

COMPUTATIONAL THINKING, MAKING, AND CULTURAL RESPONSIVENESS

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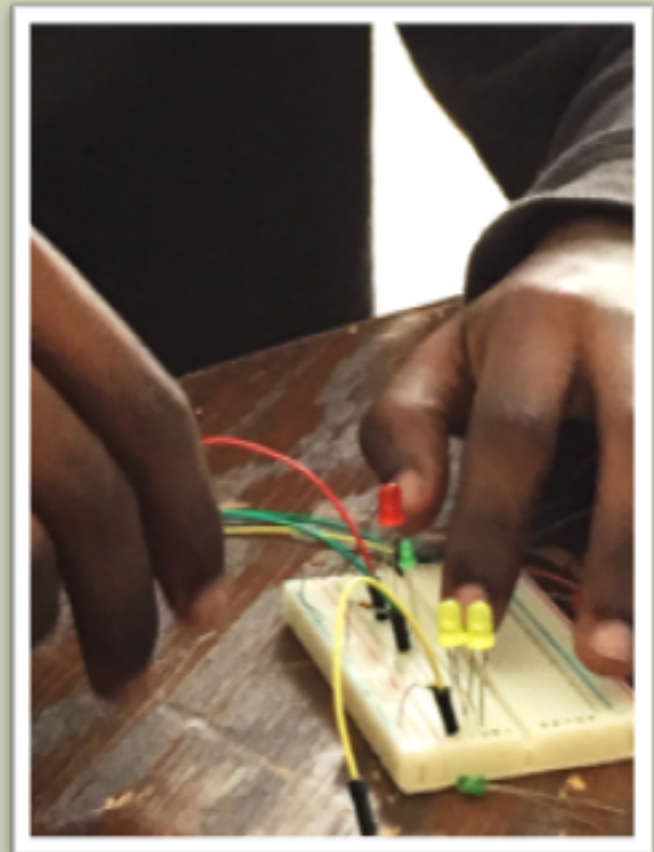
Center for
College Access
and Success

Northeastern
Illinois
University

PI – ACTMA
NSF STEM + C

ACTMA

- **Assessing Computational Thinking for Maker Activities (ACTMA)**
- **Formative assessments**
 - Embedded
 - Adaptive
 - Culturally Responsive
- **Informal (Makerspaces)**
- **Formal (Classrooms)**
 - Physics



MAKING COMPUTING EQUITABLE

- How can everyone be successful?
- How can we build upon the skills and knowledge students already have?

MAKING COMPUTING EQUITABLE

- Economic opportunity
- Having input in the world in which we live

Bachelors Degrees Awarded by Gender and Ethnicity, From 156 Departments Providing Breakdown Data

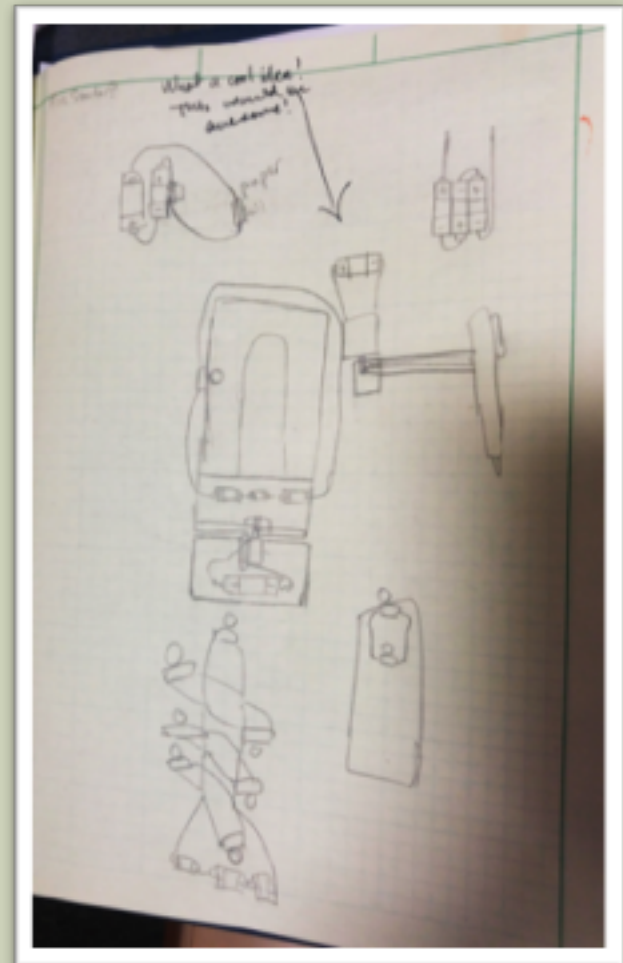
	CS					CE					I					Ethnicity Totals	
	Male	Fem	N/R	% of M*	% of F*	Male	Fem	N/R	% of M*	% of F*	Male	Fem	N/R	% of M*	% of F*	Total	%
Nonresident Alien	1,141	344	3	10	14	171	41	2	9	14	140	43	5	6	6	1,895	9.4
Amer Indian or Alaska Native	46	5	2	0	0	5	1	0	0	0	7	0	0	0	0	66	0.3
Asian	2,738	870	8	24	35	522	97	11	26	33	398	181	17	16	24	4,851	24.2
Black or African-American	350	79	5	3	3	73	19	7	4	7	174	62	20	7	8	795	4.0
Native Hawaiian/ Pac Islander	22	4	0	0	0	2	0	0	0	0	12	6	0	1	1	46	0.2
White	6,120	931	121	53	38	1,015	103	54	51	35	1,349	336	75	55	45	10,134	50.5
Multiracial, not Hispanic	322	75	6	3	3	49	10	0	3	3	75	41	3	3	6	587	2.9
Hispanic, any race	875	173	21	8	7	153	23	29	8	8	312	79	2	13	11	1,686	8.4
Total Res & Ethnicity Known	11,614	2,481	166			1,990	294	103			2,467	748	141			20,060	

MAKING COMPUTING EQUITABLE

- Reevaluate how we introduce concepts of computing
 - Computational Thinking (CT)
 - Making
 - Culturally Responsive Pedagogy (CRP)
- Assessment
 - Multimodal
 - Often

COMPUTATIONAL THINKING (CT)

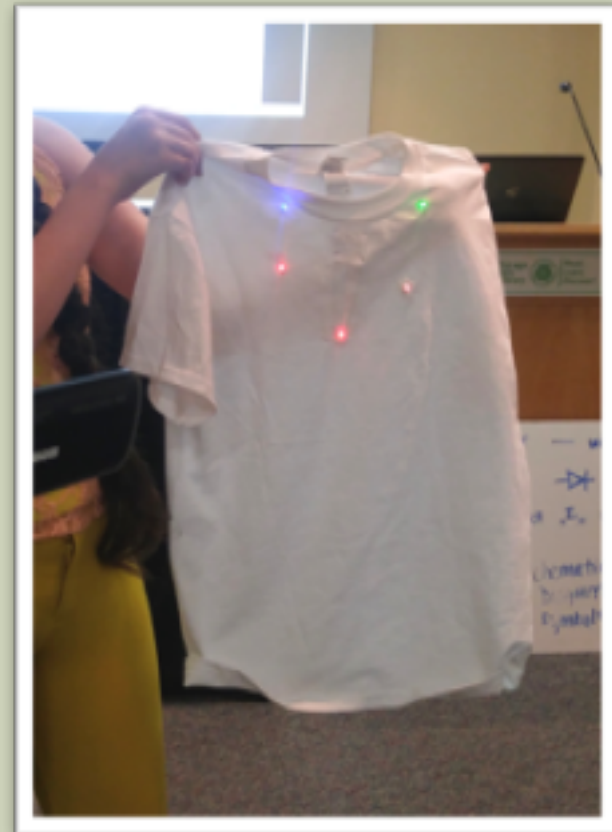
- Beyond programming
- Wing (2006)
 - Understanding what computing can do to solve problems
- Martin (2018)
 - Connecting computing to things in the real world
- Papert (1996)
 - Computing enables self-efficacy
 - Ideas give us the power to act



COMPUTATIONAL THINKING CONCEPTS & APPROACHES

■ Computing at School (2015), Brennan & Resnick (2012)

- Decomposition
 - Pattern recognition
 - Abstraction
 - Algorithms
 - Evaluation
- Iteration/Remixing
 - Debugging
 - Questioning



COMPUTATIONAL THINKING DISPOSITIONS

- International Society for Technology in Education (ISTE) and the Computer Science Teachers Association (CSTA) (2011)
 - Confidence in dealing with complexity
 - Persistence in working with difficult problems
 - Tolerance for ambiguity
 - The ability to deal with open ended problems
 - The ability to communicate and work with others to achieve a common goal or solution

MAKING



- Instructor creates experiences that build upon students' existing knowledge
- Sharing “objects-to-think-with” (Turkle, 2007)
- Students are empowered with “technological fluency” through their interactions with technology and materials (Papert, 2000)

MAKING



(Buechley, 2013; Tzou, Scalone & Bell, 2010)

CULTURALLY RESPONSIVE PEDAGOGY

■ Ladson-Billings 1995

■ Conception of self and others

- All students capable of success
- Teaching as mining (Freire, 1974)

■ Social relations

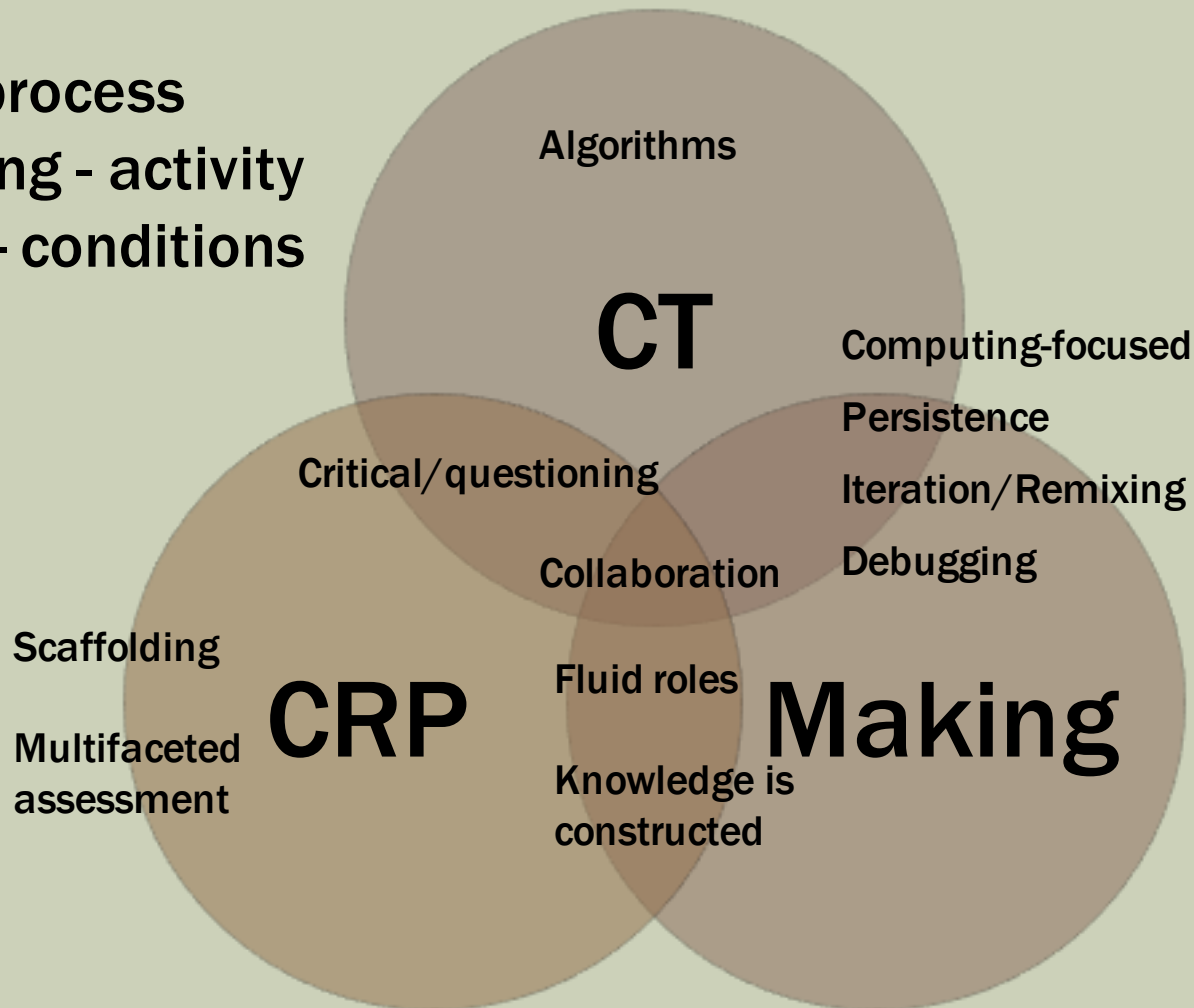
- Fluid teacher-student relationships
- Collaborative community of learners

■ Conceptions of knowledge

- Knowledge is constructed
- Knowledge must be viewed critically
- Scaffolding to make learning accessible
- Assessment must be multifaceted

COMPUTATIONAL THINKING (CT) + MAKING + CULTURALLY RESPONSIVE PEDAGOGY (CRP)

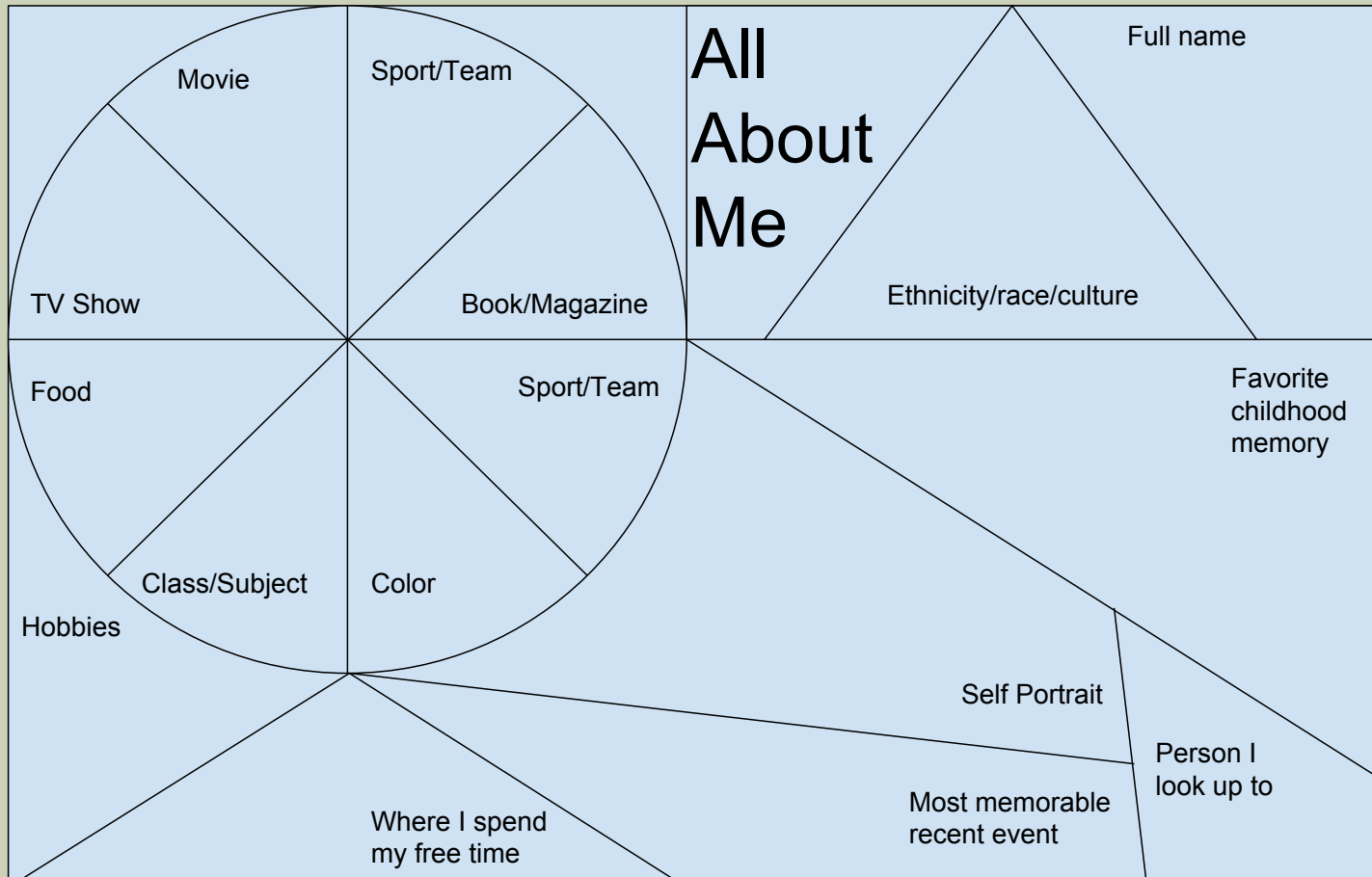
- CT - process
- Making - activity
- CRP - conditions



ACTMA SUMMER PROGRAM

- 2016 & 2017
- 2 weeks
- Public Library
- Physics Activities in a Makerspace
 - Circuits → E-textiles → Makey Makeys → Arduinos
- Embedded assessments
- Develop CT skills through making, while employing CRP

ALL ABOUT ME



A worksheet template titled "All About Me" designed for a self-reflection activity. The template is divided into several sections by geometric shapes. On the left, a large circle is divided into eight equal sectors, each labeled with a topic: "Movie", "Sport/Team", "Book/Magazine", "Sport/Team", "Color", "Class/Subject", "Hobbies", and "Food". To the right of the circle, the title "All About Me" is written in a large, bold font. Below the title, the worksheet is divided into several rectangular and triangular sections, each labeled with a topic: "Full name", "Ethnicity/race/culture", "Favorite childhood memory", "Self Portrait", "Person I look up to", "Most memorable recent event", and "Where I spend my free time".

All About Me

Full name

Ethnicity/race/culture

Favorite childhood memory

Self Portrait

Person I look up to

Most memorable recent event

Where I spend my free time

Movie

Sport/Team

Book/Magazine

Sport/Team

Color

Class/Subject

Hobbies

Food

<http://bit.ly/ACTMA-CRdocs>

DATA ON MY DAY

Student Name:		Grade:		
Activity	Start time	End time	Location	Notes
Ex.) Make breakfast	7:22 AM	7:26 AM	Kitchen-Home	Toast with jelly
Ex.) Walk to school	7:37 AM	7:46 AM	Home-School	Went out of way to pick up a friend
Ex.) Finish HW	7:51 AM	7:58 AM	School	Forgot to finish HW so I tried to finish quickly before class started

<http://bit.ly/ACTMA-CRdocs>

ASSET MAPPING

Name	Address	Grade
Ex.) Aldi Grocery Store	123 Main Street, Springfield, IL 12345	B

Where do you go to school?

Name	Address	Grade

Where do you go to shop? (non-food items)

Name	Address	Grade

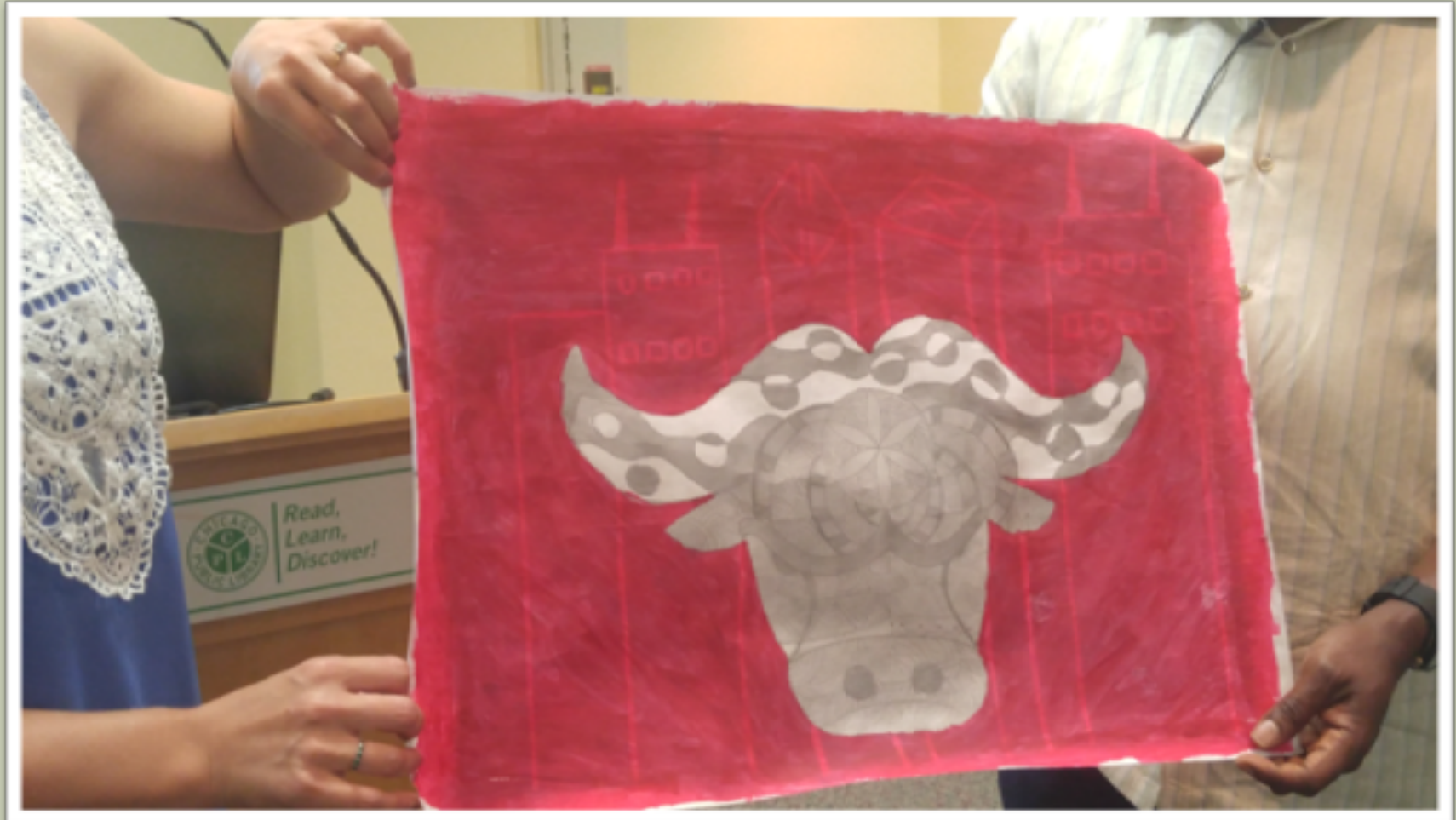
Where do you go to work?

Name	Address	Grade

Where do you go out to eat?

Name	Address	Grade

SHOW AND TELL



CULTURALLY RESPONSIVE CHECKLIST

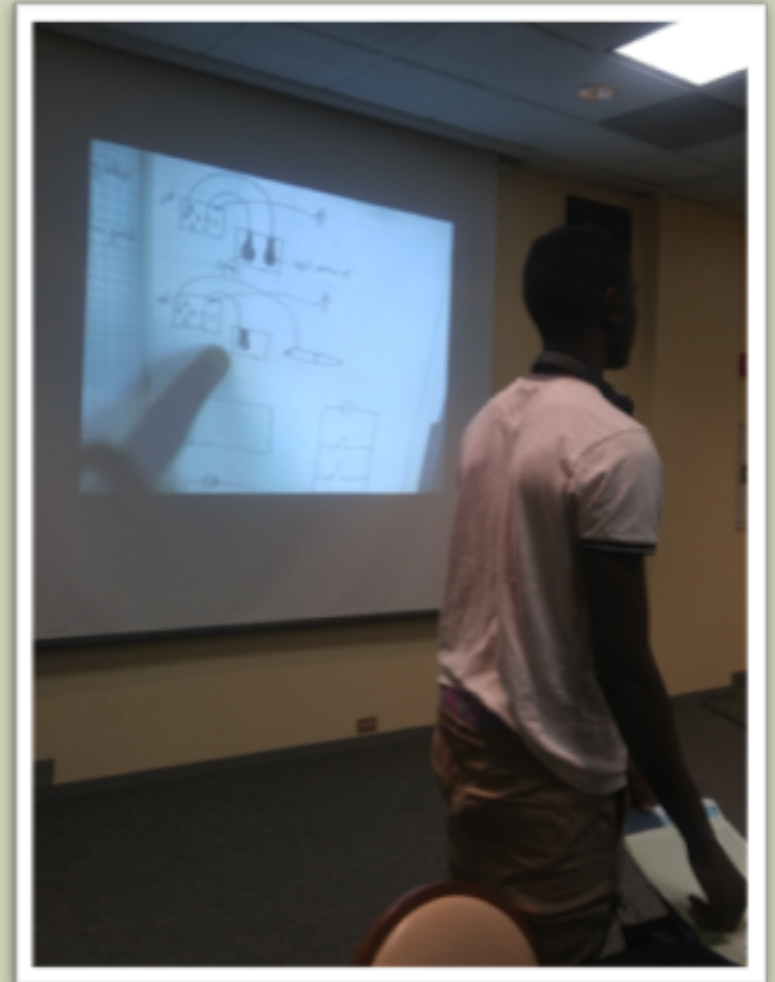
Culturally Responsive School Makerspace Checklist				
Name:	Subject (e.g., Maker activity team session):		Date/Time:	
1. Collaborative and Individual Learning Environment:	Consistent	Inconsistent	Not Present	Notes:
a. Environment encourages collaboration and small group discussion, as well as individual work. <i>- Desks or tables in small groups</i>	<input type="checkbox"/>	<input type="checkbox"/>	Ex) <input checked="" type="checkbox"/>	I have students in rows; need to change to groups for next week (how to do in small room?)
b. Failure is celebrated, encouraged, and expected as part of the design thinking/maker process <i>- Anchor charts or student created posters discussing failure/design process</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
c. Play is encouraged <i>- Materials are out to explore with before direct instructions are given</i> <i>- Sometimes just let them play, no overarching goal</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
2. Inclusive Teaching Techniques:	Consistent	Inconsistent	Not Present	Notes:
a. Incorporates diverse learning styles <i>- Audio, visual, tactile, etc. learners are supported through multimodal materials and resources</i> <i>- Ss not only learn in multiple styles but can showcase their learning using multiple methods and strategies</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

- Collaborative Learning Environment
- Inclusive teaching techniques
- Integrating students' lives/cultures
- Connects to resources

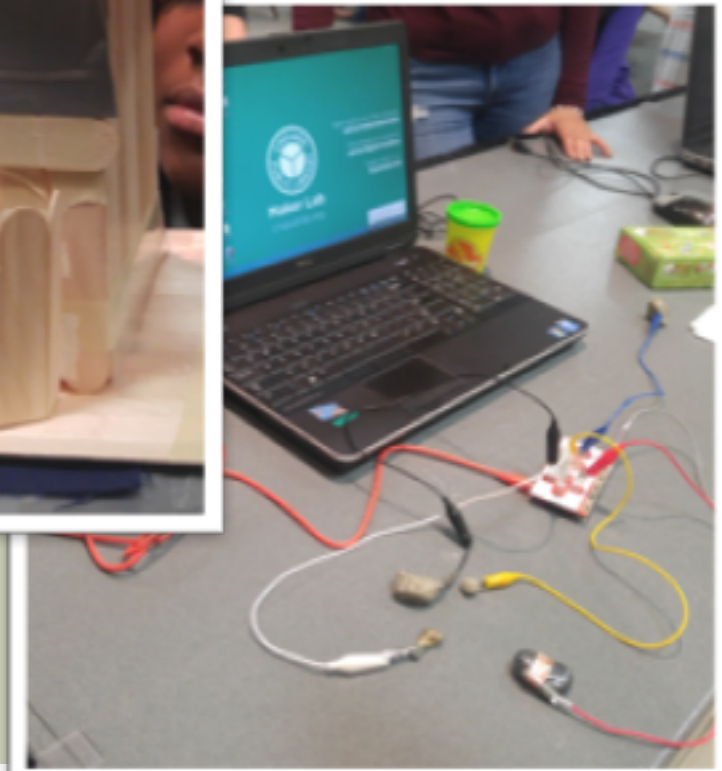
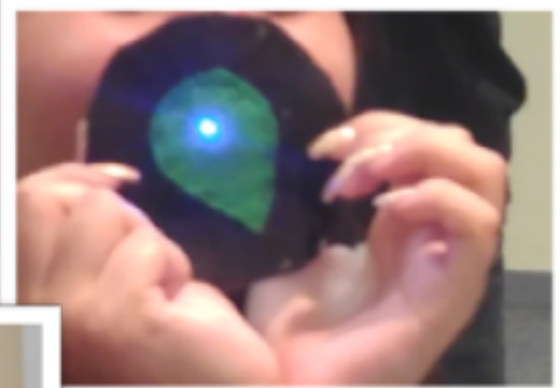
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ASSESSMENTS

- **Formative**
 - Notebooks
 - Prompts & probes
- **Summative**
 - Dispositions
 - Pre/post CT
 - Performance
 - Artifact Rubrics



RESULTS



RESULTS

- Use of culturally responsive pedagogy created space for students' individual cultures to become integrated in projects.
- The act of making created a space for open conversation and collaboration.
- “Performance” moments & informal student conversations opportunities to make connections

RESULTS

- Promising assessment practices
 - Drawing
 - Using vocabulary with materials
 - Debugging
 - Fluid roles

ROOM FOR IMPROVEMENT //

NEXT STEPS

- Embrace inequity conversation
- Be more intentional about tying cultural responsiveness into the CT, physics, and making
- Access to resources
- Examine the efficacy and psychometric features of maker activities and assessment strategies on CT and physics learning with more students
- Develop professional development

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THANK YOU!

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