



# I-Engineering Tools to support engineering practices & identities

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# Why Identity?



Do I see myself in STEM?  
Am I recognized for what I  
know and can do?  
Do others welcome me in  
STEM?

**“I’m a make-a-difference expert!”**

*People will love my solar powered light up scooter! People will say, ‘Who made this? The tiny person who is always in the background did this?’ It’s awesome!*  
**Little kids can do ginormous works!** Jayla, 11

# What do we mean by Identity?



## Identities in STEM practice

- Knowledge & Practice
- Using Knowledge & Practice to take Action (Agency)
- Being Recognized for what I Know and can Do

# I-Engineering

*Engineerlam.org*

Teaching Engineering Practices in the context of Engineering for Sustainable Communities

Goal: To promote equitable and meaningful **learning** and **identity work** in engineering among all students in the middle grades.

## Key Design Features

- Iterative design work with the community
- Defining authentic problems facing local community & designing actual solutions
- Embedded Disciplinary Core Ideas (Energy transformations, sources and systems)
- Tools to support Identity Work

## Integrating design features across the unit

- Embedded in unit are two separate design cycles
  - Each incorporates core practices and DCIs working towards deeper learning
- Tools are used repeatedly through unit for supporting identity work:
  - Emphasizing agency & recognition in addition to K&P
  - Forms of community engagement/dialog
  - Student work

## How can I make my classroom more sustainable?

Unit Flow		
1	Introduction	Big Ideas in Engineering for Sustainable Communities
2-4	Iterative Design Cycle 1	Sustainable Electric Art: Using iterative design cycles to make electric art cards/trinkets for family/friends.
5-10	Iterative Design Cycle 2	Sustainable Classrooms: Defining Problems  Sustainable Classrooms: Defining Problems brainstorming, sketching up w/ tech and social specs, revising sketches, prototyping with testing and revision cycles
11-12	Community Sharing	Communicating ideas to the community

# Ariel's Umbrella

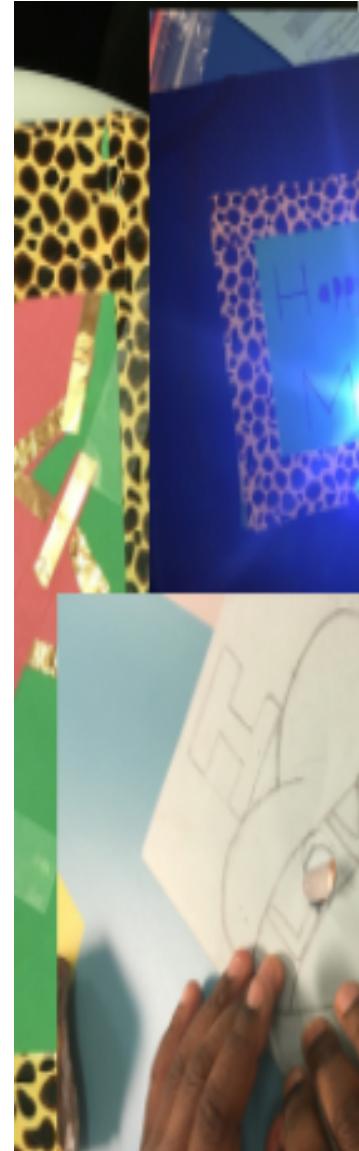


## Identity Reflection Tool

1. What **knowledge** and **practices** did the students develop and use?
2. How were the students **recognized** for their expertise?
3. In what ways, did students use their expertise in meaningful ways (**agency**)?
4. How is identity work supported (or not) by the interactions among students' knowledge/practices, recognition and agency?

## Iterative Design Cycle 1: Electric Art

- Design Challenge: You forgot to get a present for a friend or family member, but you do have copper tape, LED lights and a battery.
  - Iteration 1: Complete a paper circuit template
  - Iteration 2: Create an electric art present
  - Iteration 3: Powering with a green energy source



# Knowledge and Practice

Katie: So if you did copper loops for the whole flower, do you know why it wouldn't work?

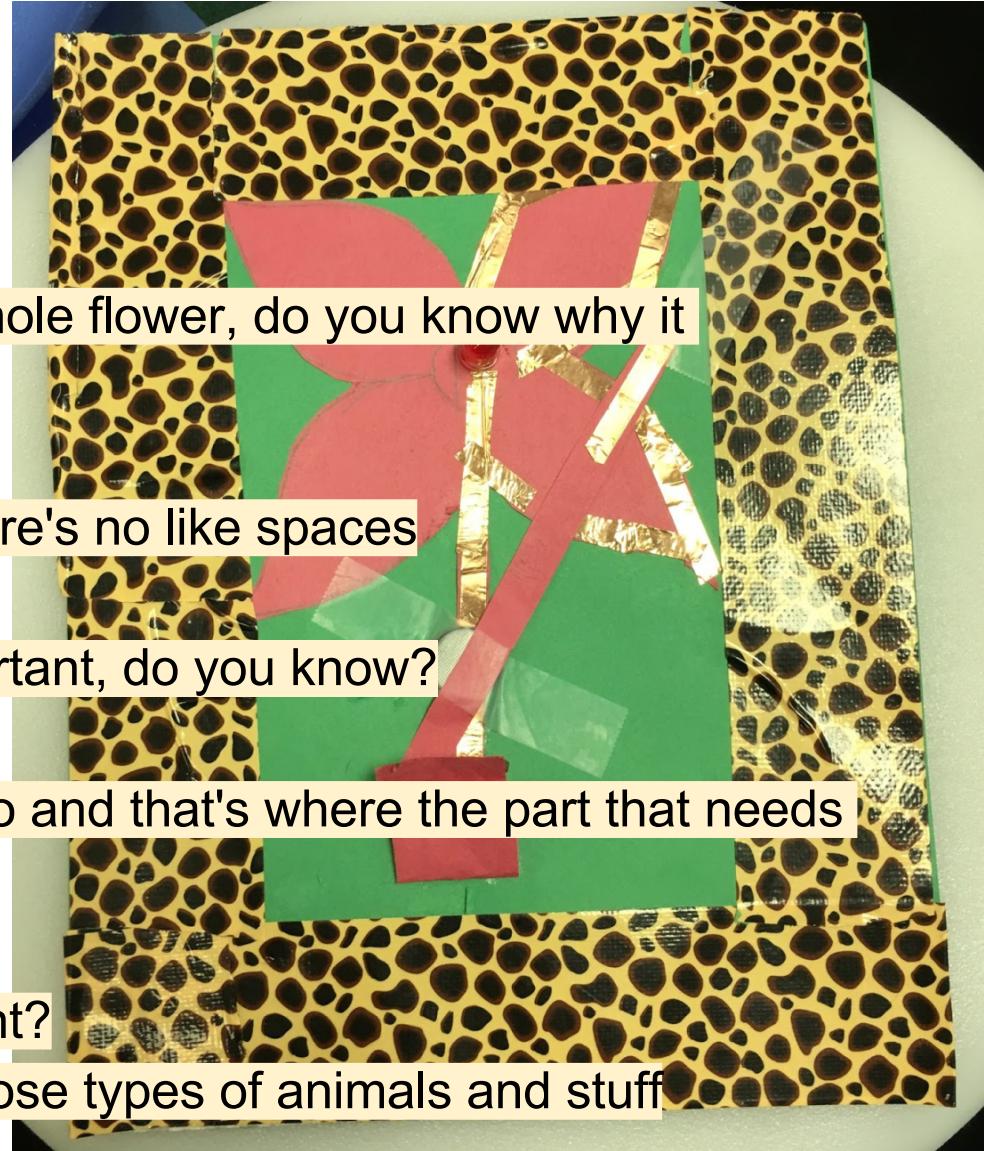
Jaden: Because there's no breaks in it, there's no like spaces

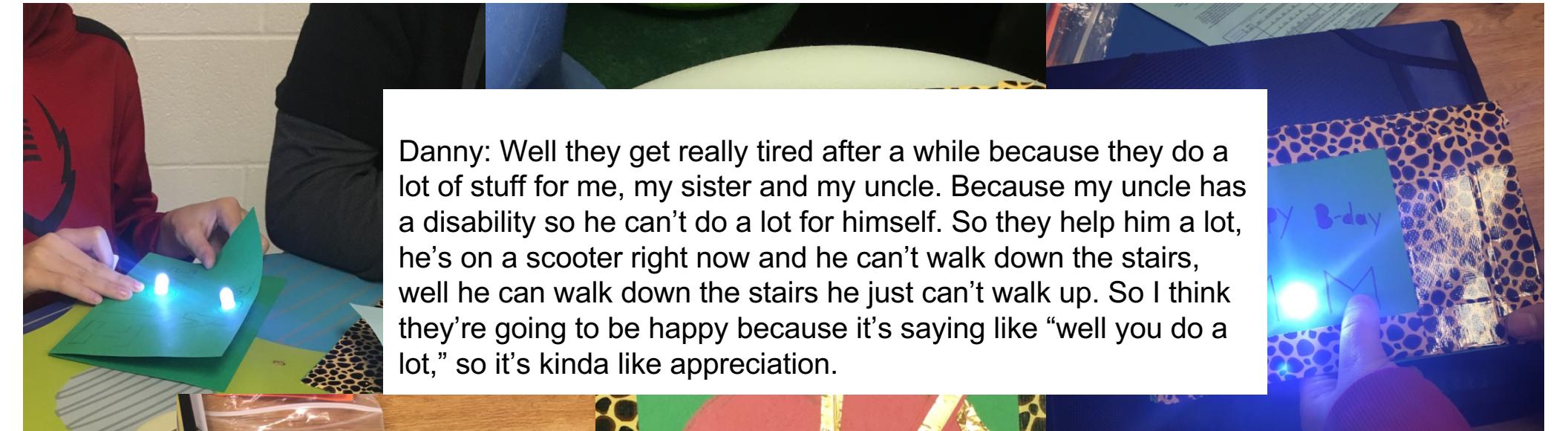
Katie: Okay, and why are the spaces important, do you know?

Jaden: That's where the switch needs to go and that's where the part that needs to turn it on needs to go.

Katie: How did you choose the leopard print?

Jaden: Because my mom, she likes like those types of animals and stuff





Danny: Well they get really tired after a while because they do a lot of stuff for me, my sister and my uncle. Because my uncle has a disability so he can't do a lot for himself. So they help him a lot, he's on a scooter right now and he can't walk down the stairs, well he can walk down the stairs he just can't walk up. So I think they're going to be happy because it's saying like "well you do a lot," so it's kinda like appreciation.

Katie: Why did you choose to make it for your mom?

Malik: Because she's a special person in my life.

Katie: So did you end up giving it to her?

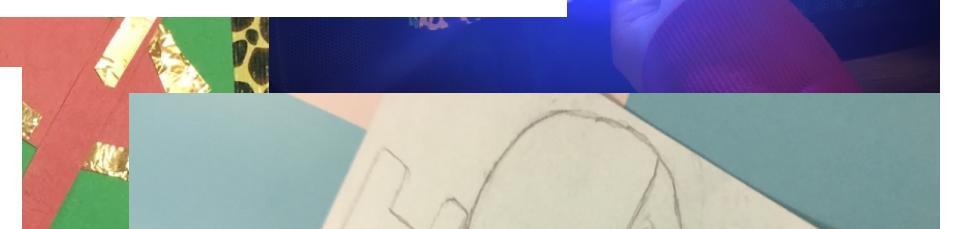
Malik: yeah.

Katie: Oh okay. And did she like it?

Malik: Yeah. She liked it.

Katie: What did she say about it?

Malik: She said it was a really good card and thank you.



Aman: This is my drawing I made it for my dad.

Katie: Okay. Cool.

Aman:: Yeah, I made him dressed like a super hero.

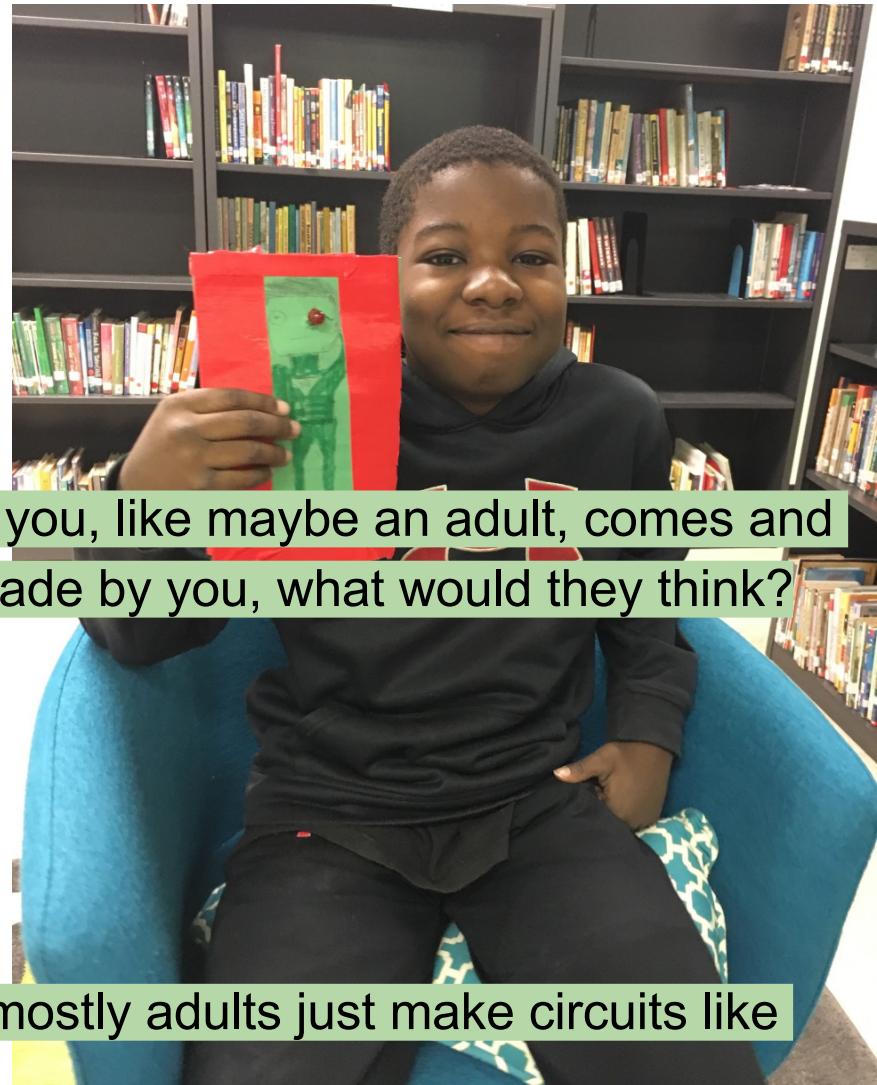
# Recognition

Katie: What if someone who doesn't even know you, like maybe an adult, comes and sees your electric art card and finds out it was made by you, what would they think?

Aman: I think they might be amazed

Katie: Okay, why would they be amazed?

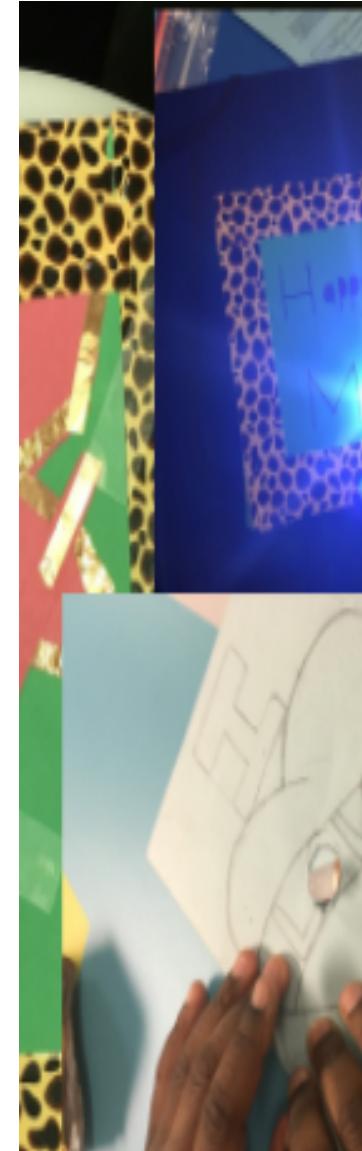
Aman: Cause a sixth grader made a circuit and mostly adults just make circuits like that.



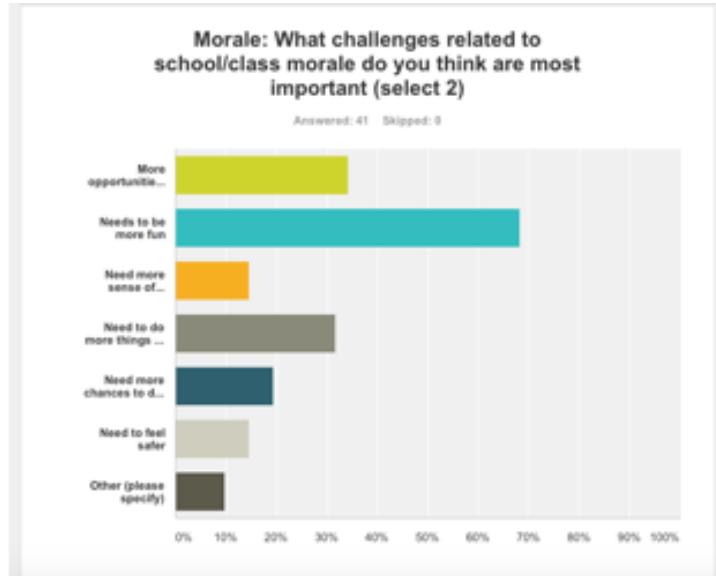
## Iterative Design Cycle 2: Sustainable Classrooms

**Design Challenge:** Design an engineering solution that makes your school community more sustainable that uses:

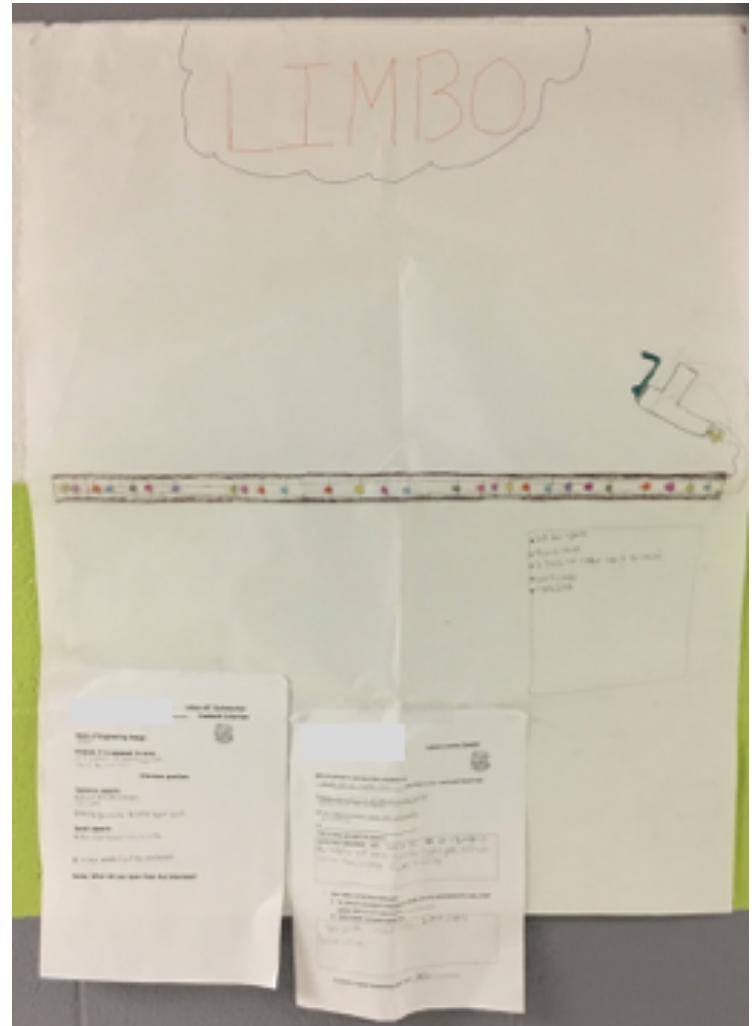
- A green energy source
  - LED lights
  - Copper tape
  - Available classroom materials
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- **Iterative Design Cycle**
    - Define the problem through community ethnography
    - Sketch solution
    - Community feedback
    - Prototype
    - Optimizing through community feedback and technical tests
    - Share prototypes with the community



# Light-Up Limbo: Defining the problem



# Designing a Solution



# Light up limbo

## Story of the engineering invention:

We made our invention because people in our classroom were not having fun so we wanted to help with that.

We created the limbo by using 23 led lights, a hand crank, a yard stick and copper tape. We did a parallel circuit so the electricity can flow through it.

We first drew it then started building it and made changes we needed to make.

Some people said that they thought that it would be fun to do a limbo in class.

## About the engineers:

- Cory plays football
- Lucena likes to dance
- Aaliyah has been to New York

Materials: 23 light, copper tape, hand crank and a yard stick



## Identity Reflection Tool

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## THE CHALLENGE

Create a present  
for a friend! You have:

- ◆ LED LIGHT BULBS
- ◆ 3V BATTERIES
- ◆ COPPER TAPE
- ◆ CRAFTS SUPPLIES

What can you make?



# ENGINEERING DESIGN CYCLE

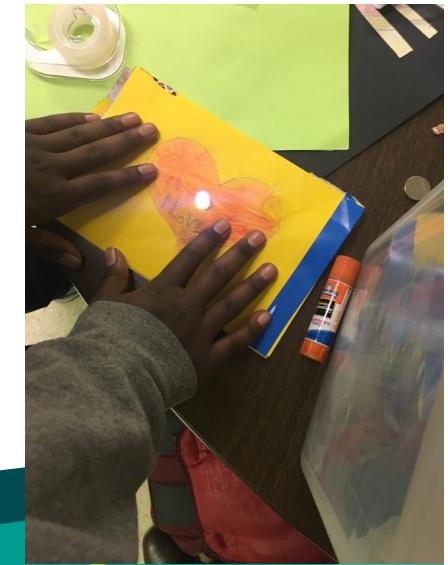
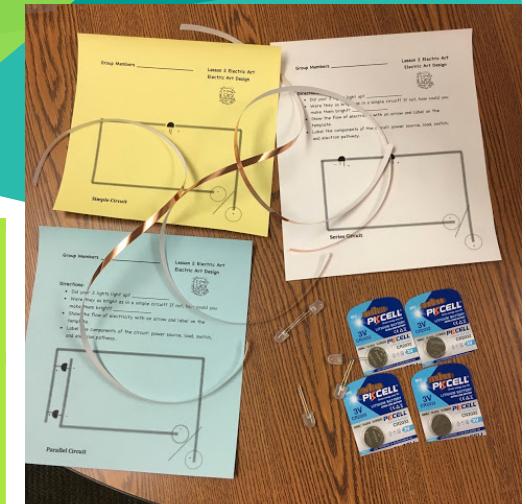
- ◆ How will you design the electric art card to benefit the person you give the card to?
- ◆ **Technical/Social:** How will you balance the technical dimensions of your electric art card design with social aspects of the design?



# Activity Flow

- Observations of materials & predictions of their purposes
- Experiencing materials: Trying to make a complete circuit
- Comparing simple, series and parallel circuits
- Applying to electric art
- Powering electric art with sustainable energy sources

MATERIAL	OBSERVATIONS	PURPOSE
COPPER TAPE	sticky, shiny, thin, flimsy, metallic	To wrap something. Transfer the electric energy from the battery to the light.
BATTERY	Rough on one side. Made of metal. Shiny side is positive, rough side is negative.	To power the LED.
LED LIGHT	Putting “sticks” on either side of the battery causes LED to light up. One side is longer than the other. Long one goes on rough side and short one goes on smooth. Pointy. Top part is made of plastic.	“Twinkle like a star” “Call attention to something special”



# Your Turn!

Explore the materials and make your own electric art!

We have provided templates in case they are helpful, but we also recognize your expertise as science teachers.

As you make your electric art, think about how this supports your: K+P, Agency, and Recognition.

Visit our website for more resources: [engineeriam.org](http://engineeriam.org) →  
Tools page

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