



# TECHNOLOGICAL FLUENCY THROUGH CIRCUIT BENDING

ERIK BRUNVAND



# General Education



- \* At the University of Utah: Three of four “intellectual exploration” areas
  - \* Humanities
  - \* Fine Arts
  - \* Social & Behavioral Science
  - \* Applied Science
- \* *What about technology?*  
*Engineering problem solving?*  
*Technological fluency?*  
*Computational thinking?*



# Technological Fluency

## *Being Fluent*

*with*

INFORMATION

TECHNOLOGY

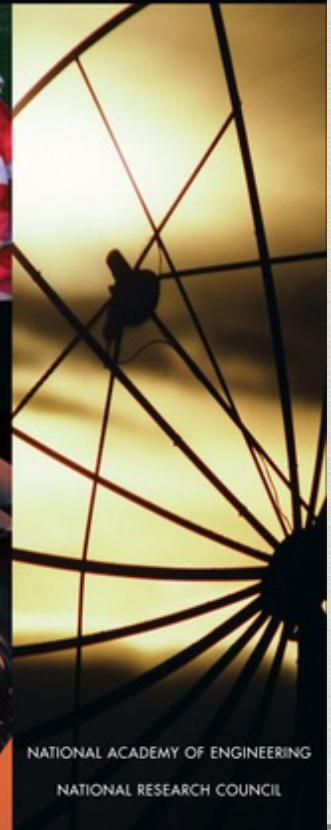
COMPUTER SCIENCE AND TELECOMMUNICATIONS BOARD NATIONAL RESEARCH COUNCIL



**TECHNICALLY SPEAKING**



WHY ALL AMERICANS NEED TO  
KNOW MORE ABOUT TECHNOLOGY



NATIONAL ACADEMY OF ENGINEERING  
NATIONAL RESEARCH COUNCIL

# Technological Fluency

- \* Technological *literacy*
  - \* Implies only basic knowledge of the subject
  - \* A skills-based idea
- \* Technological *fluency*
  - \* Enables manipulation of the medium
  - \* The ability to handle unintended and unexpected problems



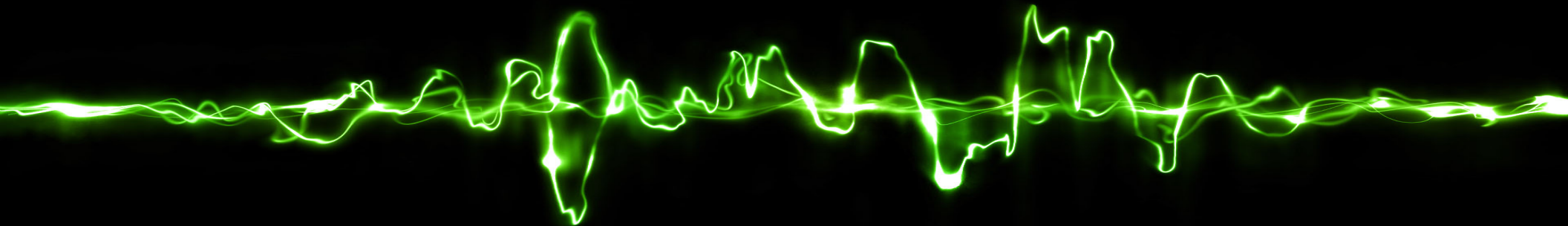
# Technology Focus

“Electronic technology is pervasive in our modern world but how it actually works can be a mystery to many people. In this class students will explore the fundamentals of electronic technology with a goal of increasing their technological fluency.”



# But not an “Engineering” Course

Through hands-on labs and projects students will gain a fundamental understanding of how electronic things work and what are their capabilities and limitations. This will be explored in the context of making art and noise with electronic components, some of which will be built from scratch, and some of which will be discovered from existing cast-off or broken devices.





# Making Noise: Sound Art and Digital Media

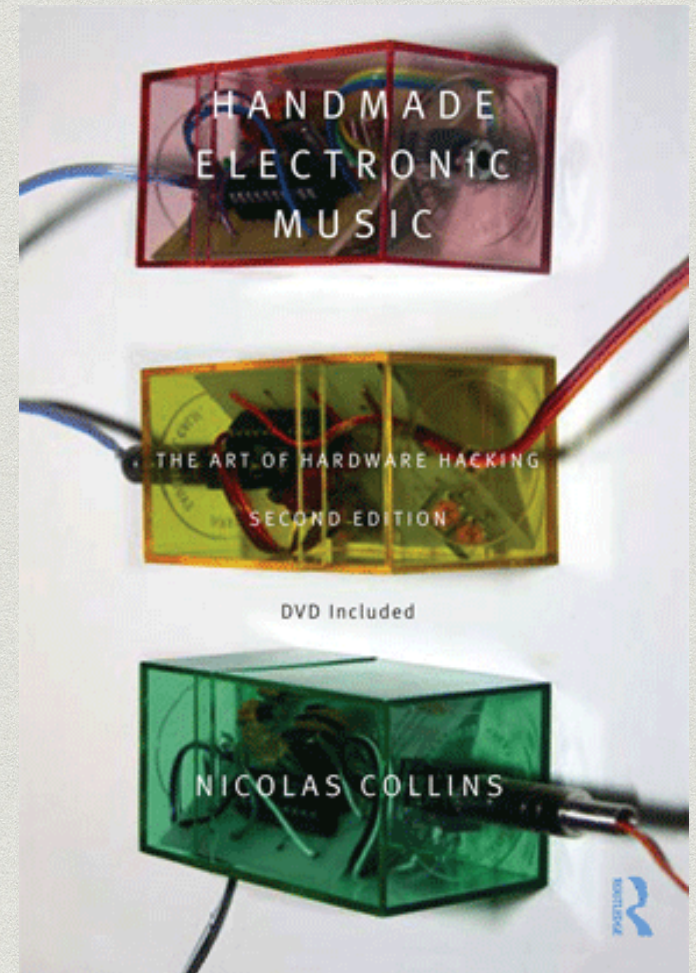
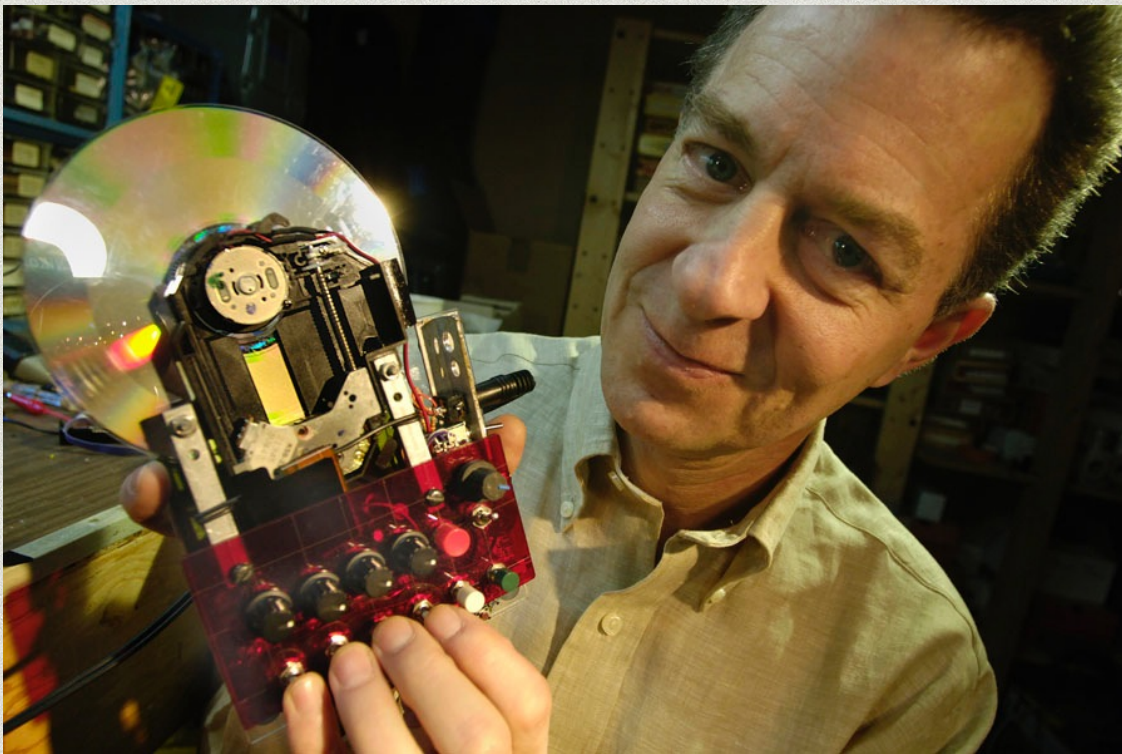
- \* Semester-length general education course
- \* Carries either Fine Arts or Applied Science designation
  - \* ... at least for two years
- \* Developed through a program sponsored by our Office of Undergraduate Studies
- \* Introduce technology in an arts context
  - \* Specifically **Sound-Art**





# Textbook

- \* Handmade Electronic Music
- \* Nicolas Collins



# Circuit Bending

Creatively hacking and re-purposing (upcycling?) electronics in the service of making sound

*Hardware Hacking*  
vs.  
*Circuit Bending*



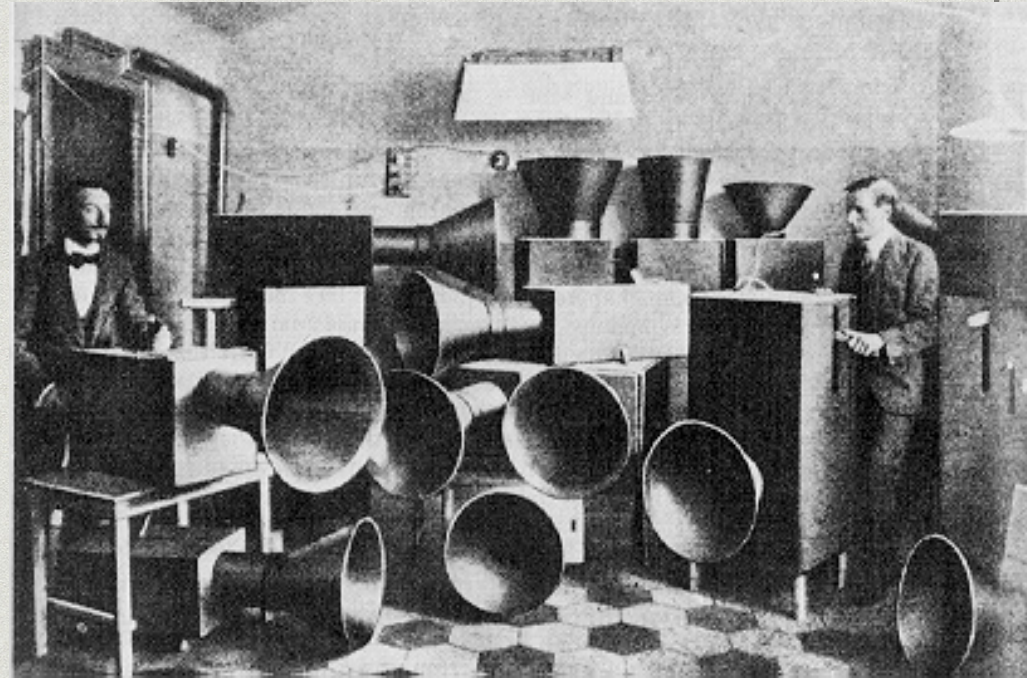
# Curriculum

- \* Reading assignments
- \* Listening assignments
- \* Projects
  - \* Induction coil recordings
  - \* Arduino sound
  - \* Toy hacking
  - \* Oscillators
- \* Final project



# Readings / Context

- \* Experimental and electronic music
  - \* Precursor to contemporary Sound-Art



Russolo - *The Art of Noise*

Varèse - *The Liberation of Sound*

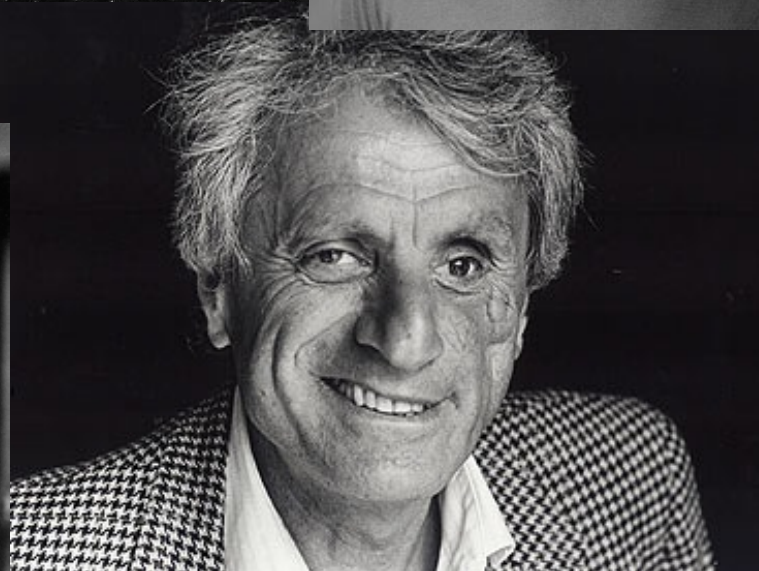
Cage - *The Future of Music - Credo*

Ussachevsky - *Music in a Tape Medium*

Stockhausen - *Advice to Clever Children*

Harley - *The Electroacoustic Music of Iannis Xanakis*

# Readings / Context



# Listening (Ear Training)

- \* From *100 Exercises in Listening and Sound-Making* by R. Murray Shafer, Arcana Editions, 1992
- \* Listen to sound/noise around you
- \* Practice listening/hearing from a critical perspective

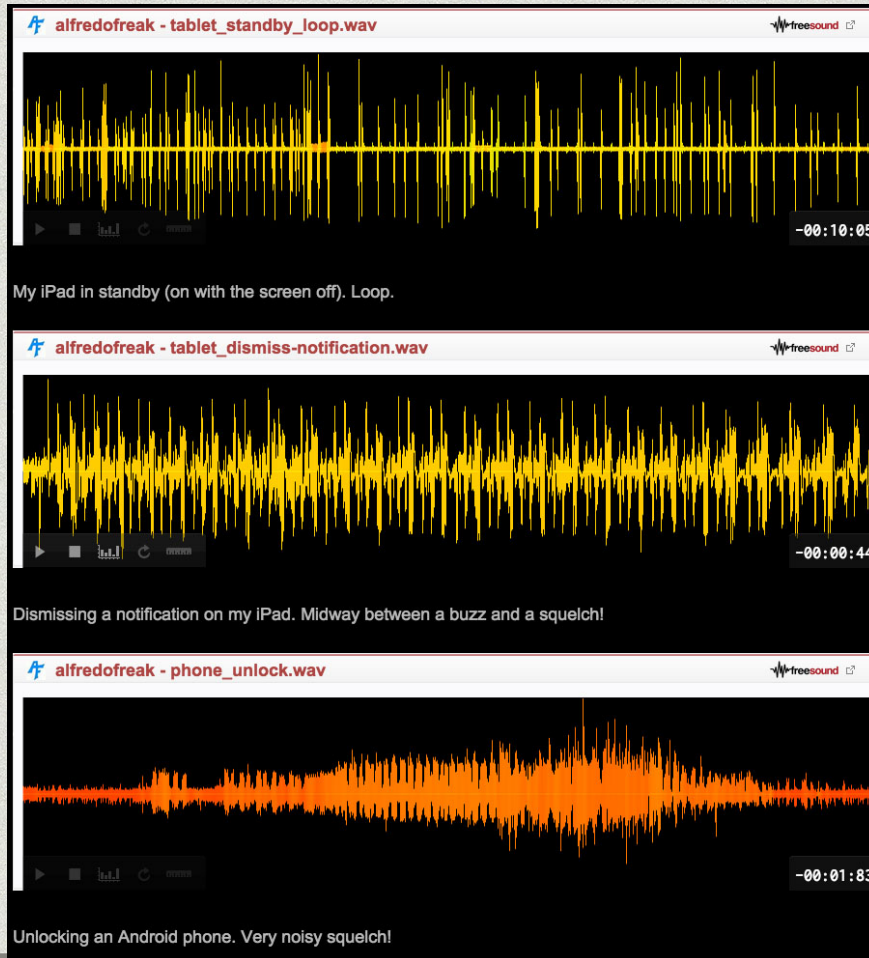
## Examples:

- Take 10 min and write down all the sounds you hear
- Find a pitched sound in your environment, hum that pitch, walk around the block, what happens?
- Bring an interesting sound to class
- Make lists of old sounds and new sounds



# Project: Inductive Coil Recordings

Use inductive coil to record EM noise in your environment



# Project: Arduino Sound

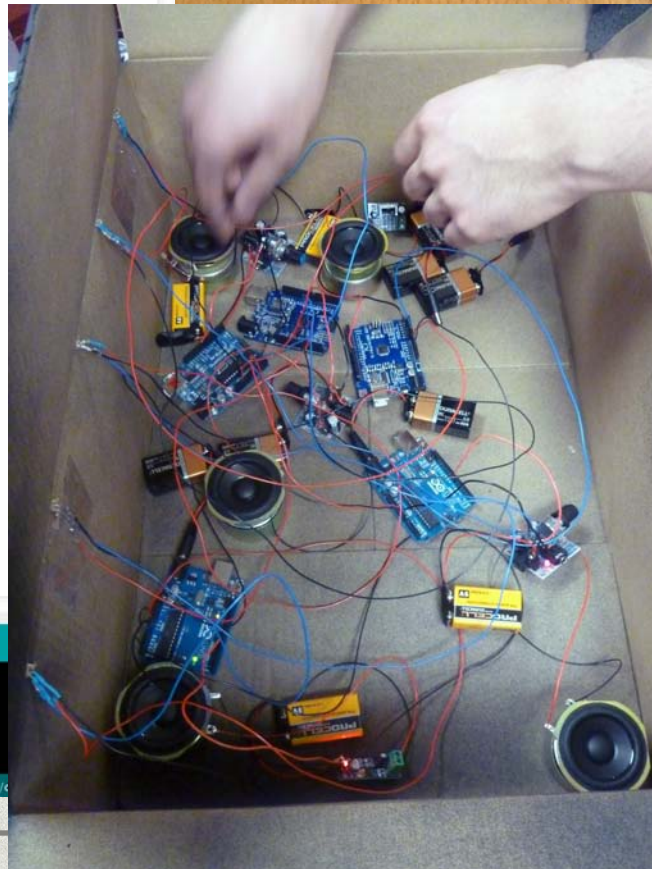
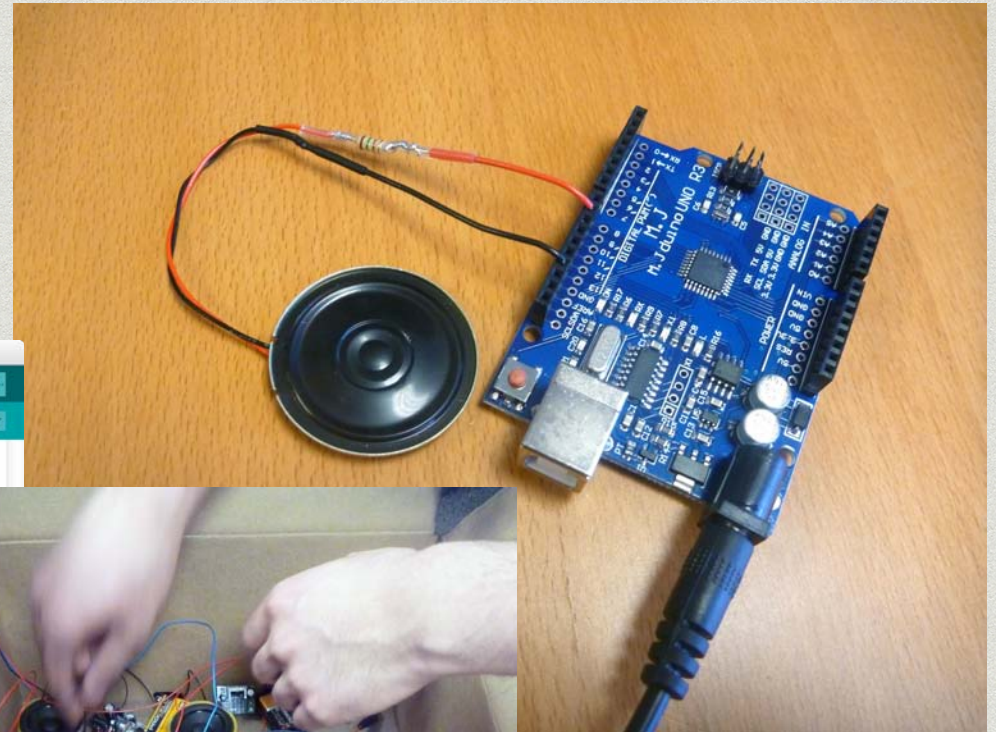
Simple programmed sound using Arduino "tone" library

```
SimpleTone1 | Arduino 1.6.3
SimpleTone1 pitches.h
/* VERY simple tone program */
#include "pitches.h"
int speakerPin = 9; // atch the speaker to pin 9

void setup(){
  pinMode(speakerPin, OUTPUT); // Make speakerPin an output
}

void loop(){
  tone(speakerPin, NOTE_A4); // tone fires up an A4
  delay(1000); // play it for 1 sec
  noTone(speakerPin); // stop the tone
  delay(300); // "play" some silence
  tone(speakerPin, NOTE_B4); // play another tone
  delay(1000);
  tone(speakerPin, NOTE_C3);
  delay(500);
  tone(speakerPin, NOTE_CS5);
  delay(2000);
  tone(speakerPin, NOTE_D3);
  delay(1000);
}

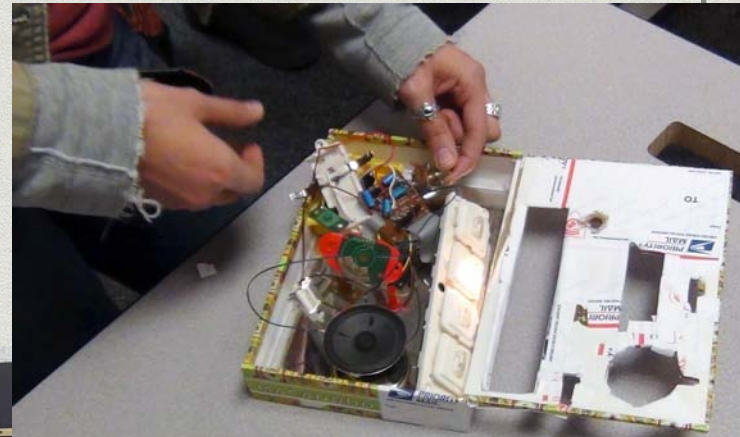
1 Arduino Duemilanove or Diecimila, ATmega328 on /
```





# Project: Hacked Toy

Circuit Bending - RC timing

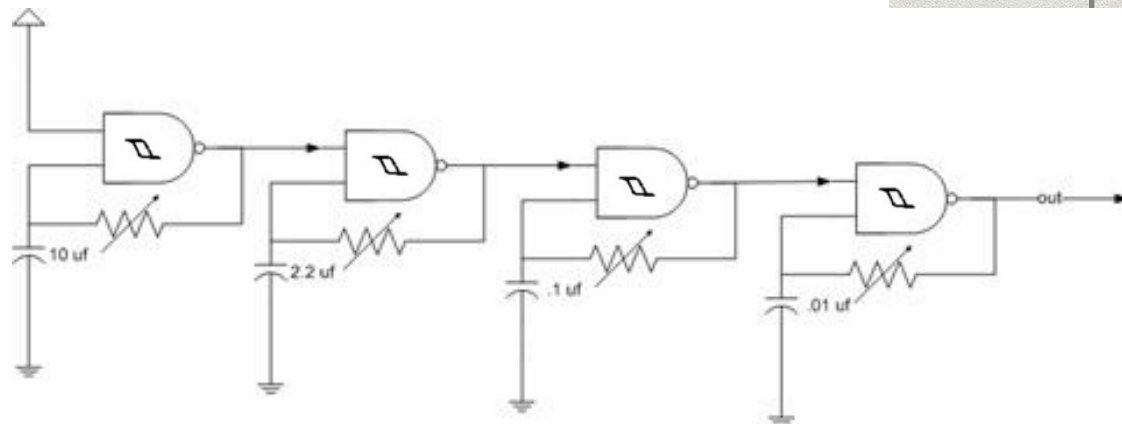
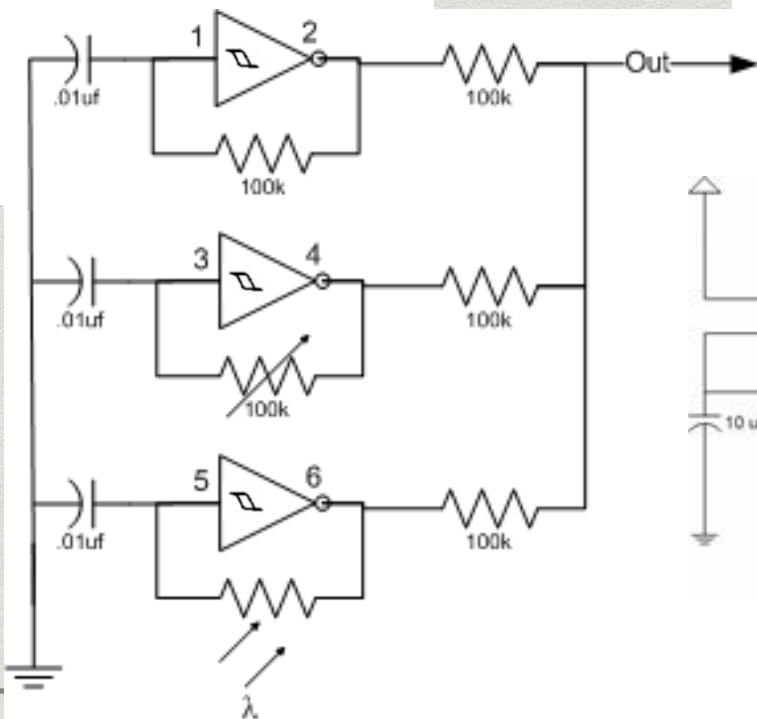
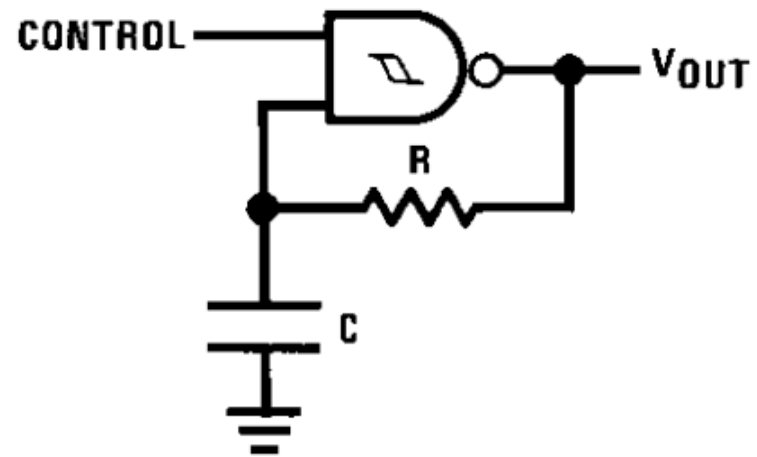
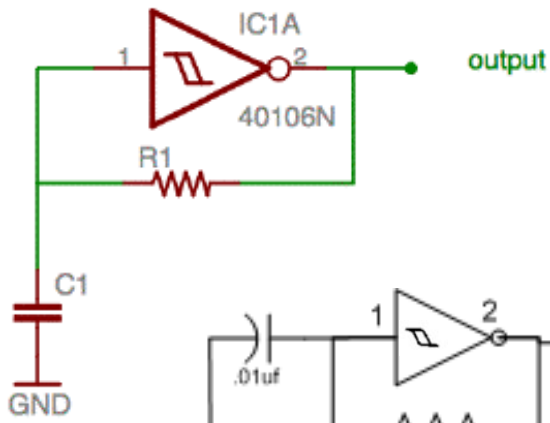


# Project: Hacked Toy



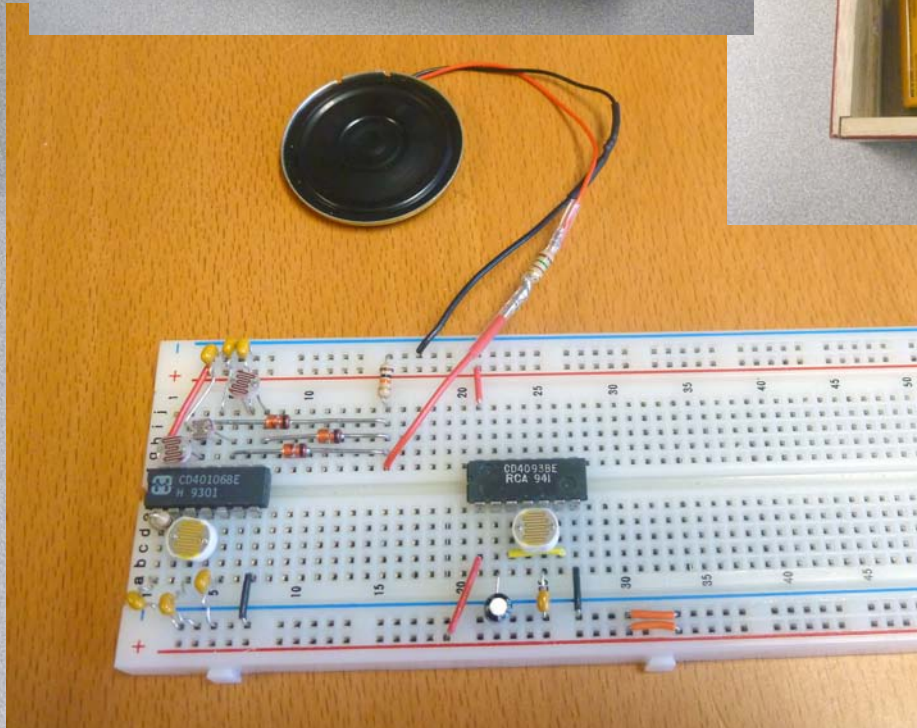
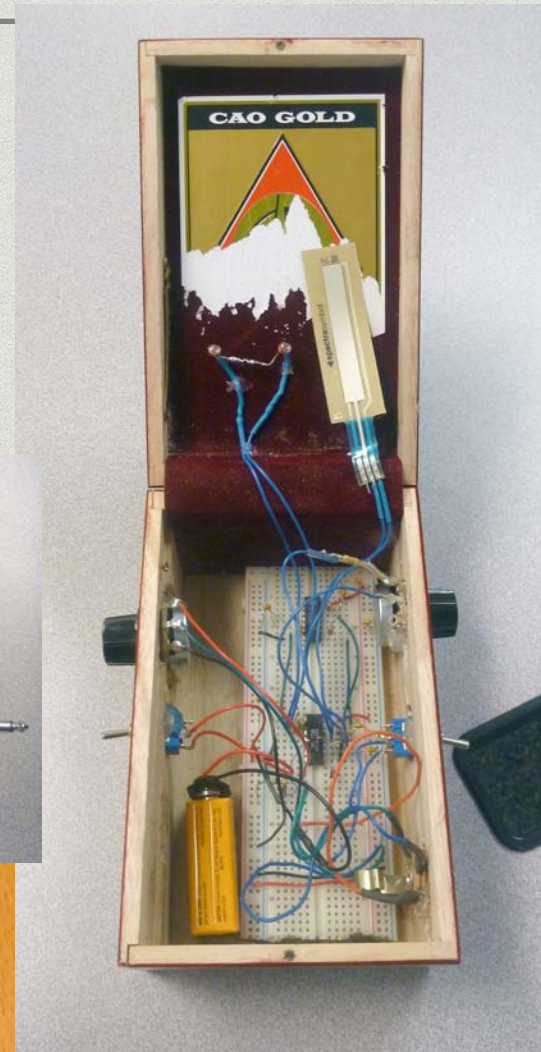
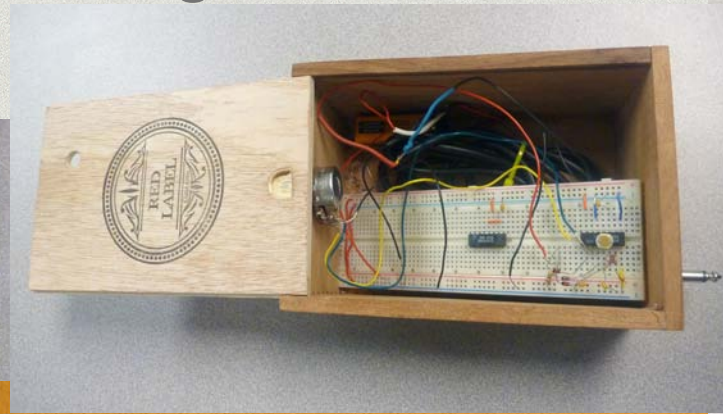
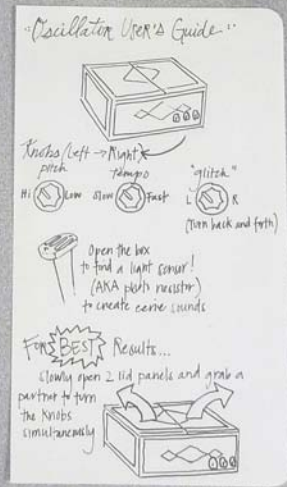
# Project: Oscillators

Very simple Schmitt-trigger oscillators  
- Inverters and NAND gates



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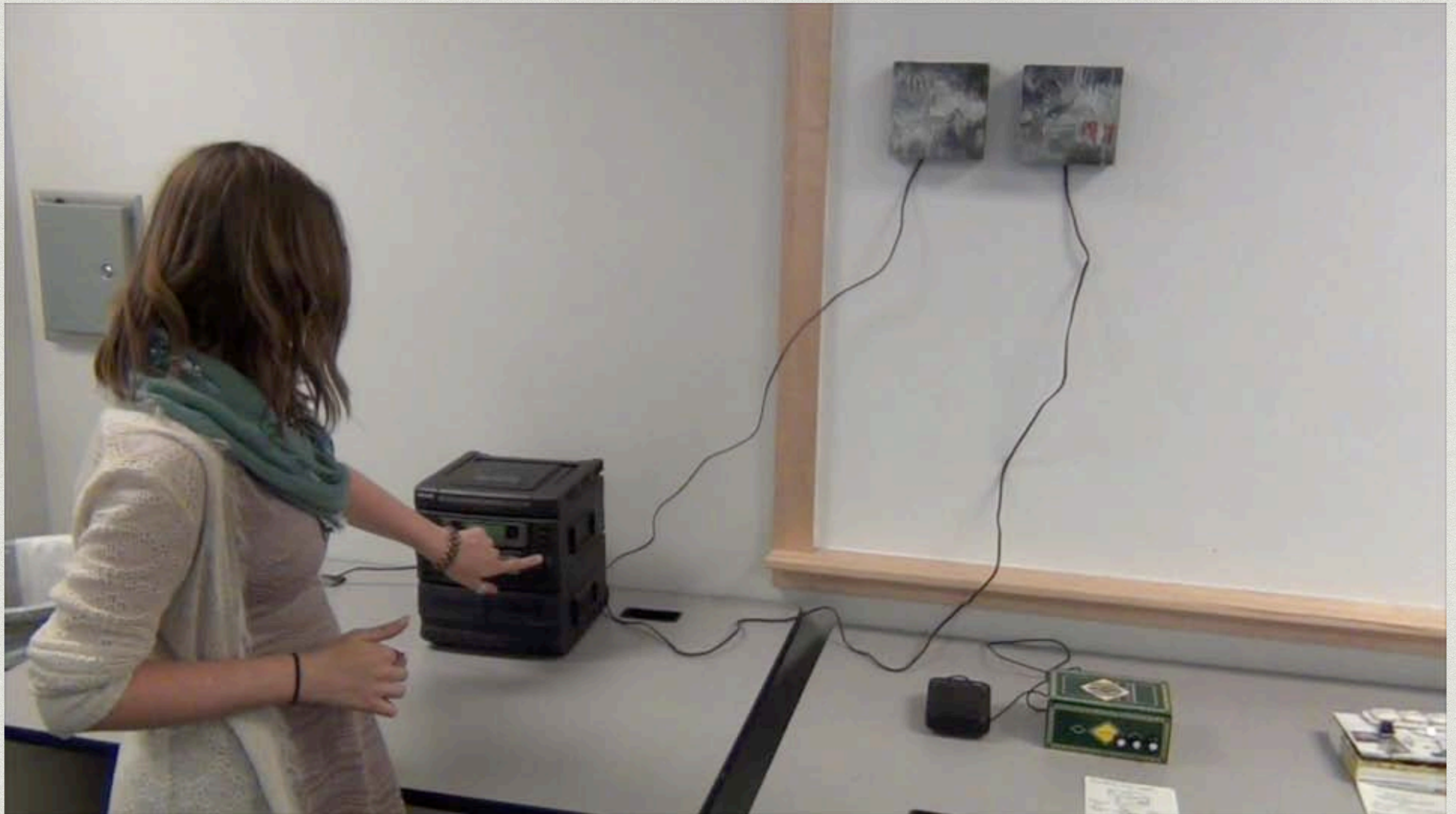
# Final Project - Sound Art

Chosen/proposed by each student

Use “raw material” from previous projects



# Final Project - Sound Art

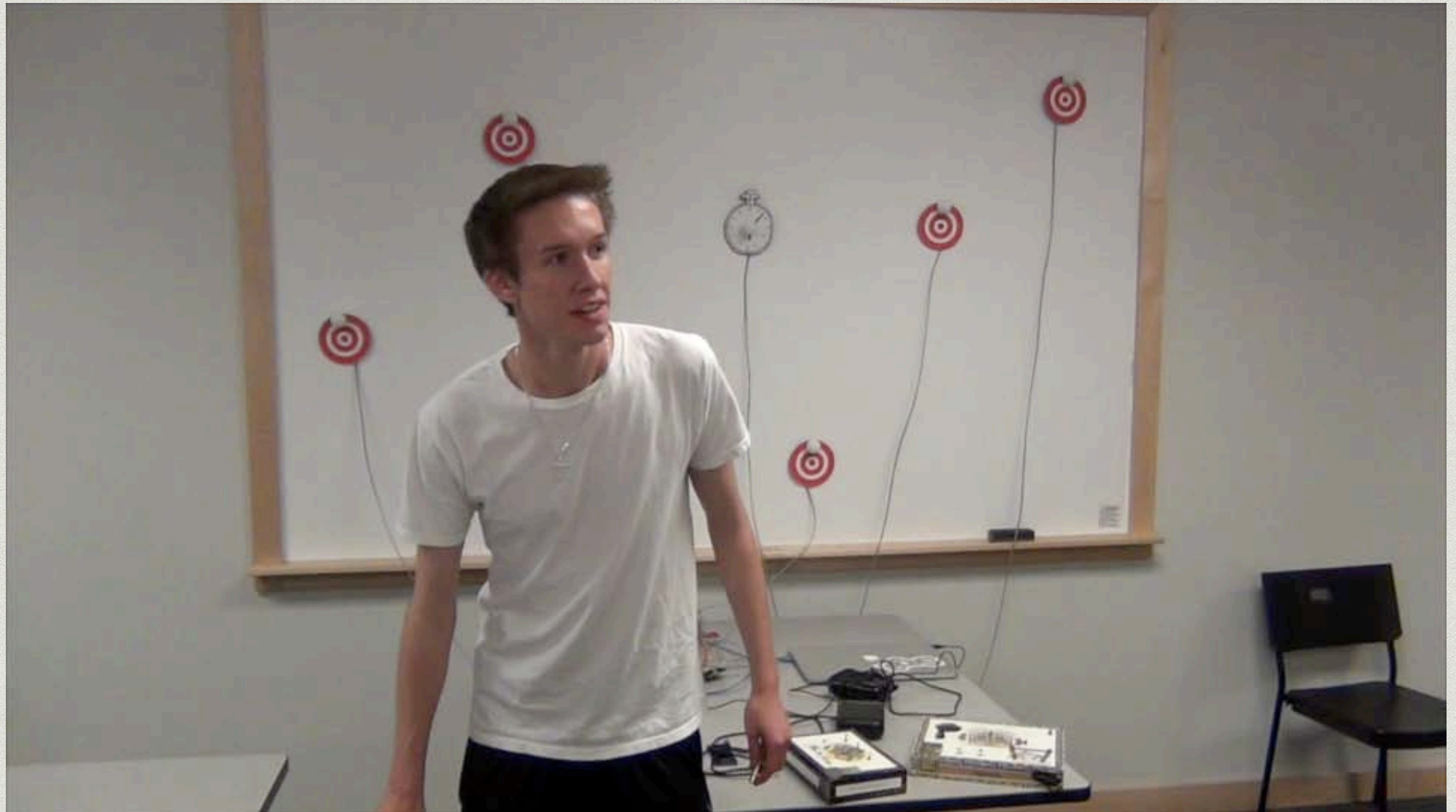


# Final Project - Sound Art





# Final Project - Sound Art



# Conclusions

An attempt to design a new *general education* course that promotes *technological fluency*

Through the lens of *Sound-Art* and *Digital Media*

*Readings and listening for context, projects for raw materials (and learning opportunities), final project for synthesis*

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