Drawdio – Making a Musical Pencil Grades 3-12     90 mins

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

1. How to use basic electronics tools to construct a printed circuit board (PCB) project
2. The principles of how a basic circuit works
3. How the Drawdio circuit produces sound
4. How these circuit components can be applied to other circuits

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. Does electricity produce sound? How can it be heard?
2. Are humans electrical conductors
3. How can an electronic circuit produce sound?

NOTES:

In this workshop, students will use basic principles of electronics and basic building skills to make their own Drawdio, an electronic device that can turn anything into a sound producing, musical device.

5 min. To start, ask students what they know about electricity, electronics, and circuits. Use this information to guide the next discussion.

5 min. Ask students the 3 essential questions above to introduce the concept of the Drawdio kit that they will be building.

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.

NOTES:

10 min. Using The Tools – project the following resource page from Adafruit:

http://ladyada.net/make/drawdio/prep.html
5 min. How to Solder Safely – watch the following video: http://www.ladyada.net/learn/soldering/thm.html

10 min. Now go through the parts using the following site: http://ladyada.net/make/drawdio/parts.html
Make sure every student has each part and that they are very careful not to lose them. Have every student hold up the part as you call it out using its correct name. Avoid calling parts “thingys”, etc.

Caution is Advised: It is important to keep the static sensitive parts in their respected bags. Damage to these parts will render activity useless.

NOTE: If time permits we have found it useful to have the students practice their soldering skills to build a steady hand with the Wonky Wire kits. http://www.apoguekits.com/wonky_wire.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.

NOTES:
30 min. Begin the build using the instructions at: http://ladyada.net/make/drawdio/solder.html

OPERATE – Does it work the way I planned?

This stage uses the built product, process or system to satisfy the intended goal.

NOTES:
20 min. Allow students to play with their Drawdios and debug any problems

5 min. Discuss other uses of the Drawdio: http://ladyada.net/make/drawdio/user.html

Discuss with the students what each basic part does and how the circuit is completed using information from: http://ladyada.net/make/drawdio/design.html

5 min. Revisit the Essential Questions for closure. How did student thinking change?
RESOURCES NEEDED – What equipment and supplies do I need?

Supplies needed:

http://ladyada.net/make/drawdio/parts.html

1. Printed Circuit Board (PCB) qty 1
2. TLC551 or similar low voltage ’555 timer chip qty 1
3. NPN transistor, EBC pinout such as PN2222 or 2N3904 qty 1
4. PNP transistor, EBC pinout such as PN2907 or 2N3806 qty 1
5. 680 pF ceramic capacitor qty 1
6. 0.1 uF ceramic capacitor (104) qty 1
7. 100 uF/6.3V capacitor (or higher) qty 1
8. 1/4W 5% 10K resistor Brown, Black, Orange, Gold qty 1
9. ½ 5% 300K resistor Orange, Black, Yellow, Gold qty 1
10. E-Switch qty 1
11. AAA Battery holder qty 1
12. Small 8ohm speaker qty 1
13. Copper foil tape 6”
14. Thumbtack qty 1
15. Pencil qty 1
16. Zip tie qty 1
17. Wire 6”

SET-UP

http://ladyada.net/make/drawdio/prep.html These are the prep directions for the workshop.
<table>
<thead>
<tr>
<th>Colorado State Standards – High School</th>
<th>21st Century Skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Physical Science</td>
<td>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 not 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</td>
</tr>
</tbody>
</table>

### Supply

<table>
<thead>
<tr>
<th>Kit</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td><a href="http://www.adafruit.com/category/28">http://www.adafruit.com/category/28</a></td>
<td>$17.50 per kit</td>
</tr>
<tr>
<td>Or buy all supplies at electronic parts store and just purchase Printed Circuit Board (PCB)</td>
<td>$5.00 per board</td>
</tr>
</tbody>
</table>

Total $17.50 for kit

*2 staff recommended*