

COMPUTER SCIENCE CSCI103

ELECTRONIC TEXTILES

CLASS MEETS TWICE PER WEEK

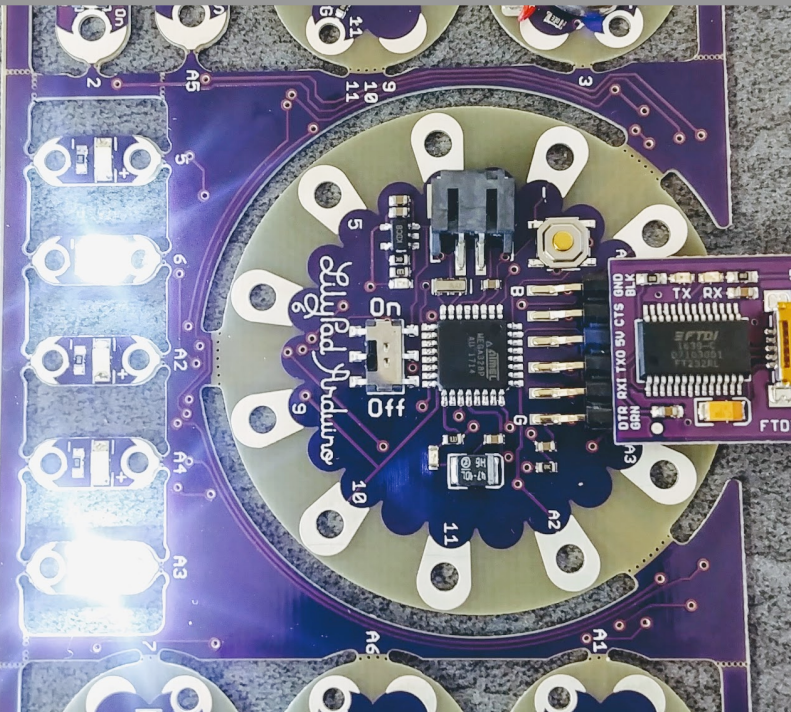
Digital data is infused throughout the entire world, escaping the computer monitor and spreading to other contexts, including the human body. eTextiles is the next step toward making everything interactive and this course introduces learners to developing their own wearable interactive technology. After completing a series of introductory projects, students propose and design their own eTextiles projects. These projects include everything from a sweatshirt with light-up turn signals for bicycling, to a wall banner that displays the current air quality of the room, to a stuffed animal that plays a tune when the lights go on, to whatever project you can conceivably accomplish with sewable Arduino inputs, outputs, and development board. This class introduces students to introductory computer programming, circuitry, and sewing with the goal of creating novel wearable artifacts that interact with the world.

Topics include:

**EMBROIDERY, SEWING
MODULAR ARITHMETIC
ELECTRONIC CIRCUITS
PAPER PROTOTYPING
INPUTS & OUTPUTS
ARDUINO PROGRAMMING
PERSONAL PROJECTS**

QUESTIONS

Email Iris Howley
ikh1@williams.edu



LEARN MORE

<https://bit.ly/CSCI103>



CSCI103:

Syllabus (Spr23)

OVERVIEW

Digital data is being infused throughout the entire physical world, escaping the computer monitor and spreading to other devices and appliances, including the human body. Electronic textiles, or eTextiles, is one of the next steps toward making everything interactive and this course aims to introduce learners to the first steps of developing their own wearable technology devices.

After completing a series of introductory eTextiles projects to gain practice in necessary skills, students will propose and design their own eTextiles projects, eventually implementing them with Lilypad Arduino components, and other found electronic components as needed. The scope of the project will depend on the individual's prior background, but can include everything from a sweatshirt with light-up turn signals for bicycling, to a wall banner that displays the current air quality of the room, to a stuffed animal that plays a tune when the lights go on, to whatever project you can conceivably accomplish with Lilypad Arduino inputs, outputs, and development board in a relatively short time period.

This class is intended for students with no computer programming background, and so a large portion of this class will focus on the development of these skills.

Learning Objectives

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

1. Select appropriate stitch styles and sew two sewable items to each other with that stitch, and secure with knots.
2. Diagram, via paper prototypes, a variety of functioning circuits for physical computing.
3. Implement electric circuit diagrams using electronic components designed for textiles, using a variety of inputs and outputs.
4. Program an Arduino to use a variety of inputs and output components, both analog and digital.
5. Design and create a creative eTextiles product that uses appropriate sewing techniques, simple & complex inputs & outputs, as well as novel Arduino code to transform those inputs & outputs.
6. Apply appropriate debugging techniques that include incremental testing and help seeking from peers, the Internet, the instructor, as well as other resources.

Courses in the Time of COVID:

I understand that this course is being offered in a time of uncertainty, and I recognize that you (and I) may encounter unexpected challenges during this semester. That includes challenges related to health and illness, technology, caregiving responsibilities, work responsibilities, and more.

My goal this semester is to support you in doing the best work you can in light of the challenges you face. I understand that Williams students face tremendous pressure to work hard, get “good” grades, and be as “successful” as possible. That said, I encourage you to remember that your health and well-being are far more important than the work you do in this class or any class. And I encourage you to take the time you need to care for yourself and for your loved ones.

If you tell me you're having trouble, I will not judge you or think less of you. I hope you'll extend me the same grace. I also ask that you be patient with me if the challenges of this semester force me to make last-minute changes to the course plan. I will do my best to communicate any changes clearly and make them with respect for the inconvenience, frustration, and confusion that change may cause.

You *never* owe me personal information about your health (mental or physical). You are *always* welcome to talk to me about things that you're going through, though. If I can't

help you, I usually know somebody who can. If you need extra help, or if you need more time with something, or if you feel like you're behind or not understanding everything, **do not suffer in silence!** Talk to me! I will work with you. **I promise.**

Please attend Student Help Hours. I'm also available through e-mail and the course discussion forum.

I want you to learn lots of things from this class, but I primarily want you to stay healthy, balanced and grounded during this continuing crisis.

Topics

modular arithmetic, debugging, conditionals, style, nested-ifs, while loops, for loops, logic, random, ...

digital circuits, paper prototyping, Arduino, switches, LEDs, light sensors, temperature sensors, buzzers, functions, ...

sewing, conductive fabric, power, websites, ...

Course Components

This course involves the following components:

- **Lectures** – we don't have a textbook, so lectures + slides will be our main form of content delivery.
- **In-Class Activities and Assignments** – individual activities to introduce and practice skills learned in class with immediate feedback. Some will be graded as homework, and some will be participation-based.
- **Individual Assignments** – it's important to get concentrated hands-on practice with new skills. These individual assignments help you do this.
- **Low-stakes Quizzes** - will help determine where the class is on certain concepts. They can also be great for helping you self-assess what you need more practice with.
- **Projects** – larger projects will combine multiple skills into one assignment. These will take more dedicated effort.
- **Code Review** – formative feedback on your code is useful for being a better programmer.

TEXTBOOK

The course will rely heavily on online materials that will be provided as needed. The SparkFun Tutorials on Lilypad will be of particular relevance:

learn.sparkfun.com/tutorials/tags/lilypad

[Links to an external site.](#)

(Iris likes "Sew Electric" by Buechley that's now out of print and for an older version of our Lilypad Arduinos)

MATERIALS

Students are provided with the necessary materials, they're something like the following:

Available from SparkFun.com

1. 1x *Lilypad ProtoSnap Plus Kit* (DEV-12922)
2. 1x *Lilypad Temperature Sensor* (DEV-08777)
3. 1x *Lilypad Vibe Board* (DEV-11008)
4. 1x *Lilypad Tri-color LED* (DEV-13735)
5. 1x *LilyPad Rainbow LED (6 Colors)* (DEV-13903)
6. 1x *LilyPad Coin Cell Battery Holder - Switched - 20mm* (DEV-13883)
7. 1x *Coin Cell Battery Holder – Unswitched – 20mm* (DEV-08822)
8. 2x *CR2032 Coin Cell Battery (20mm)* (PRT-00338)
9. *Conductive fabric* (COM-14110)
10. Depending on your proposed project, there are other components you may need but are not supplied. Using just the above listed supplies you should be able to implement a variety of interesting projects.

Other

1. Storage box

2. Some fabric to sew on (i.e., craft felt, cotton calico, an old T-shirt, other textiles)
3. Non-conductive sewing thread, embroidery floss
4. Fabric Scissors (Do not use to cut anything other than fabric!!)
5. Needle threaders
6. Depending on your proposed project, you may require specific textile objects that will not be supplied (i.e., Velcro, ribbons, more fabric, a shirt, a stuffed animal, a pennant, painted canvas, etc.). There is a small budget for these supplies, about \$5/student.

You may want to download the Arduino Desktop IDE, although the lab machines will have it: <https://www.arduino.cc/en/Main/Software>

[Links to an external site.](#)

We may use [Fritzing](#)

[Links to an external site.](#)

to map out our circuits before building them.

EVALUATION

Strive to do good work because you care about your own opportunities to learn!

There will be graded assignments to provide summative feedback on your progress on course skills. You should complete these assignments individually, without assistance from other students. Class sessions will often include some time to work on these assignments, to provide students timely assistance on their efforts. See assignment hand-outs for specific details.

Participation and Citizenship

In order to learn the most from our in-person meetings, it is necessary to attend each session, participate in small group and whole-class activities, and to complete the assignments. Oftentimes, you will need to show your assignments in class, and so if you have not done the assignment, it will be difficult to discuss your efforts with classmates. This category also includes cleaning up your workspace at the end of

class, providing respectful feedback to your peers, and answering questions in class. You will receive a mid-semester formative assessment to help you figure out what to focus on to improve your participation in the class.

Grade Breakdown

Assignments + Quizzes: 40%

Class Activities /Citizenship: 20%

Final Project: 40% (proposal, prototypes, final project)

Submission

Many assignments are due the night before class. I will implement this as 11:59pm. In order to be prepared to give you feedback, the instructor must have your submission in the morning. We will often discuss our assignment solutions in class. Submitting the day of class, just before class, or in class is therefore unacceptable, risking zero credit.

Each Assignment will describe the Submission process (sometimes we'll use [Glow](#)).

Late work will be suspect to one letter drop in grade for each day that assignment is late, as well as a 0 for the presentation portion of any assignment with a presentation component.

STUDENT HELP HOURS

Student Help Hours with Iris and the Teaching Assistants are available to help you understand concepts, get over obstacles, and discuss computer science as a whole. It's *very* normal to attend Computer Science Help Hours regularly! These hours are open, and often involve several students simultaneously. Don't be afraid to speak up!

Hours, days, locations for Student Help Hours are located on this page: [Student Help Hours](#)

EXPECTED WORKLOAD

At Williams, we operate under the course unit system (rather than the credit hour system) as the metric required by many employers, granting organizations, graduate schools, and federal agencies. In addition to the 3 hours we spend together during our class meeting time, you should expect to spend (on average) at least 10 hours per week on the academic and creative work related to class. If you find that you are spending considerably more (or considerably less!) time to engage with this course academically, please contact me so that we can determine the best course of action as you approach the materials. Should you have any additional questions about the relationship of course units to credit hours, refer to the Office of the Registrar, which [explains our course unit equivalency in greater detail](#).

STUDENTS WHO NEED ACCOMMODATIONS

If formal accommodations need to be made to meet your specific learning or physical abilities, please contact me as soon as possible to discuss appropriate accommodations. Please also contact the Director of Accessible Education, Dr. G. L. Wallace (413-597-4672) or the Dean's office (413-597-4171). We will work together to ensure this class is as accessible and inclusive as possible. Also, students experiencing mental or physical health challenges that are significantly affecting their academic work are encouraged to contact me or to speak with a dean. The deans can be reached at 413-597-4171.

THE HONOR CODE

Homework and assignments are to be the sole work of each student unless the assignment explicitly states otherwise. Students may discuss issues related to an assignment, provided that such discussions are cited in the material turned in. However, students may not collaborate on designing or writing code. Uncredited collaborations will be considered a violation of the honor code and will be handled appropriately. For a full description of the Computer Science Honor Code, please see <https://csci.williams.edu/the-cs-honor-code-and-computer-usage-policy/>. If in doubt of what is appropriate, do not hesitate to ask.



Posted on:

Apr 5, 2023, 5:47 PM

eTextiles (S23)

[Jump to Today](#)

Welcome to CSCI103 Electronic Textiles!

Deadlines for assignments, and useful resources are posted below.

- [Syllabus, Help Hours Schedule, Class Meeting details are available here](https://glow.williams.edu/courses/3619553/modules/9344576)
(<https://glow.williams.edu/courses/3619553/modules/9344576>)
- [Lecture slides, Videos, Examples, Handouts are available here](https://glow.williams.edu/courses/3619553/modules/9347724)
(<https://glow.williams.edu/courses/3619553/modules/9347724>)
- [Student Project Websites here](https://glow.williams.edu/courses/3619553/modules/9362806) (<https://glow.williams.edu/courses/3619553/modules/9362806>)

Course Summary:

Date	Details	Due
Mon Feb 6, 2023	 QUIZ: Start of Semester Survey (https://glow.williams.edu/courses/3619553/assignments/40365614)	due by 11:59pm
	 QUIZ: Syllabus Quiz (https://glow.williams.edu/courses/3619553/assignments/40365563)	due by 11:59pm
Tue Feb 7, 2023	 DO: Make a Github Account (https://glow.williams.edu/courses/3619553/assignments/40380490)	due by 9:55am

Date	Details	Due
	 READ: Markdown Cheatsheet (https://glow.williams.edu/courses/3619553/assignments/40380460)	due by 9:55am
	 Useful: Beautiful Jekyll (https://glow.williams.edu/courses/3619553/assignments/40380467)	due by 11:10am
	 Useful: HTML File Paths (https://glow.williams.edu/courses/3619553/assignments/40380461)	due by 11:10am
Thu Feb 9, 2023	 READ: How to Give an Elevator Pitch (https://glow.williams.edu/courses/3619553/assignments/40380473)	due by 9:55am
	 Useful: How Does the Internet Work (https://glow.williams.edu/courses/3619553/assignments/40380481)	due by 11:10am
	 Useful: PBS Comp Sci Crash Course: The Internet (https://glow.williams.edu/courses/3619553/assignments/40380479)	due by 11:10am
Mon Feb 13, 2023	 DO: Personal Website for Course Deliverables (https://glow.williams.edu/courses/3619553/assignments/40365590)	due by 11:59pm
Tue Feb 14, 2023	 Useful: 10 Basic Hand Embroidery Stitches for Beginners (https://glow.williams.edu/courses/3619553/assignments/40456445)	due by 11:10am
Thu Feb 16, 2023	 QUIZ: Modulo Quiz (https://glow.williams.edu/courses/3619553/assignments/40365568)	due by 9am
	 READ: What is modular arithmetic? (https://glow.williams.edu/courses/3619553/assignments/40456453)	due by 9:55am
	 Useful: Intro C-Programming Resources (https://glow.williams.edu/courses/3619553/assignments/40457080)	due by 11:10am
Mon Feb 20, 2023	 DO: Modular Hello World (https://glow.williams.edu/courses/3619553/assignments/40365586)	due by 11:59pm

Date	Details	Due
	 DO: Sewing Sampler (https://glow.williams.edu/courses/3619553/assignments/40365601)	due by 11:59pm
	 Extra Credit: Hello, ASCII Art (https://glow.williams.edu/courses/3619553/assignments/40365581)	due by 11:59pm
	 READ: Introduction to C (https://glow.williams.edu/courses/3619553/assignments/40457100)	due by 9:55am
Tue Feb 21, 2023	 Useful: C-Programming - Conditions (https://glow.williams.edu/courses/3619553/assignments/40457127)	due by 11:10am
Wed Feb 22, 2023	 DO: Sweater Weather (https://glow.williams.edu/courses/3619553/assignments/40365604)	due by 11:59pm
Thu Feb 23, 2023	 Useful: Conductors, insulators, and electron flow & Electric circuits & Circuit Simulator (https://glow.williams.edu/courses/3619553/assignments/40457157)	due by 11:10am
	 DO: Circuit Plushy (https://glow.williams.edu/courses/3619553/assignments/40365580)	due by 9:55am
Tue Feb 28, 2023	 DO: Simple Circuits Problem Set (https://glow.williams.edu/courses/3619553/assignments/40365602)	due by 9:55am
	 DO: Odd Menu (https://glow.williams.edu/courses/3619553/assignments/40365587)	due by 11:59pm
Wed Mar 1, 2023	 DO: Plushy Redux (https://glow.williams.edu/courses/3619553/assignments/40365591)	due by 11:59pm
Thu Mar 2, 2023	 Useful: LilyPad Basics: E-Sewing (https://glow.williams.edu/courses/3619553/assignments/40457190)	due by 11:10am
Tue Mar 7, 2023	 DO: Homemade Switches (https://glow.williams.edu/courses/3619553/assignments/40365584)	due by 9:55am

Date	Details	Due
	 Useful: C-Programming Tutorial on Loops (https://glow.williams.edu/courses/3619553/assignments/40457209)	due by 11:10am
Wed Mar 8, 2023	 DO: RGB Loop (https://glow.williams.edu/courses/3619553/assignments/40365596)	due by 11:59pm
Thu Mar 9, 2023	 Useful: Arduino Language Reference (https://glow.williams.edu/courses/3619553/assignments/40457235)	due by 11:10am
	 Useful: LilyPad USB Plus Hookup Guide (https://glow.williams.edu/courses/3619553/assignments/40457234)	due by 11:10am
Tue Mar 14, 2023	 DO: Think Before You Sparklie - Mid-sem Proj 0 (https://glow.williams.edu/courses/3619553/assignments/40685936)	due by 9:55am
	 Useful: Arduino/C Resources for Loops (https://glow.williams.edu/courses/3619553/assignments/40457949)	due by 11:10am
	 DO: Separate Sparklies (Mid-sem Proj 1) - 1 - flashbulb (https://glow.williams.edu/courses/3619553/assignments/40365598)	due by 11:59pm
Wed Mar 15, 2023	 DO: Separate Sparklies - 2 - bigdipper (https://glow.williams.edu/courses/3619553/assignments/40365600)	due by 11:59pm
	 DO: Separate Sparklies - 3 - synchronous (https://glow.williams.edu/courses/3619553/assignments/40365599)	due by 11:59pm
Tue Apr 4, 2023	 Participation: Mid-semester Feedback (https://glow.williams.edu/courses/3619553/assignments/40380523)	due by 9:55am

Date	Details	Due
	 Useful: Lecture Videos on a State-based Approach for Multi-flashing Fireflies, Simultaneous Sparkly Extra Credits https://glow.williams.edu/courses/3619553/assignments/40687034	due by 9:55am
	 Useful: Lecture Videos on For..loops, Random Numbers, Debugging w Serial Monitor, and Mid-Semester Project State-based Approach https://glow.williams.edu/courses/3619553/assignments/40687023	due by 9:55am
	 Useful: Lecture Videos on Lilypad Arduino, Arduino Programming, Problem Decomposition, & Mid-Semester Project https://glow.williams.edu/courses/3619553/assignments/40687019	due by 9:55am
Wed Apr 5, 2023	 DO: Simultaneous Sparklies - Mid-sem Proj 2 https://glow.williams.edu/courses/3619553/assignments/40365603	due by 11:59pm
Thu Apr 6, 2023	 Useful: Arduino References for Digital Inputs https://glow.williams.edu/courses/3619553/assignments/41048710	due by 11:10am
Mon Apr 10, 2023	 DO: Random Colors https://glow.williams.edu/courses/3619553/assignments/40365595	due by 11:59pm
Tue Apr 11, 2023	 Useful: Arduino References for Complex Inputs https://glow.williams.edu/courses/3619553/assignments/41050143	due by 11:10am
Thu Apr 13, 2023	 Useful: Arduino Buzzer References https://glow.williams.edu/courses/3619553/assignments/41050380	due by 11:10am
	 DO: Ghost Detector https://glow.williams.edu/courses/3619553/assignments/40365582	due by 11:59pm
Mon Apr 17, 2023	 DO: Jammin' https://glow.williams.edu/courses/3619553/assignments/40365585	due by 11:59pm

Date	Details	Due
Tue Apr 18, 2023	 Useful: Arduino/C References for Functions (https://glow.williams.edu/courses/3619553/assignments/41048656)	due by 11:10am
Wed Apr 19, 2023	 DO: Help, I Need Somebody (https://glow.williams.edu/courses/3619553/assignments/40365583)	due by 11:59pm
Thu Apr 20, 2023	 Useful: Arduino/C Resources for Arrays (https://glow.williams.edu/courses/3619553/assignments/41048610)	due by 11:10am
Mon Apr 24, 2023	 DO: Project Proposal (https://glow.williams.edu/courses/3619553/assignments/40365593)	due by 11:59pm
Wed Apr 26, 2023	 DO: Analog Arrays (https://glow.williams.edu/courses/3619553/assignments/40365579)	due by 11:59pm
Mon May 1, 2023	 DO: Paper Prototype (https://glow.williams.edu/courses/3619553/assignments/40365588)	due by 11:59pm
Thu May 11, 2023	 DO: Project Demonstration (https://glow.williams.edu/courses/3619553/assignments/40365592)	due by 9:55am
Fri May 12, 2023	 Participation (https://glow.williams.edu/courses/3619553/assignments/40365589)	due by 11:59pm
Wed May 17, 2023	 DO: Project Report (https://glow.williams.edu/courses/3619553/assignments/40365594)	due by 11:59pm
	 Roll Call Attendance (https://glow.williams.edu/courses/3619553/assignments/40365597)	

Electronic Textiles

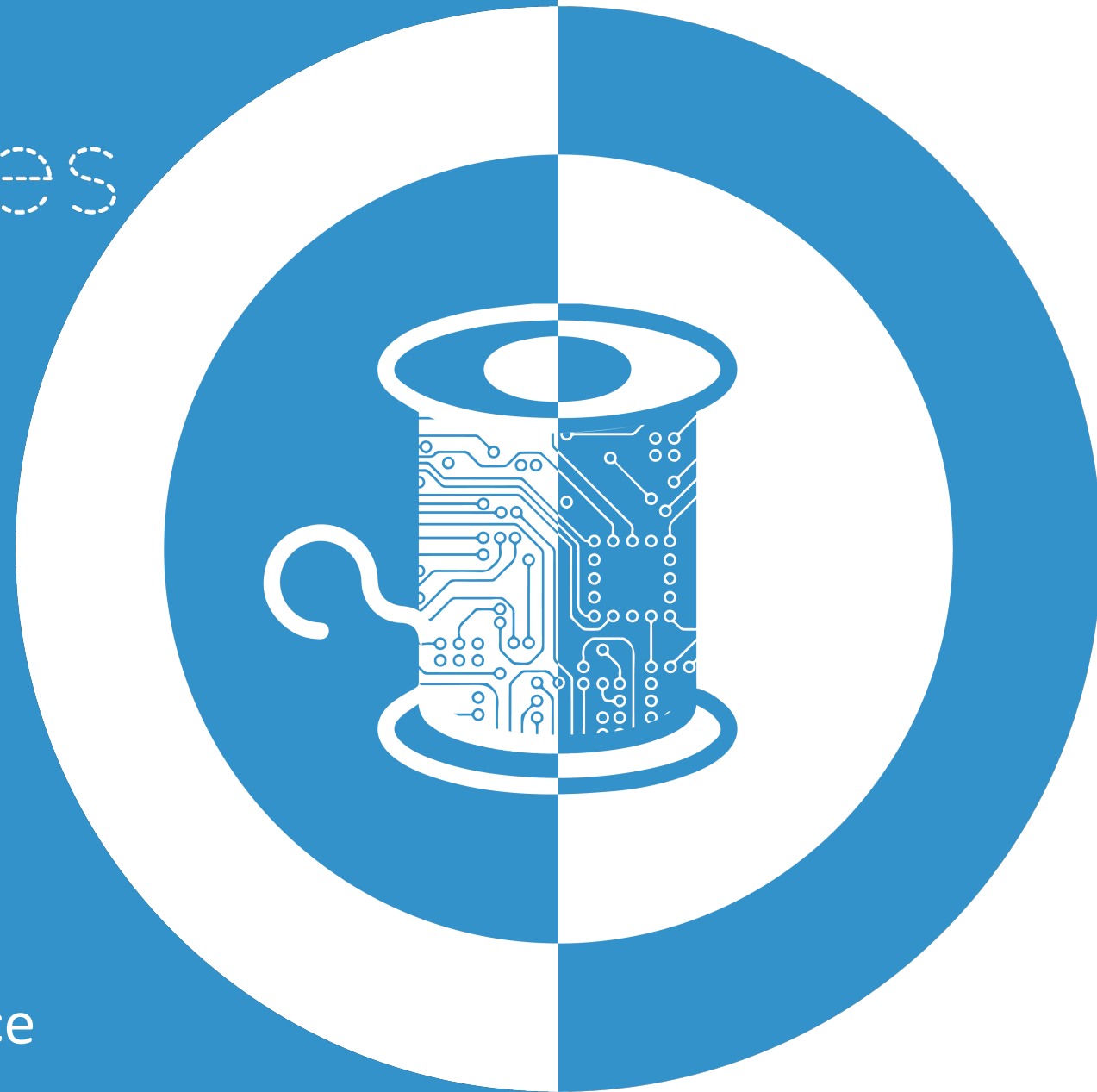
Computer Science 103

ANALOG INPUTS

Iris Howley

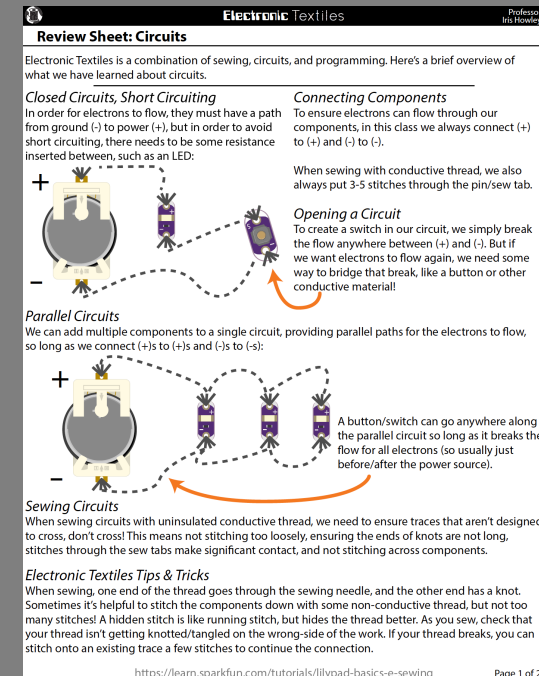
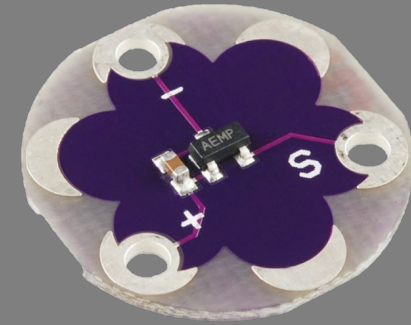
ikh1@williams.edu

Assistant Professor of Computer Science



PLEASE TAKE:

- A mask (if you don't have one)
- 1 Off-board Lilypad Temperature Sensor Component
- 1 Circuits / Arduino Components Review Sheet



WELCOME!

Today's the last required mask day.



PROJECT PROPOSALS IN 2 WEEKS



- I'll discuss the details more soon
- But tentative details are:
 - Title, description
 - Paper Prototype
 - Materials
 - PPT slide (PNG/JPG Equivalent) + Brief Presentation
- 2 Inputs, 2 Outputs
 - At least 1 analog input, 1 analog output
 - At least one output controlled by input
 - Battery Holder switch does not count
- Components must be sewn together with conductive thread



Sharing Our Random Colors



Stand-up, state your tip to your past self

Did anyone try with a button and an off-board RGB LED?



THIS LESSON

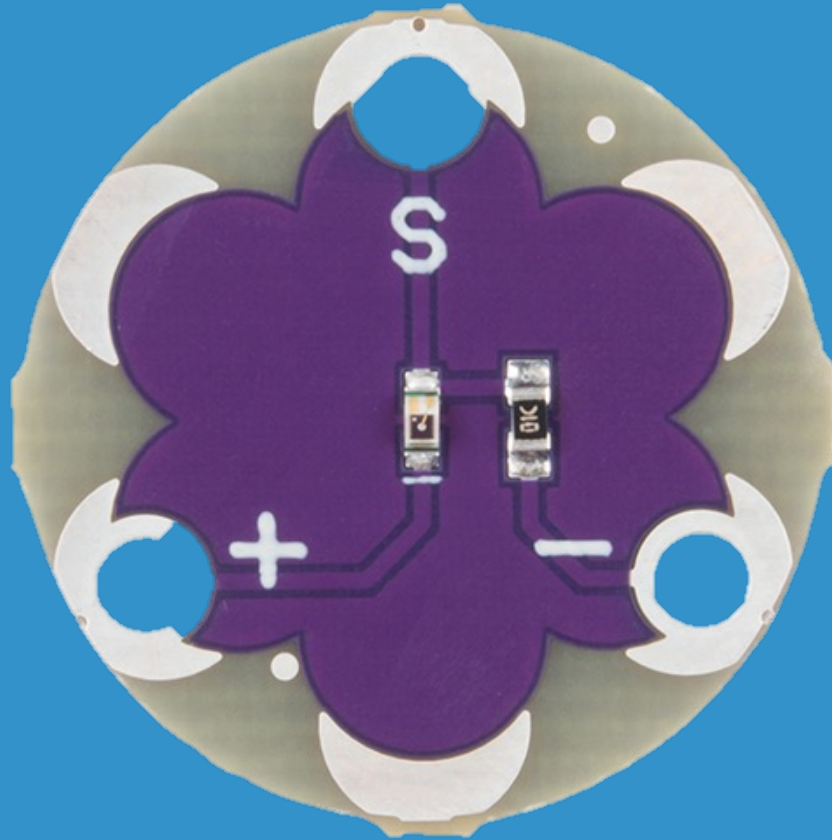
Analog Inputs.

After this lesson, you should be able to:

1. Write code to respond to analog input sensor values
 2. Find min & max values detected by analog sensors
 3. Connect off-board analog input sensors to our Arduino kit
 4. Choose appropriate data types for values we're storing
- Switches are digital inputs...sometimes we want values other than just high/low.



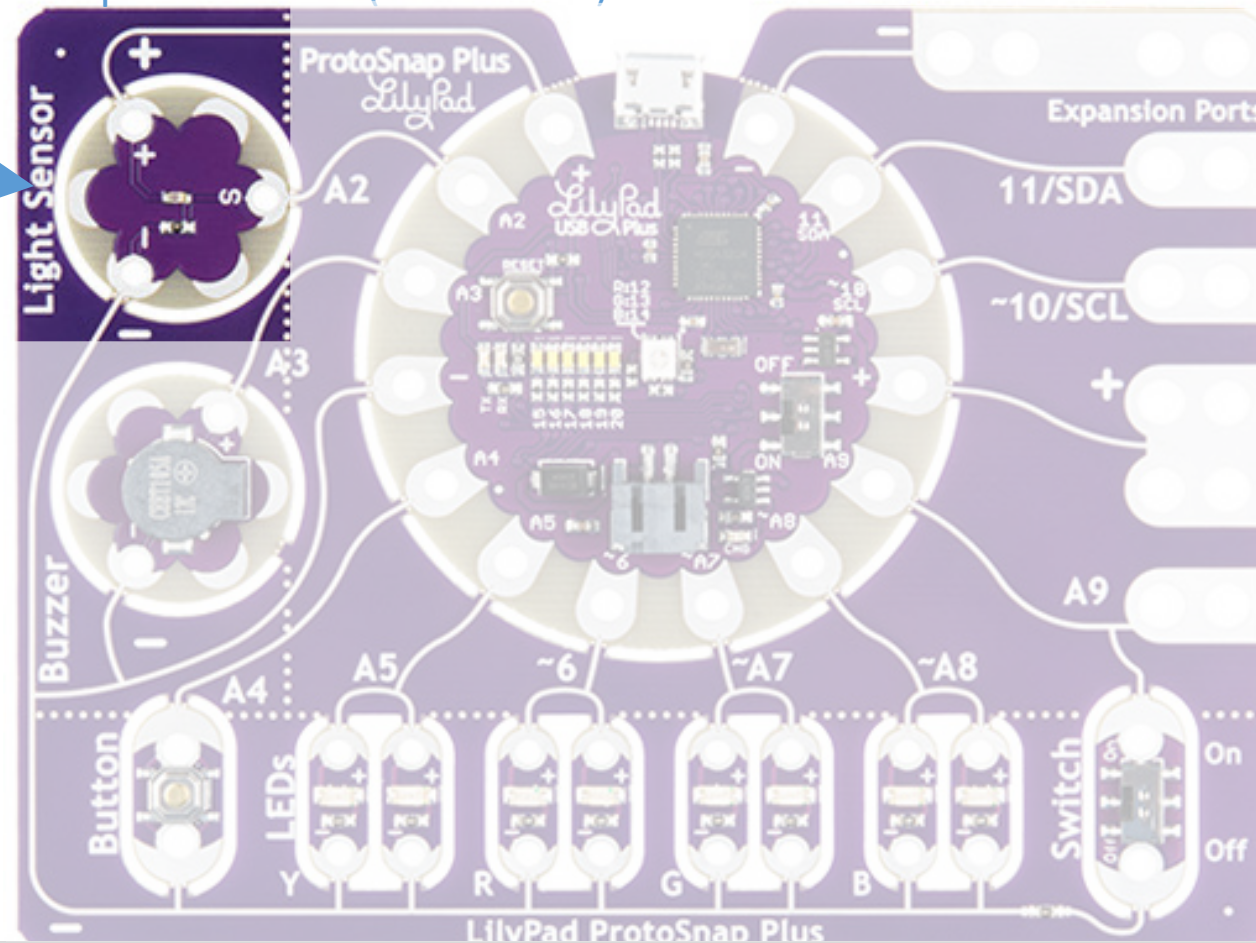
LilyPad Light Sensor



Lilypad Arduino

LilyPad ProtoSnap Development Board (DEV-11262)

Lilypad Light Sensor



<https://learn.sparkfun.com/tutorials/lilypad-usb-plus-hookup-guide>



LilyPad Light Sensor

- As more light is applied to the sensor, more current will flow from the board through the signal tab/pin
- This sensor outputs voltage between 0V and 3.3V
 - Might depend on the power source
 - Use Serial Monitor to see what min/max values for the room are
 - Customizing values to the room is super useful

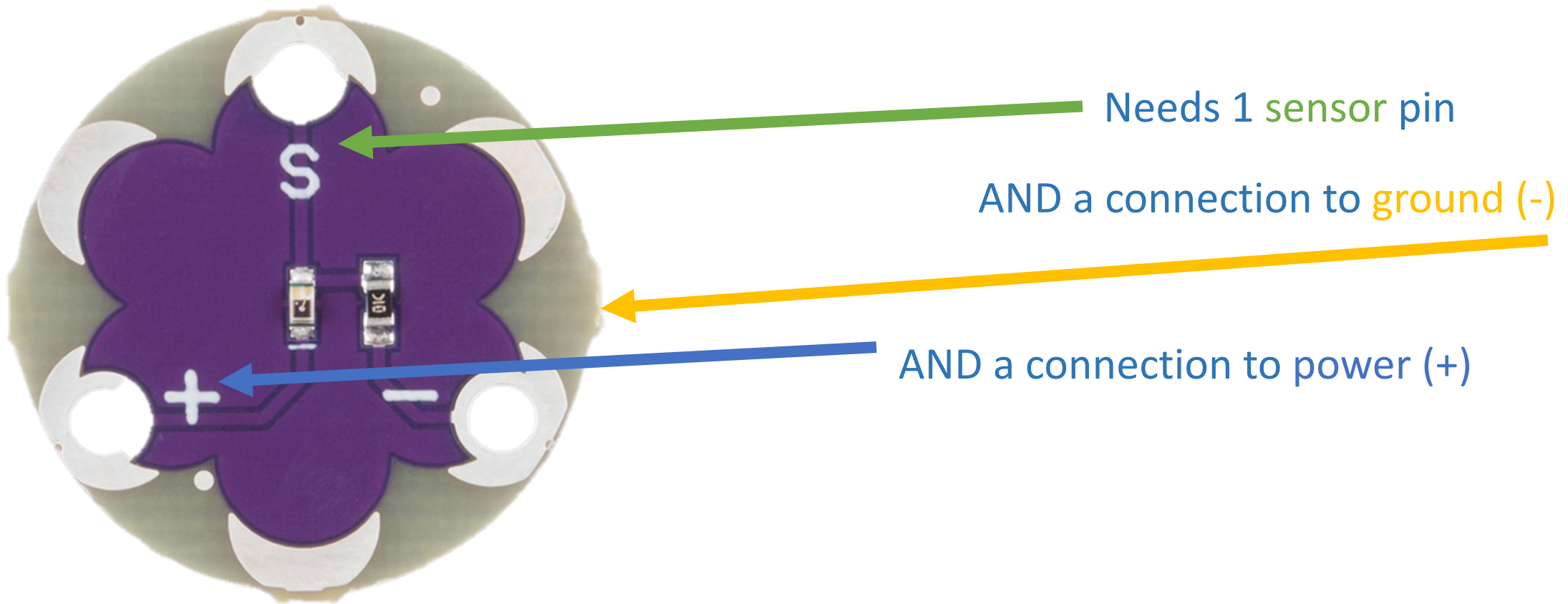


LilyPad Light Sensor

- If buttons & switches are **digital** inputs...
- ...and LEDs are digital or analog outputs...
- What might the Light Sensor be?
 - An analog input!
- Connect to an Analog pin, like A2, A3, A4, A5, A7, A8, A9
 - Analog Input Pins start with 'A'
 - So...NOT 6, 10, or 11



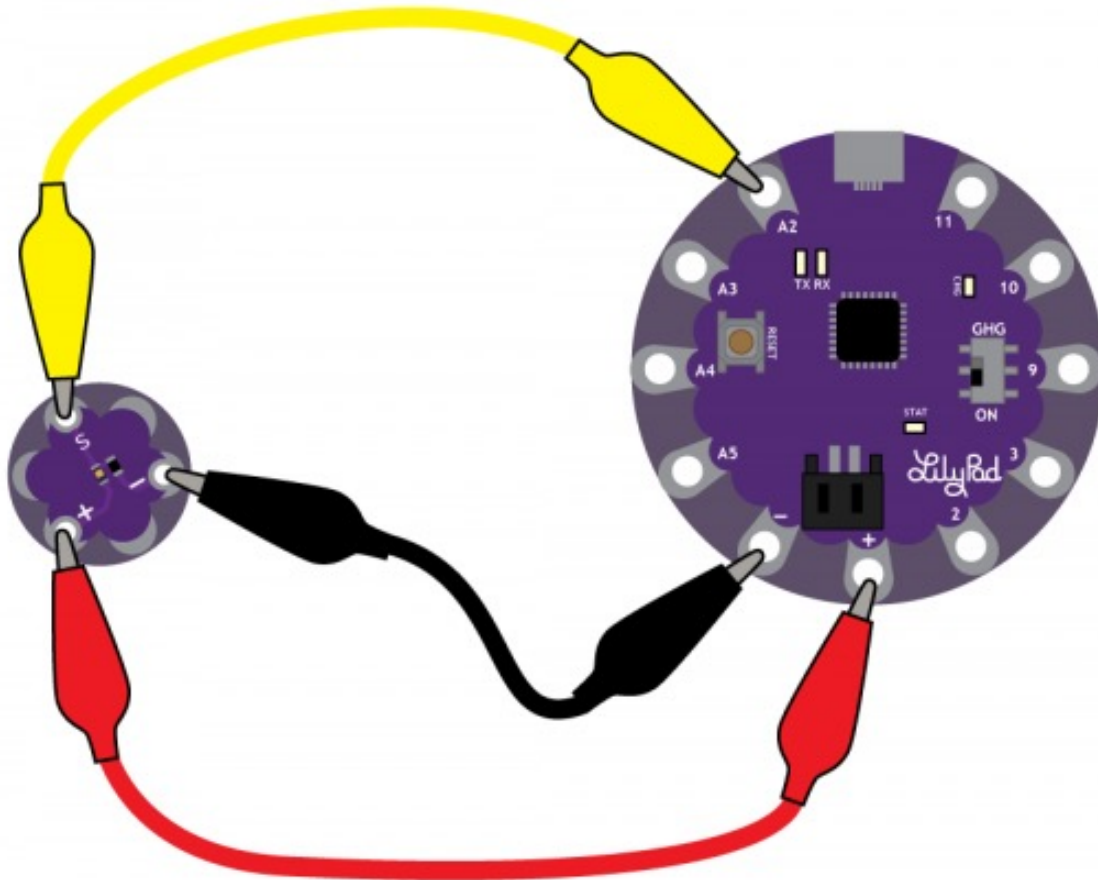
How to Connect Light Sensor



<https://learn.sparkfun.com/tutorials/lilypad-light-sensor-v2-hookup-guide>



How to Connect Light Sensor, Off-board



No (+) pin?

Can also connect to any other non-ground pin, and send HIGH voltage to it.

<https://learn.sparkfun.com/tutorials/lilypad-light-sensor-v2-hookup-guide>



LilyPad Light Sensor

```
void setup() {  
    pinMode(sensorPin, INPUT); // Declare light sensor (A2) as input  
    Serial.begin(9600); // Initialize the Serial monitor for Analog Read  
}  
  
void loop() {  
    int sensorValue; // Read-in analog value from light sensor  
    sensorValue = analogRead(sensorPin);  
    // do something with the sensorValue... // Do something  
}
```

<https://learn.sparkfun.com/tutorials/lilypad-light-sensor-v2-hookup-guide>



LilyPad Light Sensor

- To test the LilyPad light sensor:
 - Place your hand over the sensor (dark)
 - Cover it with materials of different transparency (dark)
 - Shine a cell phone screen on it (light)
 - Move it closer to a light source (light)

Since the light values depend on the room, it might be helpful to find the maximum and minimum light values for a given situation...





Think Before You Code

Decompose: Finding min/max sensor values

- Let's write code to identify the minimum & maximum [light] sensor values so we can make relative thresholds for what is "dark" and "light"
- Variables for the highest & lowest values
- When we read-in a value that's higher than highest (or lower than lowest), we need to update the variable!
- Setup:
 - Set sensor pin as input
 - Set-up Serial Monitor



Reading-in values from analog inputs

- GLOW > CSCI103 > Lectures > 15Read-Sensor-Value.ino

May look quite similar to reading-in from the button! Note: `analogRead` vs. `digitalRead`

Finding the lowest & highest light levels

- GLOW > CSCI103 > Lectures > 15MinMax-Sensor-Values.ino

How might we make this print only once, after we've run it for ~5 minutes?

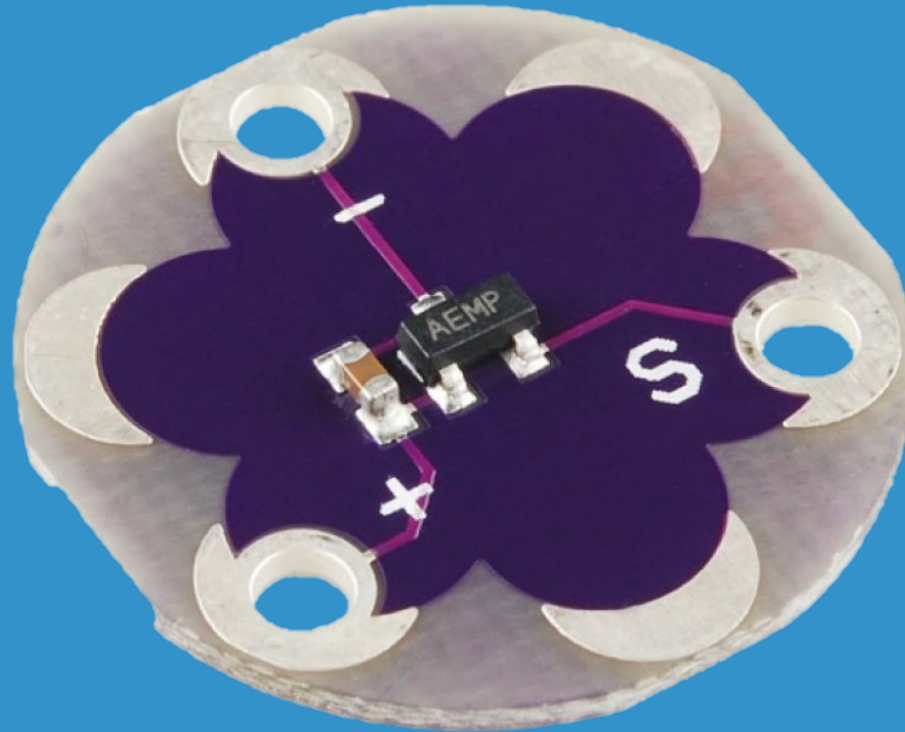
Serial.print() vs. Serial.println()

- `Serial.print(value)` prints `value` to Serial Monitor
 - with *no* `'\n'`
- `Serial.println(value)` prints `value` to Serial Monitor
 - ending with `'\n'`

<https://www.arduino.cc/reference/en/language/functions/communication/serial/print/>



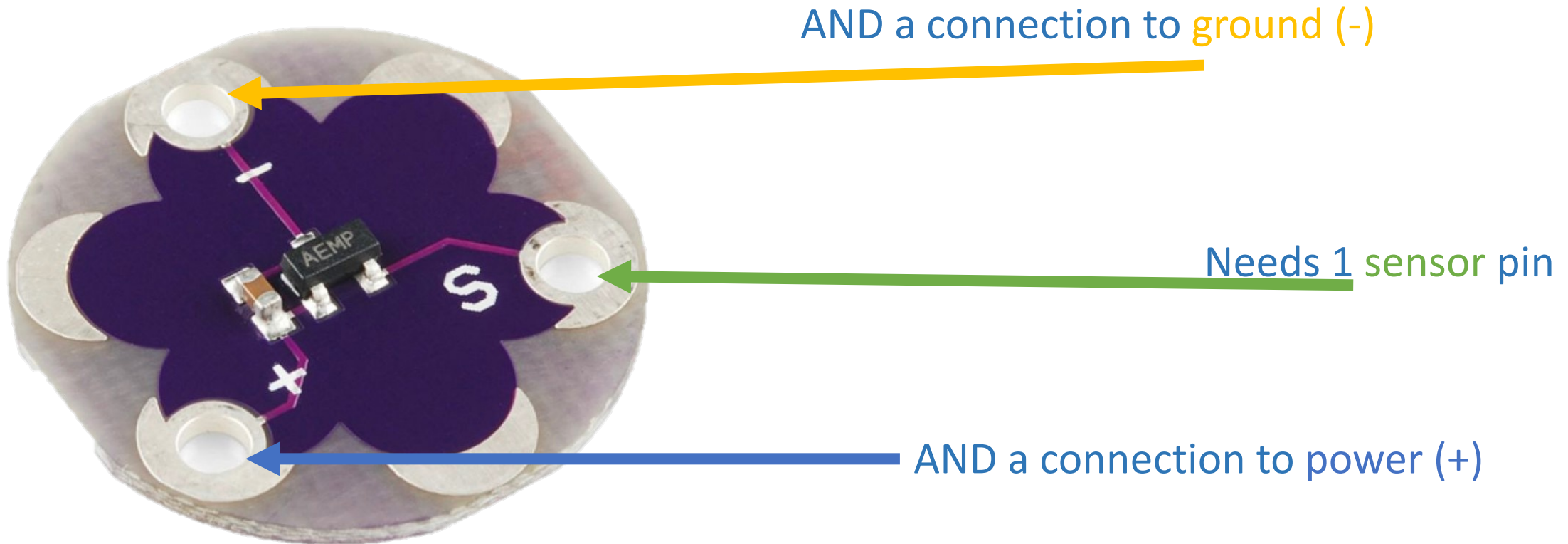
LilyPad Temperature Sensor



<https://learn.sparkfun.com/tutorials/lilypad-temperature-sensor-hookup-guide>



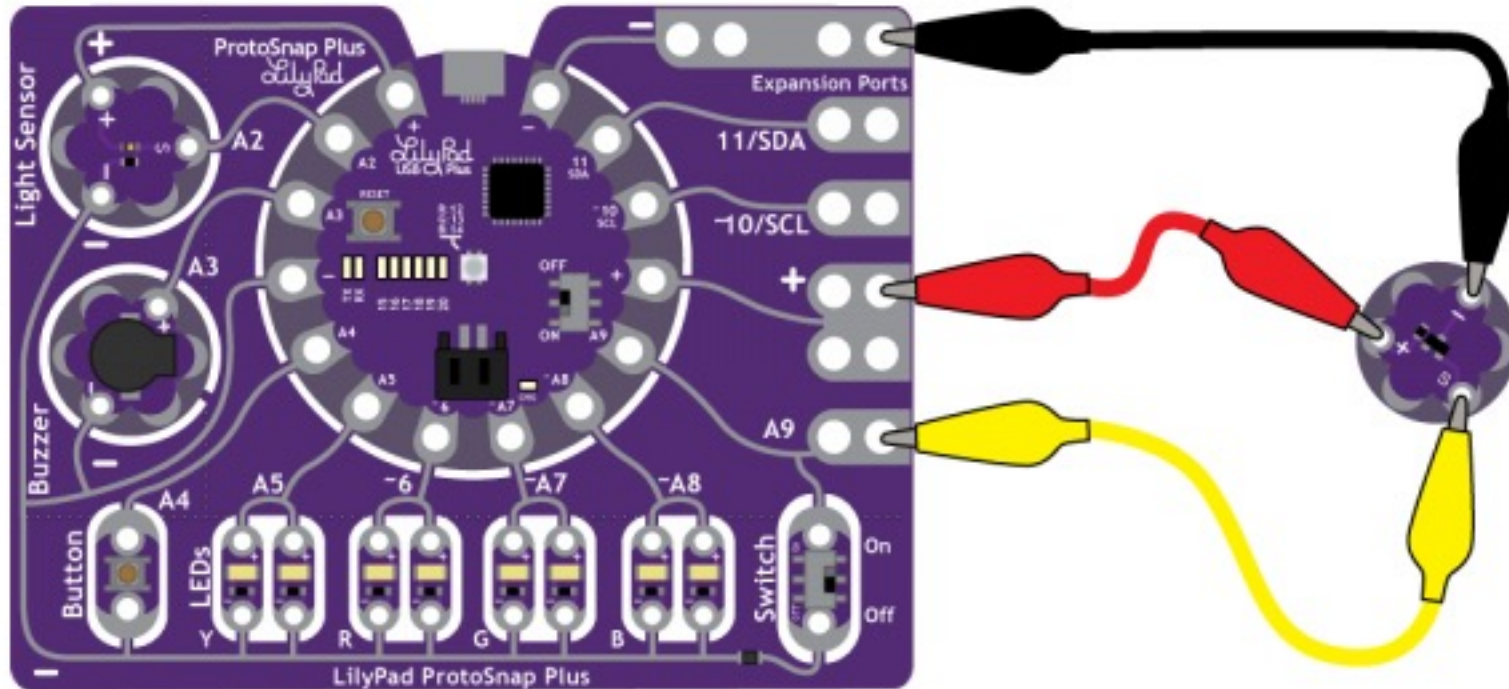
How to Connect Temperature Sensor



<https://learn.sparkfun.com/tutorials/lilypad-temperature-sensor-hookup-guide>



How to Connect Temperature Sensor



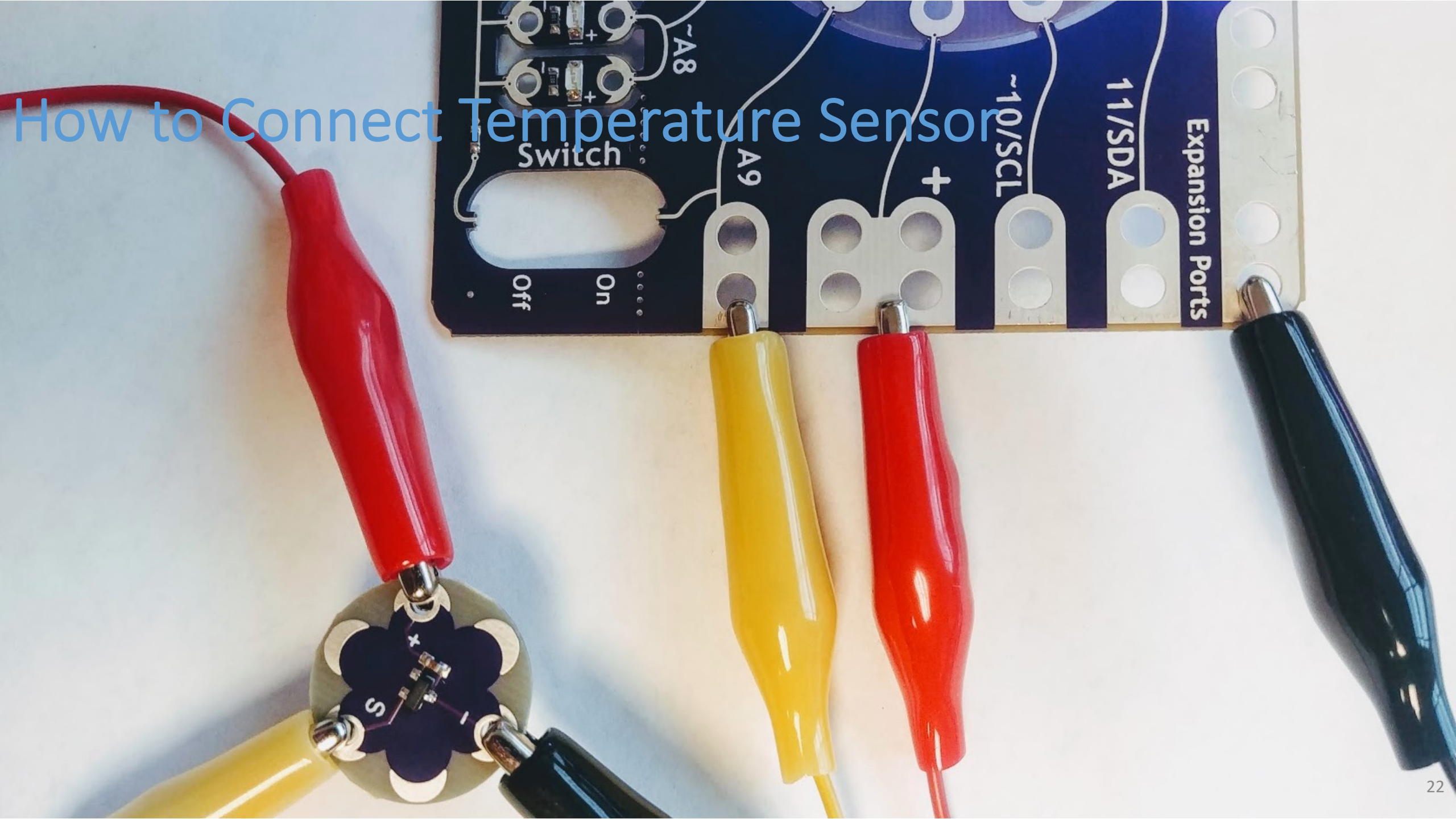
No (+) pin?

Can also connect to any other non-ground pin, and send HIGH voltage to it.

<https://learn.sparkfun.com/tutorials/lilypad-temperature-sensor-hookup-guide>



How to Connect Temperature Sensor



LilyPad Temperature Sensor

- Outputs specific voltage at set temperatures
 - 10mV for every degree Celsius
 - 0 degrees set at 0.5V
- Outputs different values, according to maximum voltage, not degrees!
 - Need to convert: raw sensor values → voltage
 - Voltage → Celsius → Fahrenheit



Converting Voltage to Degrees

- Voltage to degrees Celsius:
 - $^{\circ}\text{Celsius} = (\text{voltage} - 0.5) * 100$
- Degrees Celsius to Fahrenheit:
 - $^{\circ}\text{Fahrenheit} = (^{\circ}\text{Celsius} * 9.0/5.0) + 32.0$

<https://learn.sparkfun.com/tutorials/lilypad-temperature-sensor-hookup-guide>





TEMPERATURE SENSORS ARE ALSO ANALOG INPUTS, LIKE LIGHT SENSORS

Highly advisable to use `analogRead(sensPin)` ;

Connect to an Analog pin (starts with an 'A').



LilyPad Temperature Sensor

```
void setup() {  
    pinMode(sensorPin, INPUT); // Declare temp sensor (A9) as input  
    Serial.begin(9600); // Initialize the Serial monitor for Analog Read  
}  
  
void loop() { // Read-in analog value from temp sensor  
    int sensVal = analogRead(sensorPin);  
    float volt = sensVal * (3.3/1023.0); // Convert to voltage  
    Serial.print("\tVoltage: ");  
    Serial.println(volt);  
    float cel = (volt-0.5) * 100; // Convert to Celsius  
}
```

float is
a decimal!

<https://learn.sparkfun.com/tutorials/lilypad-temperature-sensor-hookup-guide>



Power Source Matters!



- Depending on what you use for power source, the MAX VALUE read in from your Temp sensor may change!
 - (Although, this was more a problem with the previous board)
- USB vs. Coin Cell Battery vs. LiPo battery might matter





DO NOT PUT ANYTHING WET ON YOUR COMPONENTS!

(BE CAREFUL WITH COLD ITEMS!)

Many components are washable, but not when powered on!





It's getting
late!



Uh oh!



Brrrrrrrrrr.
It's cold.



AAAAAHHHH!
SOUND THE
GHOST
ALARM



Deliverable Ghost Detector

UPCOMING



- Deliverable “Ghost Detector” see GLOW Assignment
 - Be ready to discuss what you learned in class
- Using more LilyPad components
 - Temperature Sensor
 - Light Sensor
 - RGB LED
 - Red LEDs

❖ Remember to bring all your supplies to class!



Ghost Detector

- When it's "dark" and "cold" a ghost must be nearby!
- Sound the alarm! Turn on all the red lights! Including the on-board RGB LED
- No lights should be on if it's not dark/cold
- (Use variables at the top of your code to store what you consider to be "dark" and "cold" values for the sensor)



Ghost Detector

- Useful resources:
 - GLOW > CSCI103 > Modules > Lectures/Examples/Handouts
 - Arduino Language Reference: <https://www.arduino.cc/reference/en/>
 - Danger zone!
 - Don't use any other Internet resource!





WE'RE STILL **NOT SNAPPING
OFF ANY PIECES OF OUR
ARDUINO PROTOSNAP KIT!**

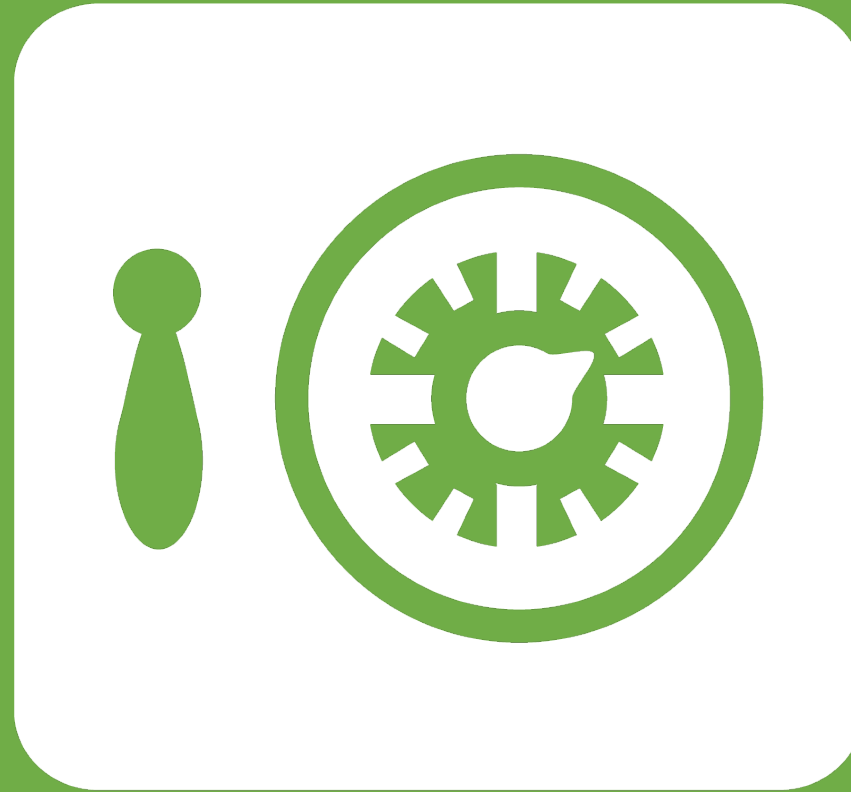
QUESTIONS?

Please contact me!

end.



Electronic Textiles



Leftover Slides



Ground (-) Pins

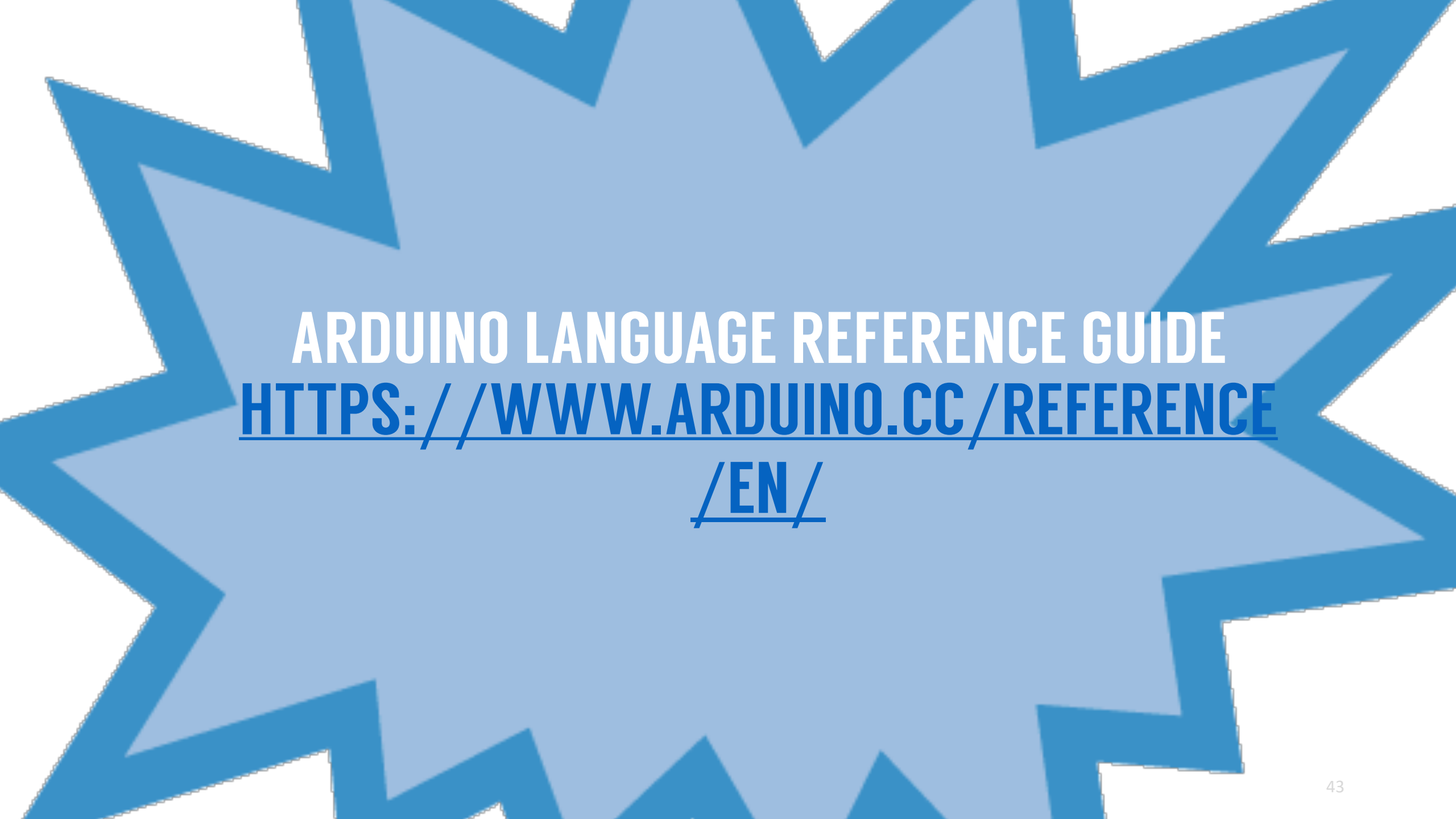
- If the component has a pin marked for ground (-), it must be connected to a ground (-) pin on your Arduino.
- You can connect many components to ground (-) and power (+) pins/expansion ports. Should be fine.



Reminder: Shortcut Operators

<code>counter = counter + 1;</code>	<code>counter += 1;</code>	<code>counter++;</code>
<code>counter = counter + 23;</code>	<code>counter += 23;</code>	
<code>counter = counter - 1;</code>	<code>counter -= 1;</code>	<code>counter--;</code>
<code>counter = counter - 17;</code>	<code>counter -= 17;</code>	





ARDUINO LANGUAGE REFERENCE GUIDE
[HTTPS://WWW.ARDUINO.CC/REFERENCE](https://www.arduino.cc/reference/en/)
/EN/

COMPUTER SCIENCE COLLOQUIUM THIS FRIDAY



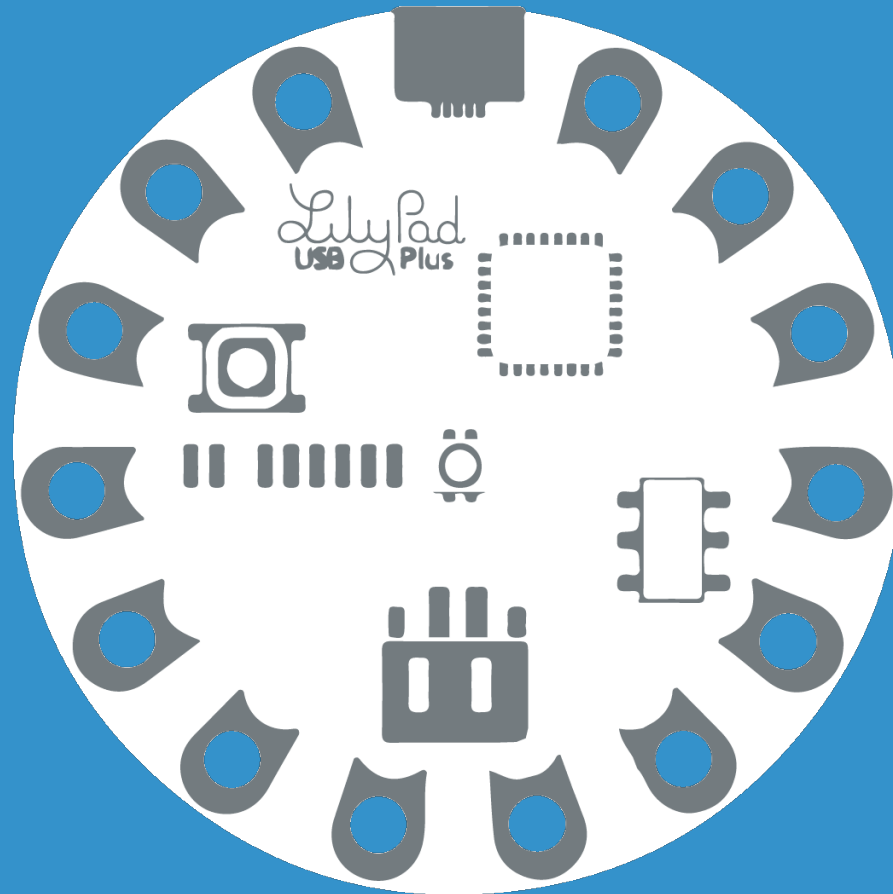
Friday mm/dd at 2:35pm in Wege Auditorium

“Title TBD”

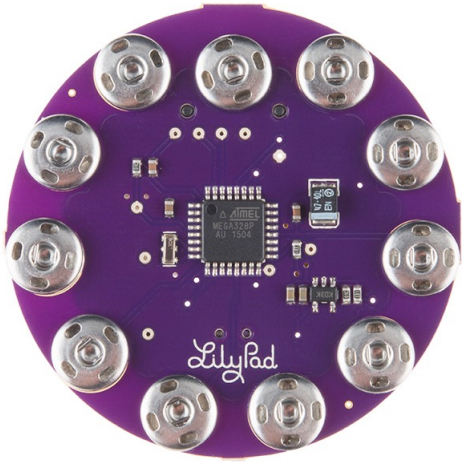
Speaker



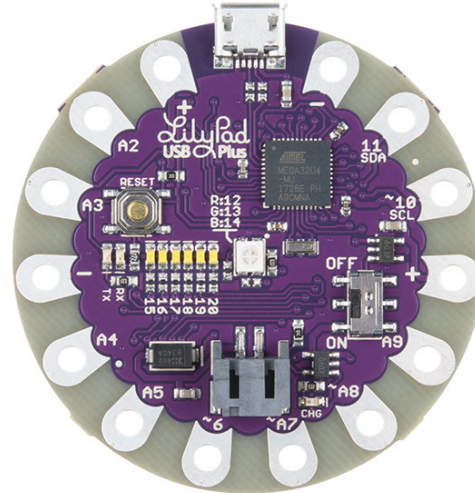
Lilypad USB [Circuit] Board



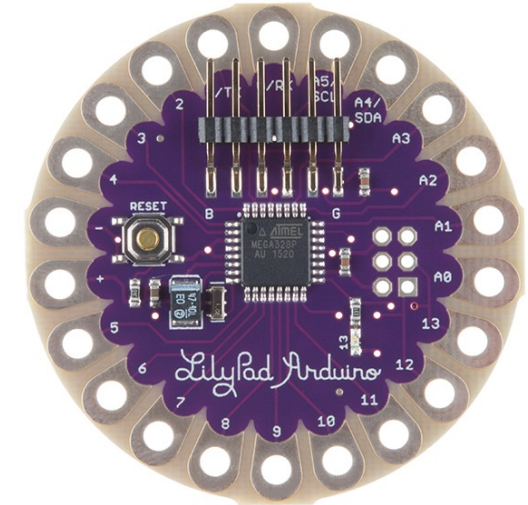
Lilypad Arduino



SimpleSnap



Lilypad USB Plus



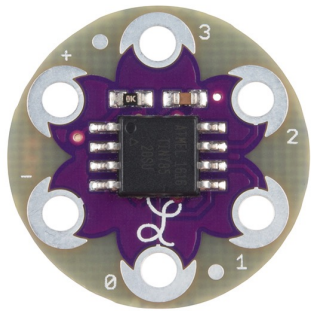
328 Main Board

- How many/kind of sew tabs
- Onboard on/off switch
- External power socket
- USB/6-pin UART Connector

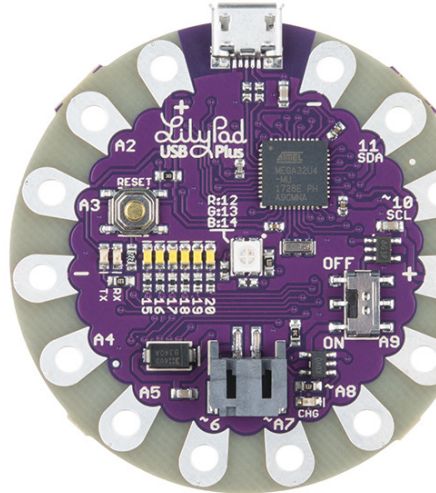
https://www.sparkfun.com/etextile_arduino_comparison_guide



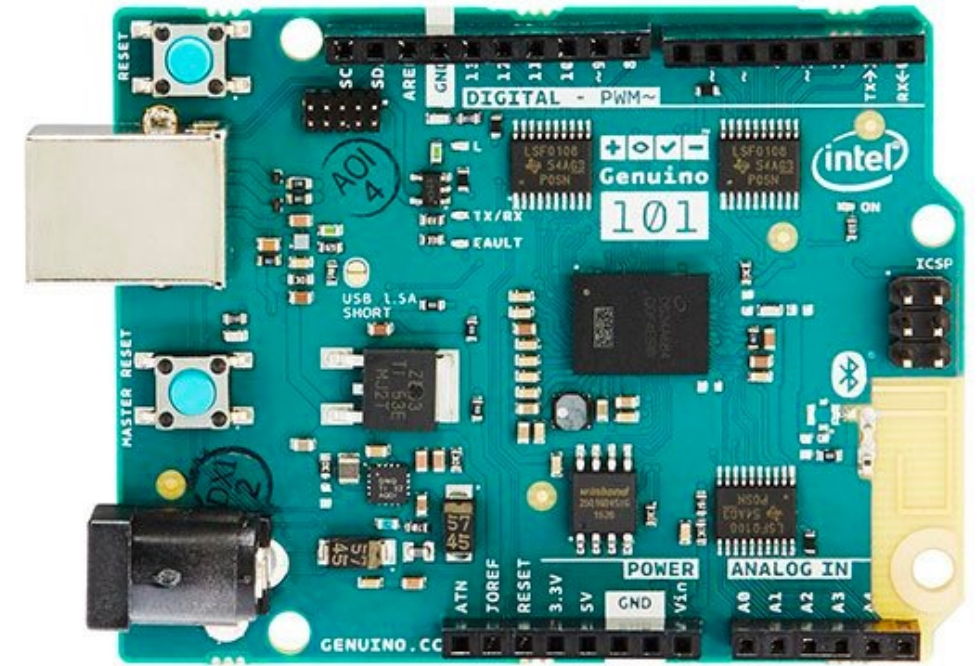
Lilypad Arduino



LilyTiny



Lilypad USB Plus



Arduino/Genuino

- Pre-programmed w. 4 different behaviors
- Blink, heartbeat, breathe, random fade
- Not sewable tabs! Pins.
- ...lots of other differences...

https://www.sparkfun.com/etextile_arduino_comparison_guide

