conversion efficiency of a variety of energy transformations

Inquiry Questions:
3. Scientists or engineers often say energy is “lost.” Is there a word that might be better than “lost?” Why?

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<th>Supply</th>
<th>Price</th>
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<tr>
<td>Dough supplies – for 6 batches (X students)</td>
<td>$15.00</td>
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<tr>
<td>batteries</td>
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<td>LEDs</td>
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<td>DC Motors</td>
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<td>Wire</td>
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<td>Wire stripper (1 for each group)</td>
<td>$4.00 a piece × 5 = $20.00</td>
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Cost/student=$ 2.90 (based on 25 students) | 2 staff recommended