

# Scientizing Daily Life with New **Social, Mobile, &** **Wearable Technologies**



Tamara L. Clegg \* University of Maryland

# Scientizing Framework

## The Four Building Blocks

### Seamless Scientizing



Mobile, social, ubiquitous

### Scientizing the Body



Wearables

## Future Work



# Seeing the World through Scientific Lenses



Finding **practical**  
applications

Using Science to Achieve  
**goals**

**Scientizing** daily life activities

Procedural & Conceptual  
Understanding

Interest

Social Interactions

Personal  
Connections

# **Building Blocks**

to disposition development



# Scientizing Framework

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Wearables

Future Work

# Science Everywhere



Social Media App

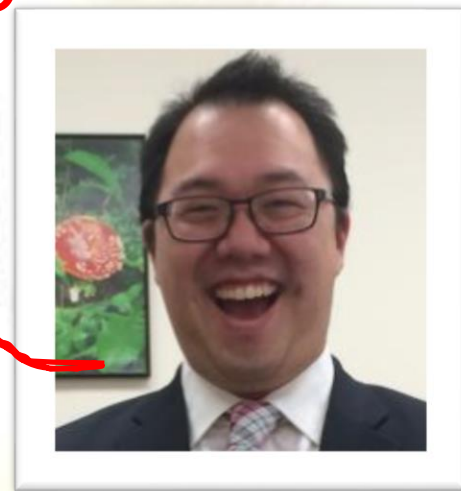
Interactive Displays

**Home \* School \* After-school**



June Ahn

Jason Yip



**Science Everywhere  
Team**

Daniel Pauw \* Judith Uchidiuno \* Beth Bonsignore \* Austin Beck \* Caroline Pitt \* Kelly Mills \* Lautaro Cabrera



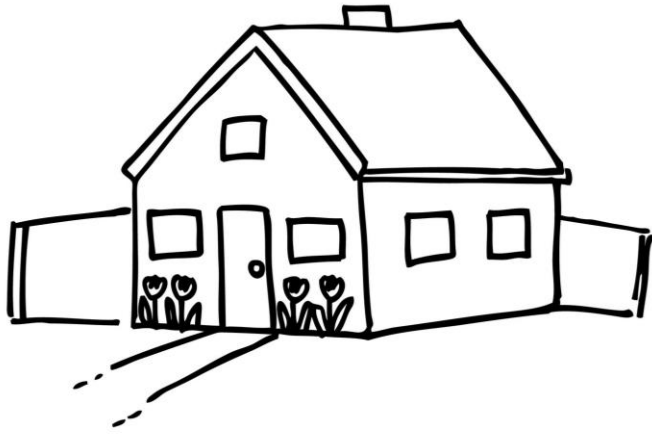
Systemic **obstacles** in low-SES communities

# Unequal learning opportunities

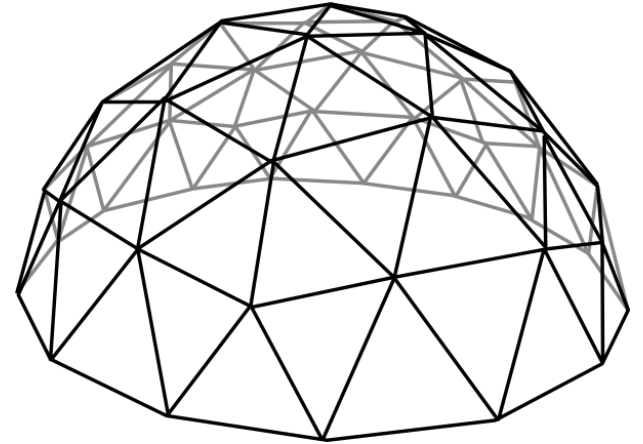
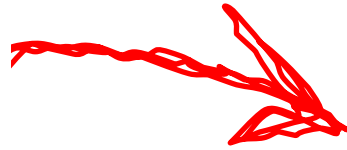
Higher SES groups spend **disposable** income on **out-of school opportunities**

Duncan & Murnane, 2011





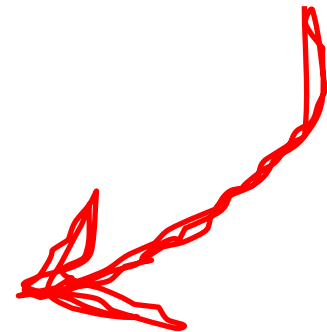
Home



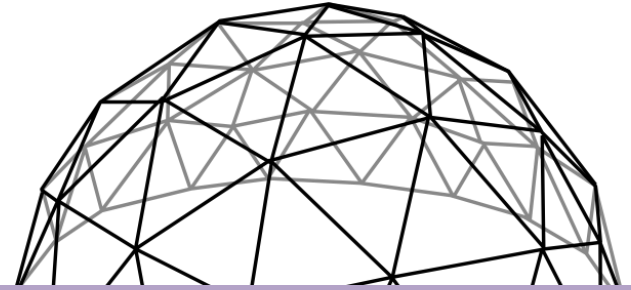
After school



School







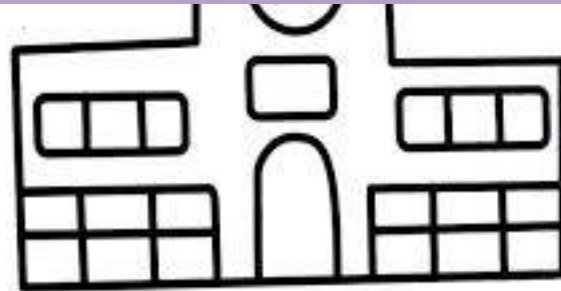
**Technology alone...**

Home

**Information  
Flow  
Practices**

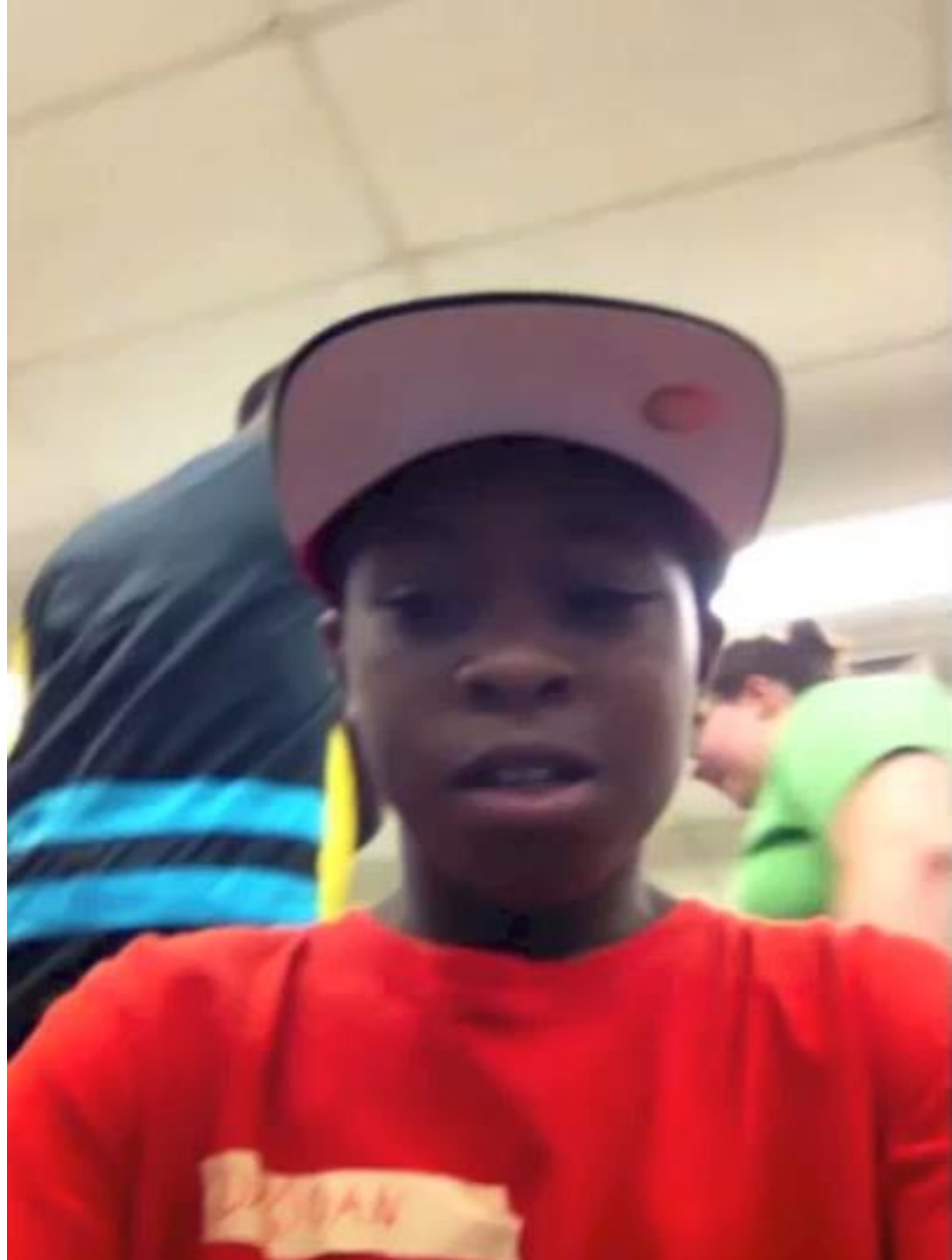
After school

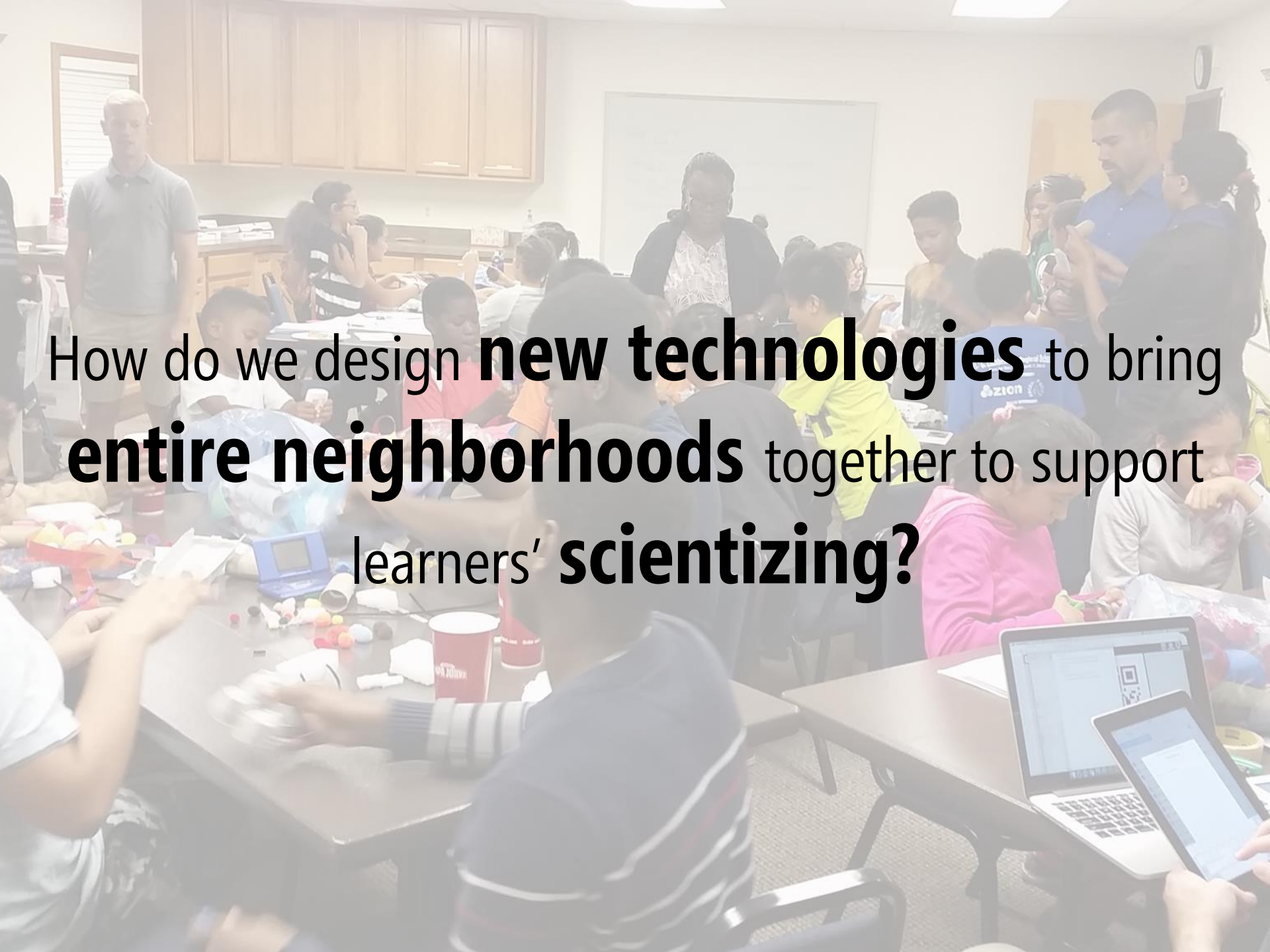
**is not enough**



School

**Social media** can  
make resources  
**visible**





How do we design **new technologies** to bring **entire neighborhoods** together to support learners' **scientizing?**



Maryland

Seattle



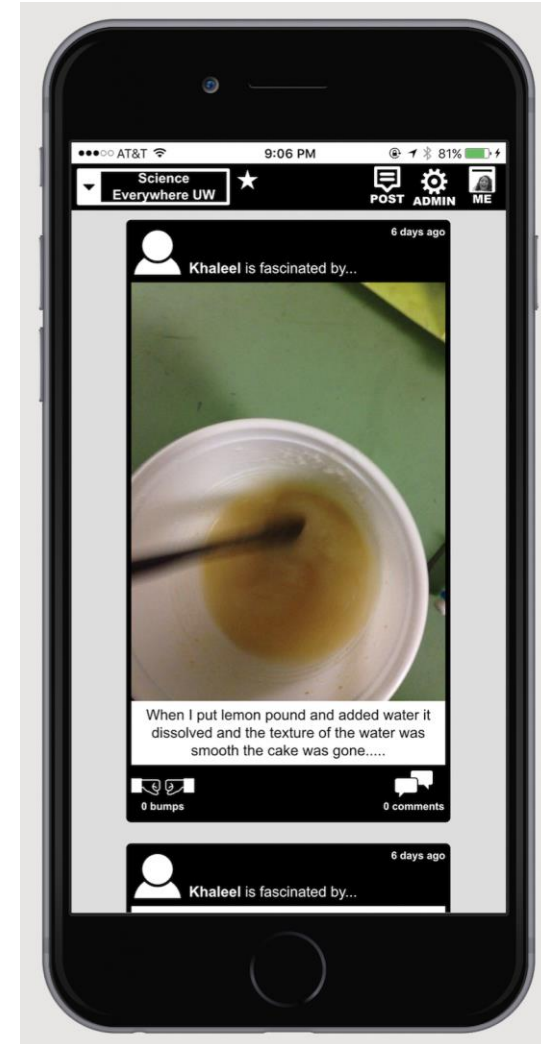
**Home**

**School**

**Community**



Tangible, community displays



Mobile social media



Miguel

17 days ago

EVERYONE, can you please lend me your help on a good science project idea. I need one for my science (stem) fair



5 bumps



4 comments



Hi Miguel, you could do a project on air plane designs!!!



EDIT

What a great question, Miguel!! I have a couple of ideas - wanna talk about it on Thursday? Or, if you like, go to the website, [sciencebuddies.org](http://sciencebuddies.org) and it has lots of ideas!!



Sciencebuddies.org is a really good website that is were I got all my science projects from 😊



EDIT

Cool, Mary That's awesome!! 😊😊



tap to edit comment

# Community Middle School

## Home

# Science Everywhere Program

# Science Everywhere App

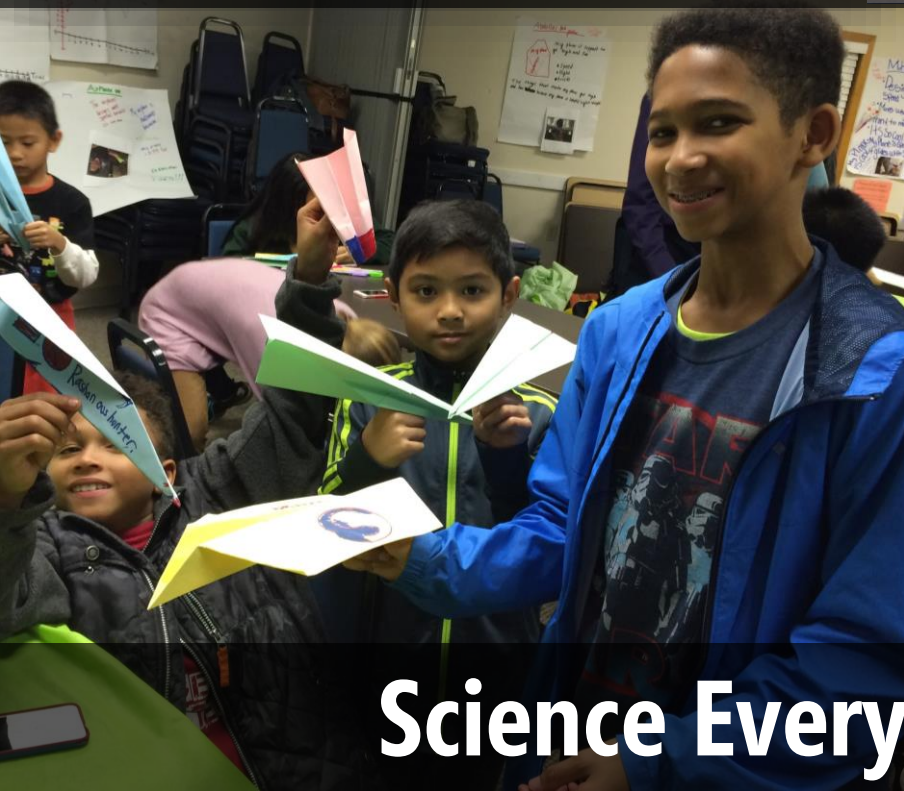




Kitchen Chemistry



\* Engineering \* Fun



Science Everywhere Meetings





# Design Sessions and Parent Workshops



**Children \* Parents \* Teacher**



researchers facilitators

science teacher



30-35 youth

Public school

Ages 6 – 16

**Science Everywhere Community**

# **Preliminary Findings...**



What are the **opportunities** and **challenges** of leveraging **social media** to support **scientizing** across contexts?

1 February 2016

EDIT Alexia




Planting Zinnias at homework club.

5 bumps 1 comment

27 February 2016

Patience is wondering about...



Does the brown part of the banana make it sweeter?

2 bumps 2 comments

16 February 2016

Kristen



How dose eggs come to have a different texture when put together with oil,salt,and heat

3 bumps 2 comments

15 February 2016

EDIT Malcom

I wonder if you place something outside under the sun will it affect the way it looks/taste?! 🤔

4 bumps 2 comments

# Opportunity

New contexts for recognizing science





# Extending Science Everywhere Experiences

5 days ago



Kara



The gravel truck broke the side way but in last picture at least i still have a chunk of it until my dad coverd it with stuff they used for roads



4 bumps



2 comments





# Challenge

**After-school facilitators and parents need help promoting scientific practices and skills**



“First try at the rock candy. If u put it in the freazer does it effect how it form than if u just leave it out? 🤔”

Text Speech

Emojis



Joanna

22 October 2015



We post it to much for us

3 bumps

0 comments

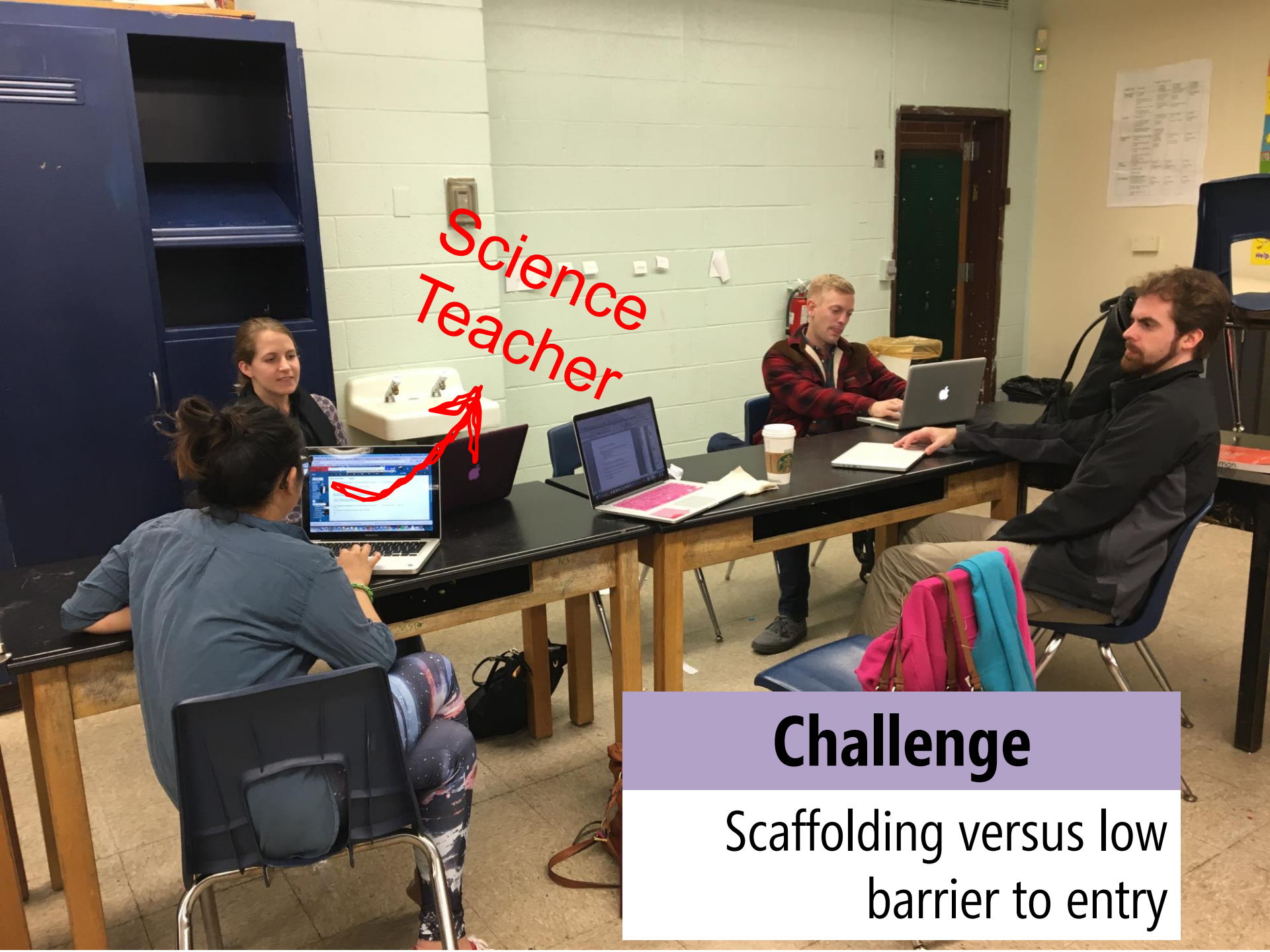
“We post it to much for us”

# Ill-formed Exploratory Science



22 October 2015





Science  
Teacher

## Challenge

Scaffolding versus low  
barrier to entry

2119 A

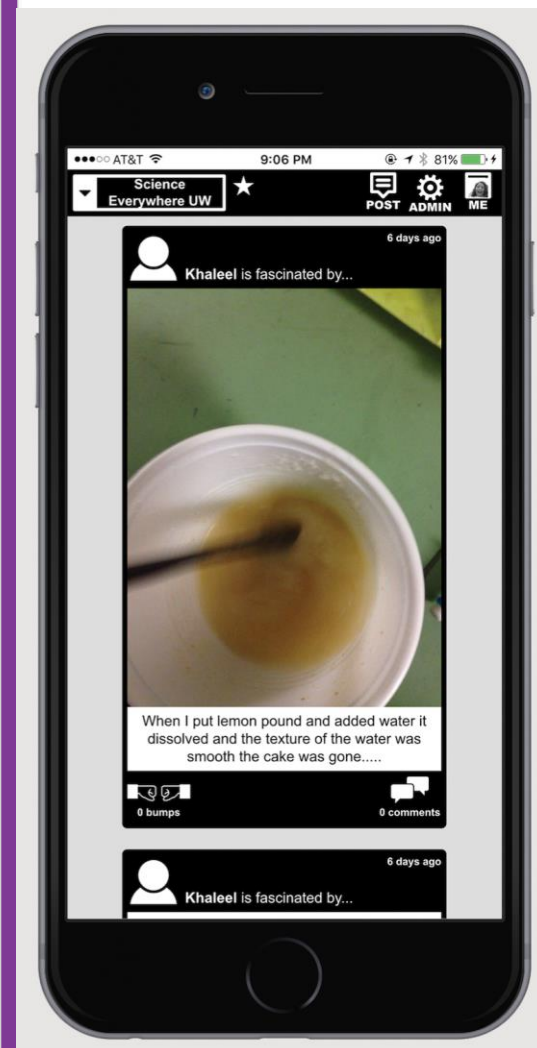
# Challenge

Getting parents and mentors engaged with children's posts






Tangible, community displays



Mobile social media








**TAMMY CLEGG**  
noticed...



Poster collaboration

Poster scarf is awesome. I'm jealous.

Lisa is wondering about...  
What's the fastest track record set here at tufts?




Ariel is fascinated by...  
Instant hand sanitizer

June is wondering about...

Linking to this event



Elizabeth  
How do ultrasounds measure blood flow and help doctors find blood vessel blockages?




Elizabeth  
The third rail on the Boston "T". I wonder how it powers the train?



Elizabeth  
How do people plan subway routes...?



Jason realized...  
Researchers in design workshops are fun



Iulian is fascinated by...

tests



Ruohan  
Science everywhere!!!




Victor

# Scientizing Framework

## The Four Building Blocks

### Seamless Scientizing



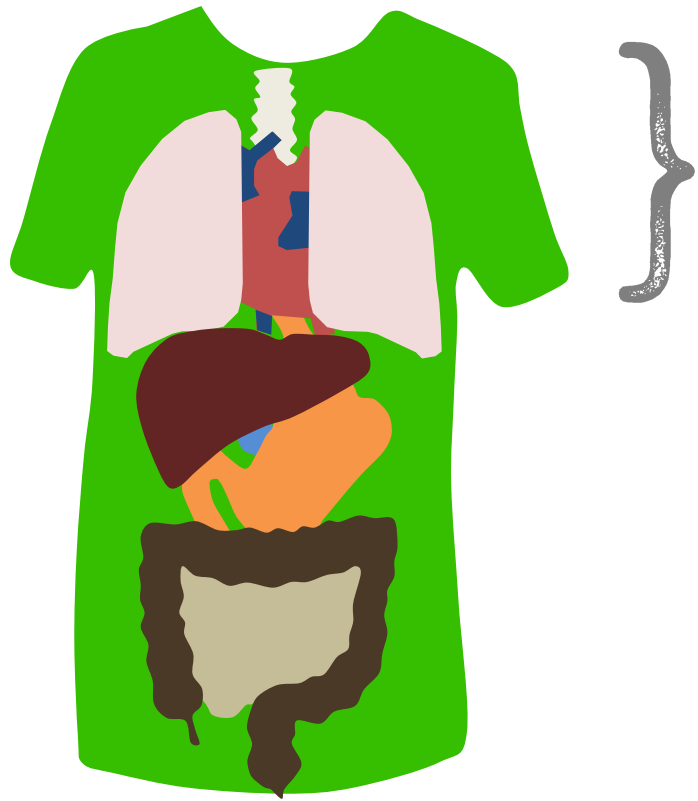
Mobile, social, ubiquitous

### Scientizing the Body



Wearables

Future Work



What if our clothes revealed how our body's **functioned**?

How could this **change** the way **children learn** about and understand their bodies?

Could a t-shirt be a **platform** for **experimentation** and **inquiry**?

# Live Physiological Sensing & Visualization

LPSV





Angelisa Plane



Amy Green



Vanessa Oguamanam \* Seokbin Kang



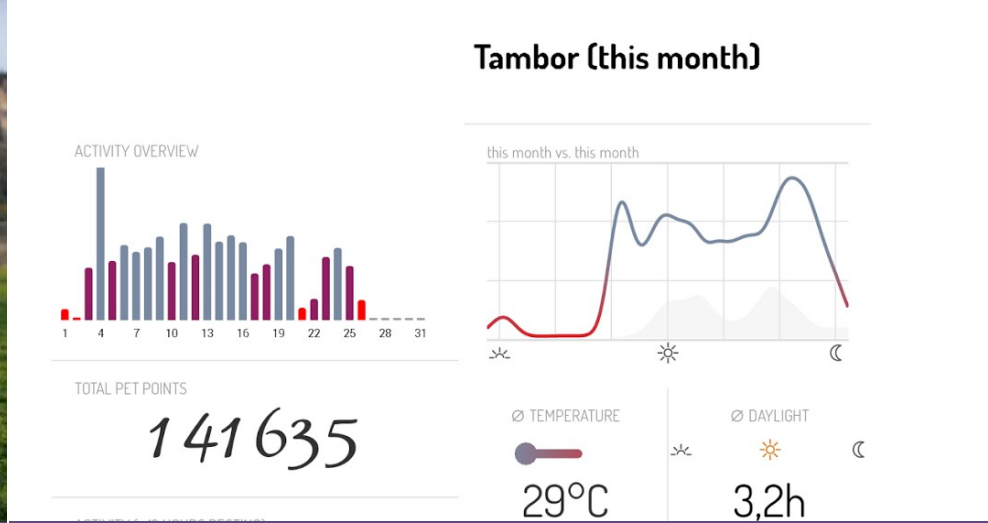
Leyla Norooz

# BodyVis Team



A young woman with long brown hair and a pink shirt is looking at a mannequin wearing a green long-sleeved shirt. A young man with dark hair and a blue shirt is looking at the mannequin. The background shows a window with a view of a building and a white curtain.

How can **LPSV tools** support **life-relevant, collaborative** STEM learning experiences for youth?



Sports

Math Analysis

# Personal Relevance

Lee, 2015







## Games



## Personal Health

# Personal Relevance

Carter Ching, 2015; Xu et al., 2012

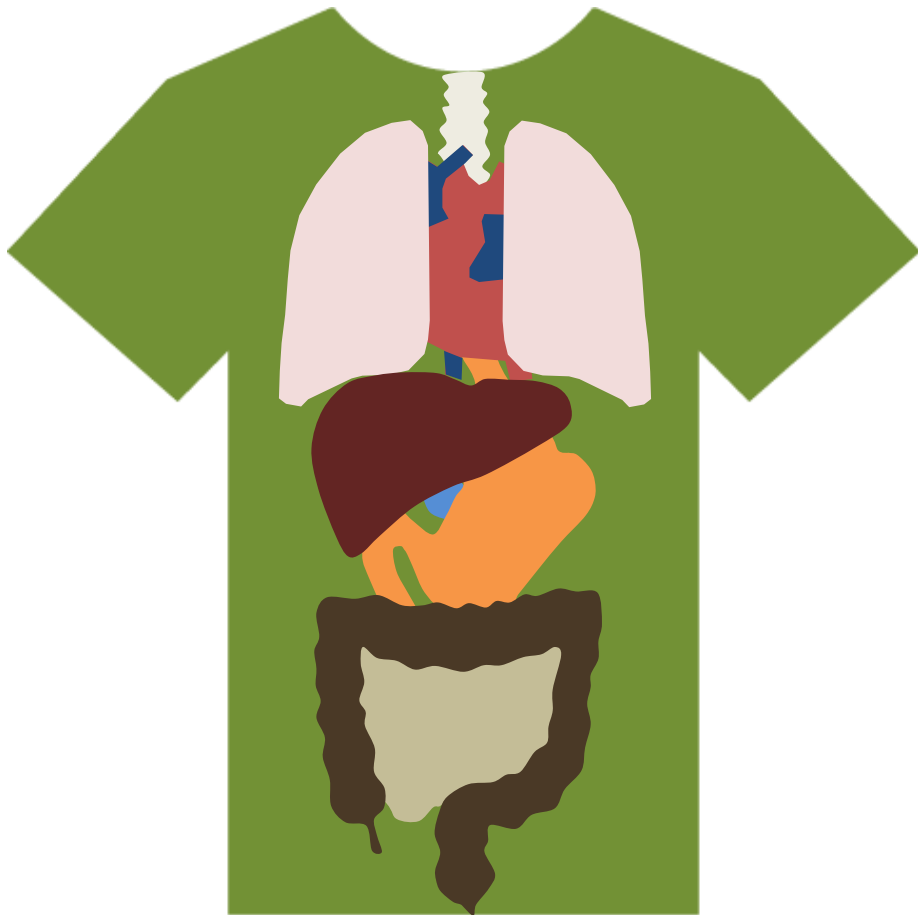
# Collaborative Inquiry



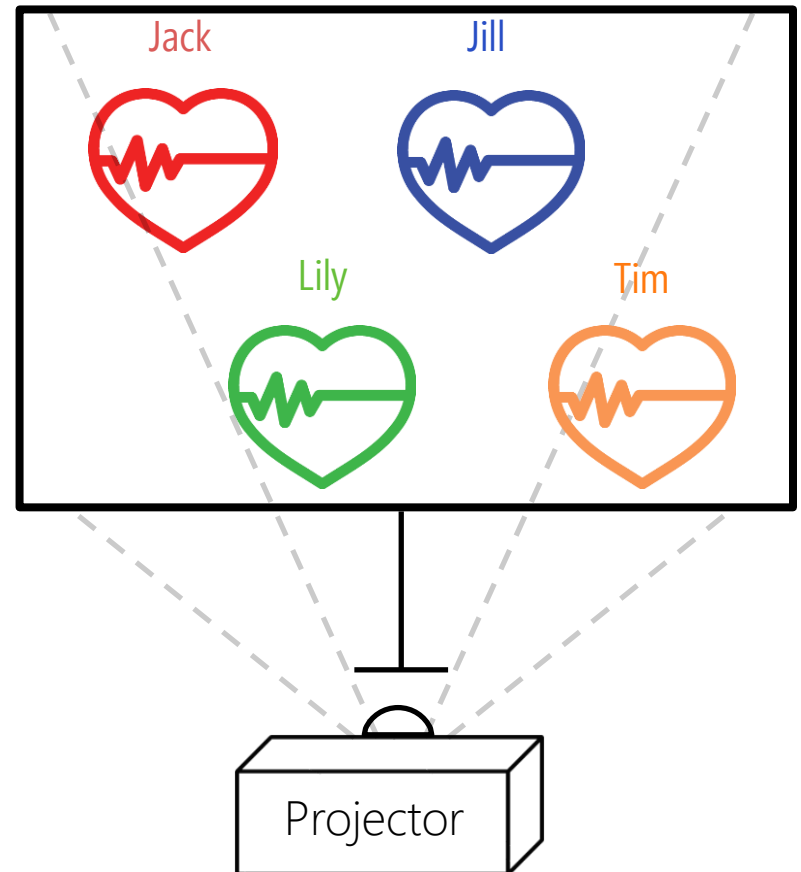
# Collective Inquiry

# LPSV Tools

BodyVis



SharedPhys



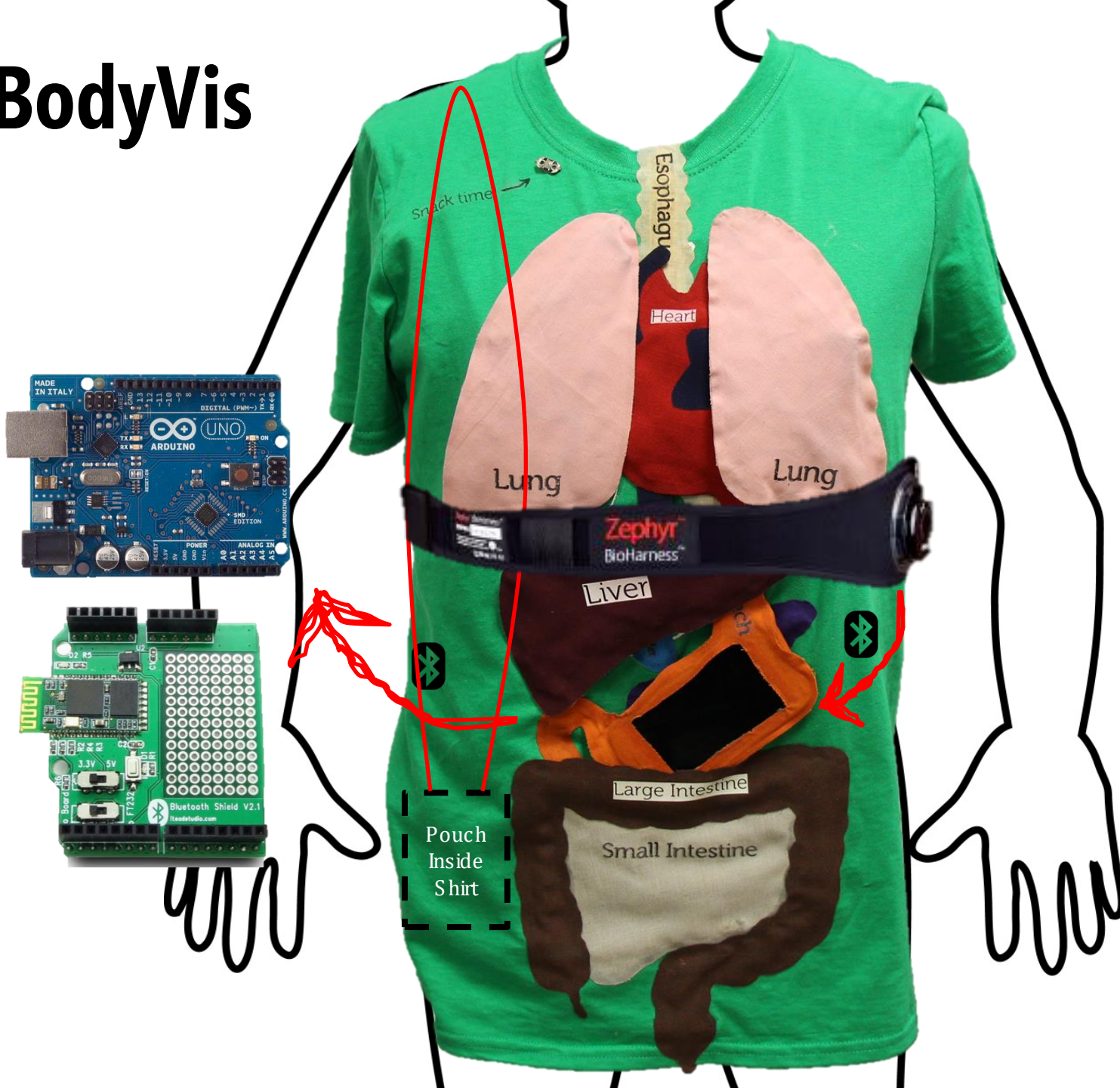


A group of children are sitting on a carpeted floor, engaged in a hands-on design activity. They are using various materials like cardboard, plastic, and markers to create prototypes. One child is writing on a large sheet of paper. The paper has handwritten notes and diagrams. The notes include 'Lungs inflate + deflate can show big & small breaths' and 'Small in to function as roller coast'. There are also drawings of a fan-like structure made of cardboard and a structure made of plastic and yellow material.

# Participatory Design with Children

Druin, A.

# BodyVis







The heart and lungs visualize wearers' live heart and breathing rate.



Does not support  
**comparison** across learners

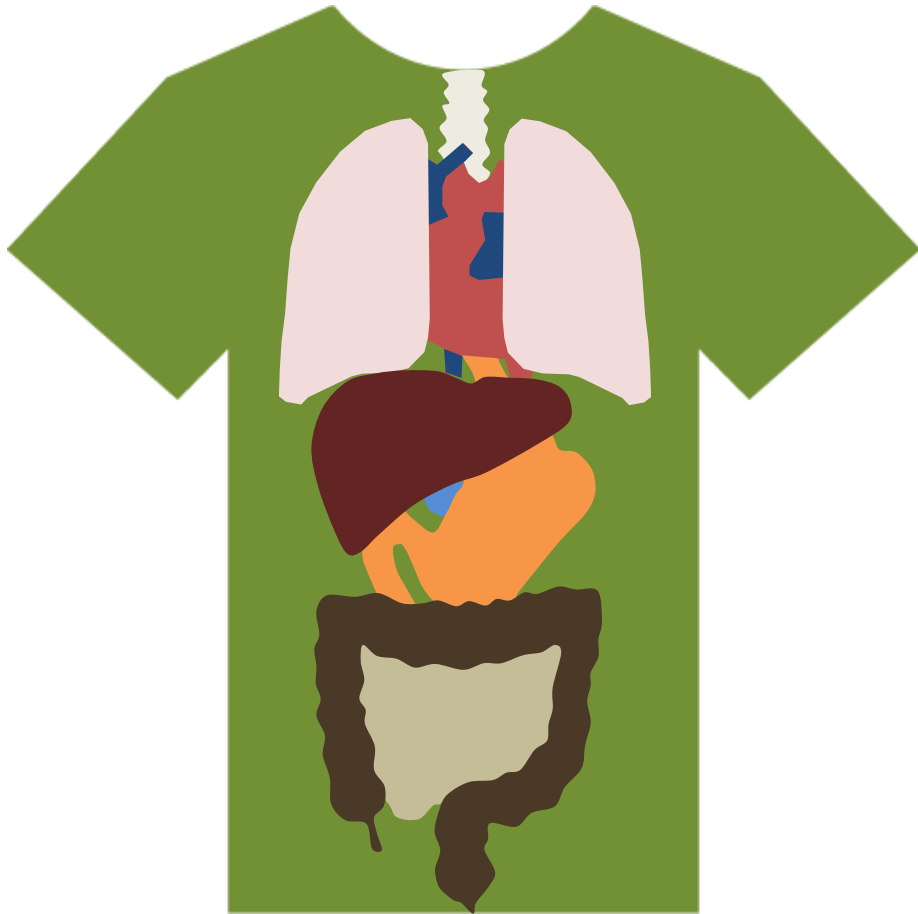
Need more support for  
quantitative **analysis**

Hard to see data **over time**

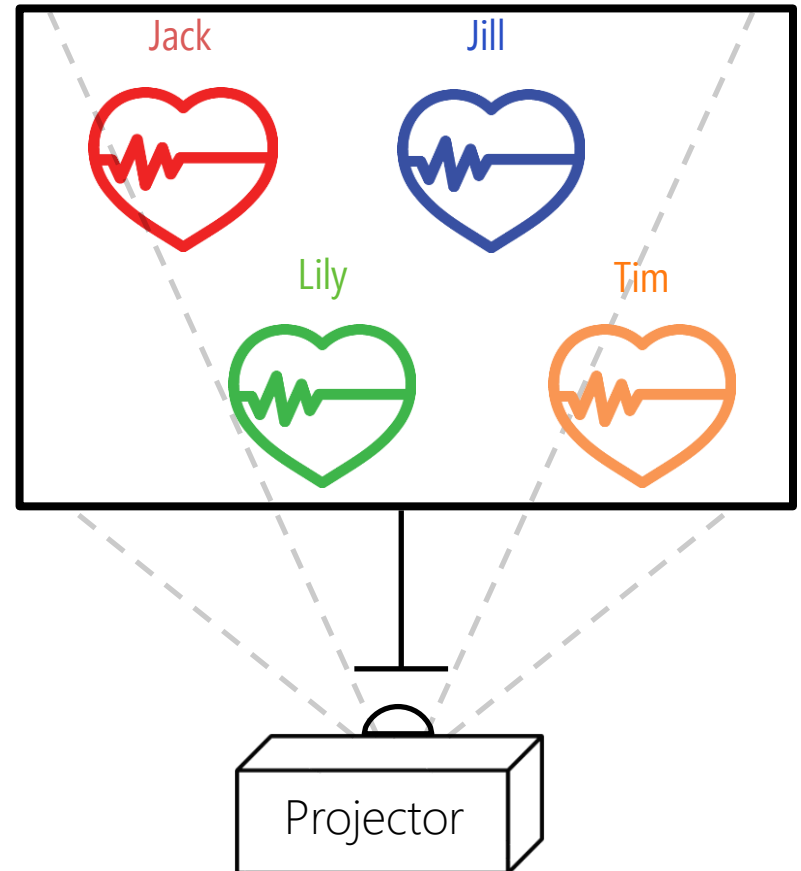
Limitations

# LPSV Tools

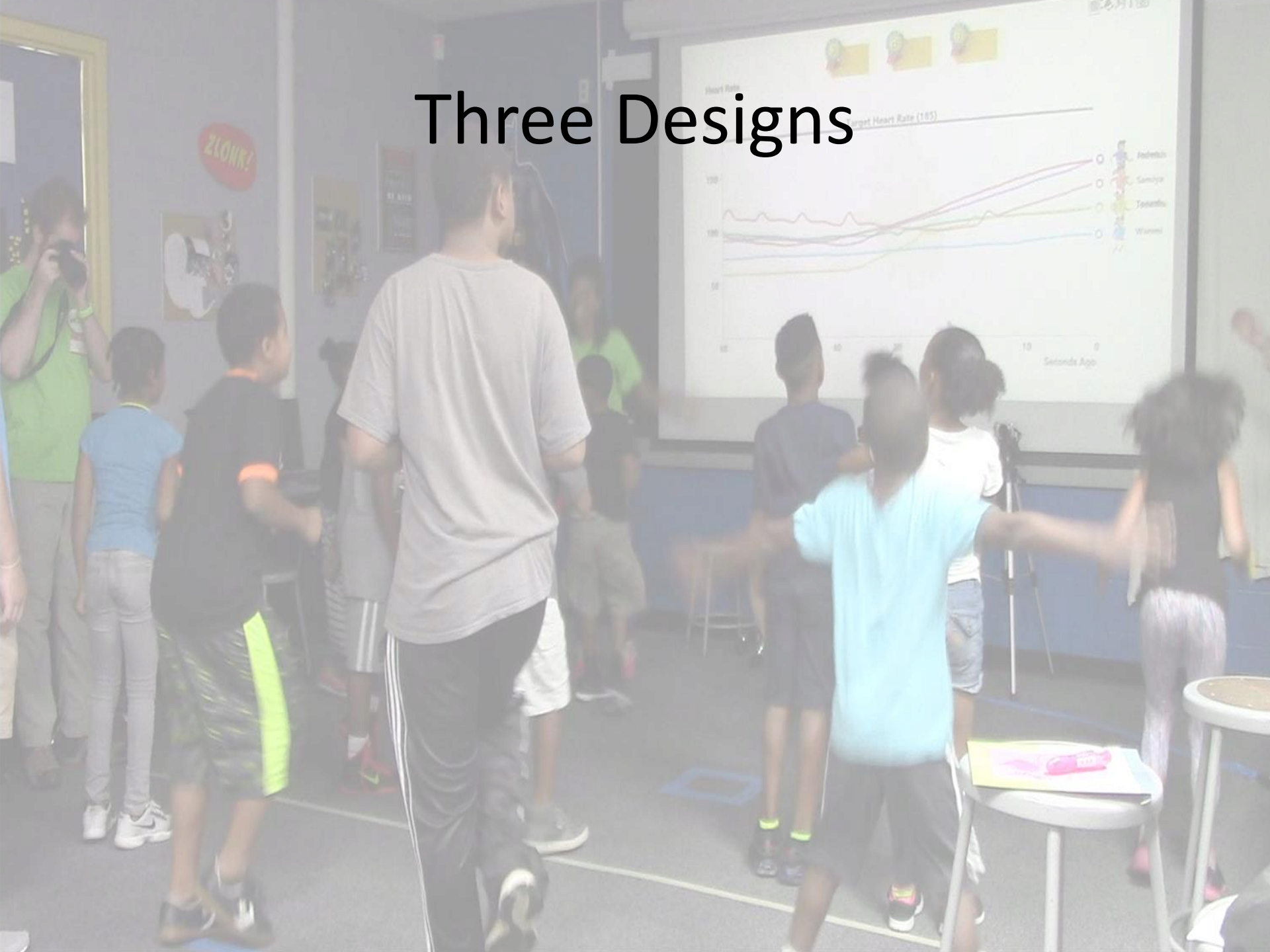
BodyVis



SharedPhys



# Three Designs





# Three Designs

## Magic Mirror

Basic human **physiology & anatomy**

## Animal Avatar

Structures and processes **across animals**

## Moving Graphs

Relating **health and human activity**

# Three Designs

## Magic Mirror

Basic human  
**physiology &  
anatomy**

## Animal Avatar

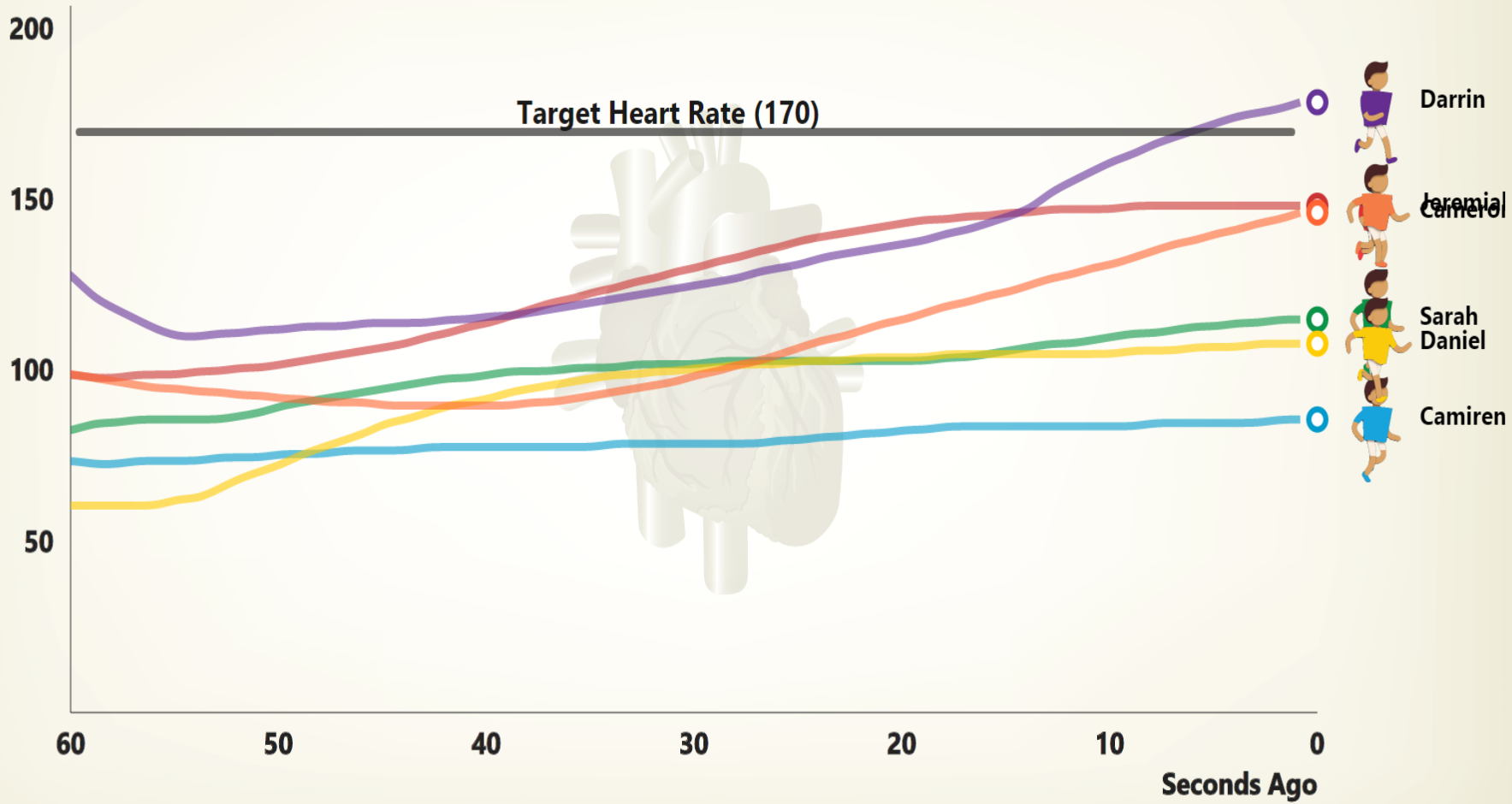
Structures and  
processes **across  
animals**

## Moving Graphs

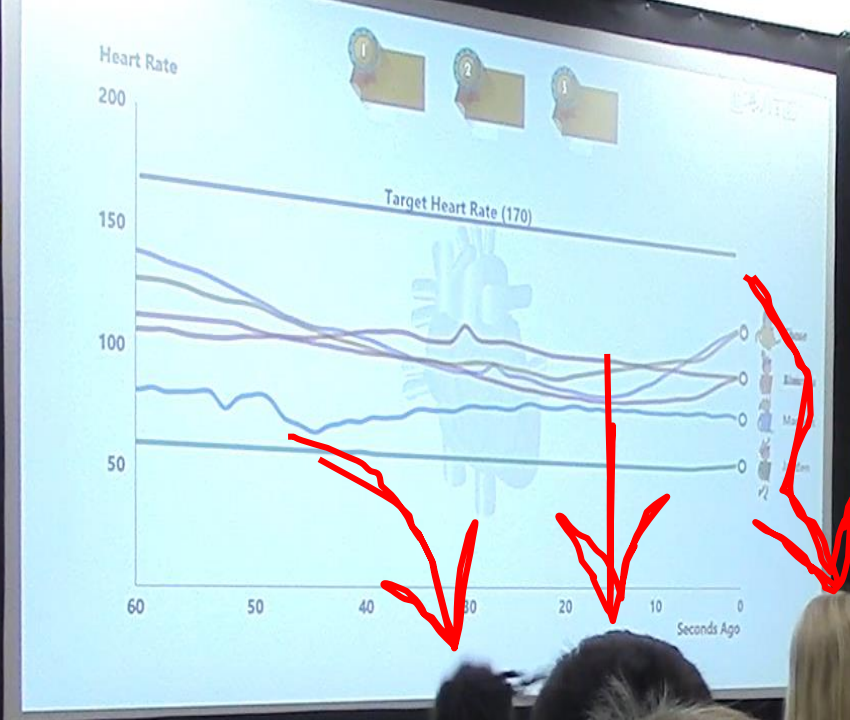
Relating **health and  
human activity**



# Heart Rate

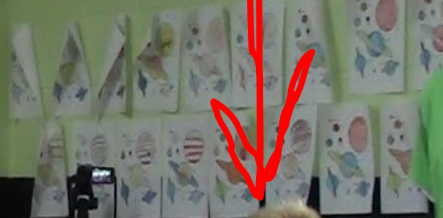
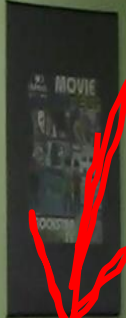






MARTIAN MONDAYS

ENGINEERING DESIGN PROCESS CASE STUDY



# Moving Graphs



# Collective Inquiry

*Evo Room*

Collaborative Negotiation

Work toward common goal

Building on ideas

Community Knowledge base



# Activity Design

Participatory Design

## Goal

To collaboratively design learning activities that utilized our LPSV tools

# Activity Design

## Participatory Design

**Children**



# Activity Design

## Participatory Design

**Children**



**Teachers**





# Activity Design

## Participatory Design



# Activity Design

## Participatory Design



# Learning Activities



Small groups or pairs  
brainstorm activities



Make  
predictions



Test with BodyVis or  
SharedPhys



Discuss  
results



# Sessions

**BodyVis**

**SharedPhys**

# Sessions

BodyVis



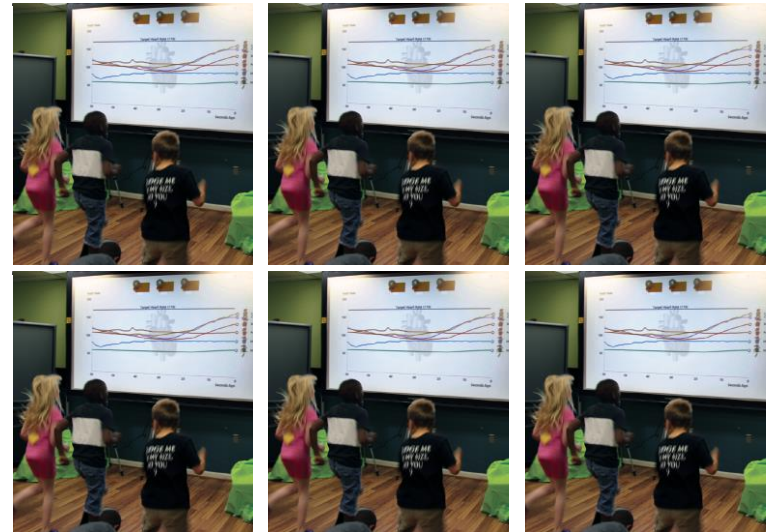
SharedPhys

# Sessions

## BodyVis



## SharedPhys



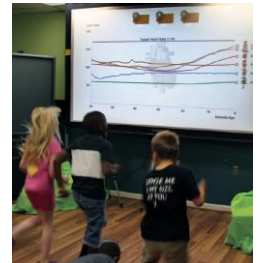


# Sessions

Joint 2<sup>nd</sup> and 3<sup>rd</sup> grade  
private school classroom



Out of school programs (Boys &  
Girls Club)



# Participants

BodyVis

SharedPhys

# Participants

## BodyVis

6-13

Ages



34 Male

61

Participants



27 Female

## SharedPhys

5-13

Ages



42 Male

69

Participants



27 Female



**Findings...**

# Findings

Life-  
relevance

Collaboration

# Findings

Life-  
relevance

Collaboration



# Life-Relevance



Utilizing everyday activities to form hypotheses

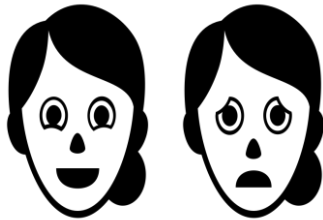
# Life-Relevance

**BodyVis**

**SharedPhys**

# Life-Relevance

BodyVis



Emotion →  
Physiology

SharedPhys



“

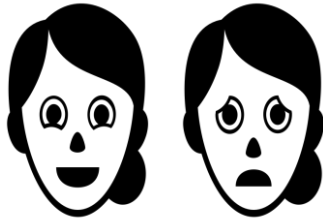
I kind of felt embarrassed because all these people were staring at me. So it kind of went up.

”



# Life-Relevance

## BodyVis

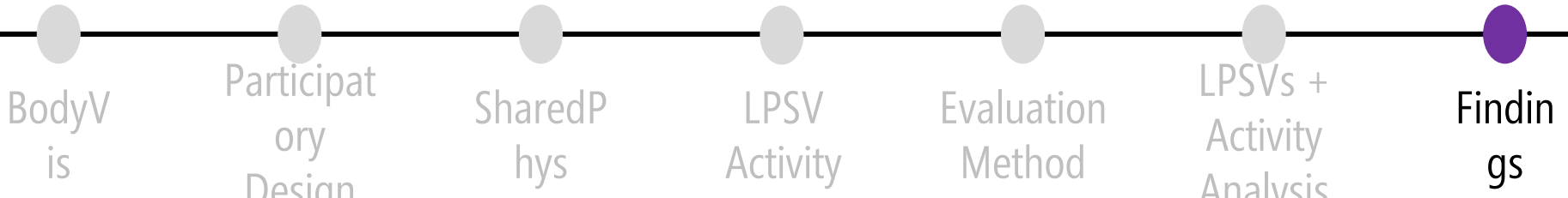


Emotion →  
Physiology

## SharedPhys



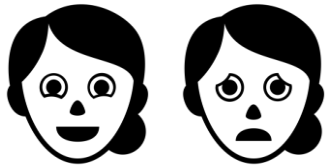
Connection  
between bodies  
& visualization





# Life-Relevance

## BodyVis



Emotion → Physiology

## SharedPhys



Connection between  
bodies & visualization



Games and  
competition







# Findings

Life-  
relevance

Collaboration

# Collaboration



Discussing proposed activities – unknown category

# Collaboration

**BodyVis**



Discussing causes  
after each activity

**SharedPhys**



[You are] using so much muscles. Your head is going that way, your arms are going this way. So you're using too much energy.



BodyVis

Participatory Design

SharedPhy  
s

LPSV Activity

Evaluation Methods

LPSVs + Activity  
Analysis

Findings



# Collaboration

## BodyVis



Discussing causes  
after each activity



Changing  
predictions during  
discussion

## SharedPhys

# Collaboration

## BodyVis



Discussing causes after each activity

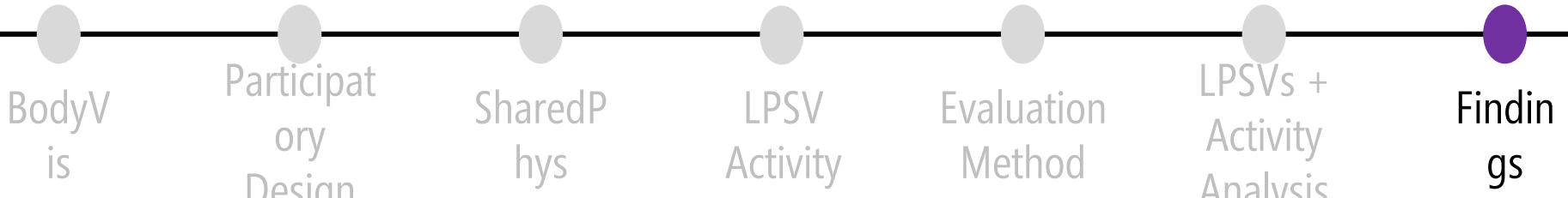


Changing predictions during discussion

## SharedPhys



Conversational collaboration between non-wearers





# Collaboration

## BodyVis



Discussing causes after each activity



Changing predictions during discussion

## SharedPhys



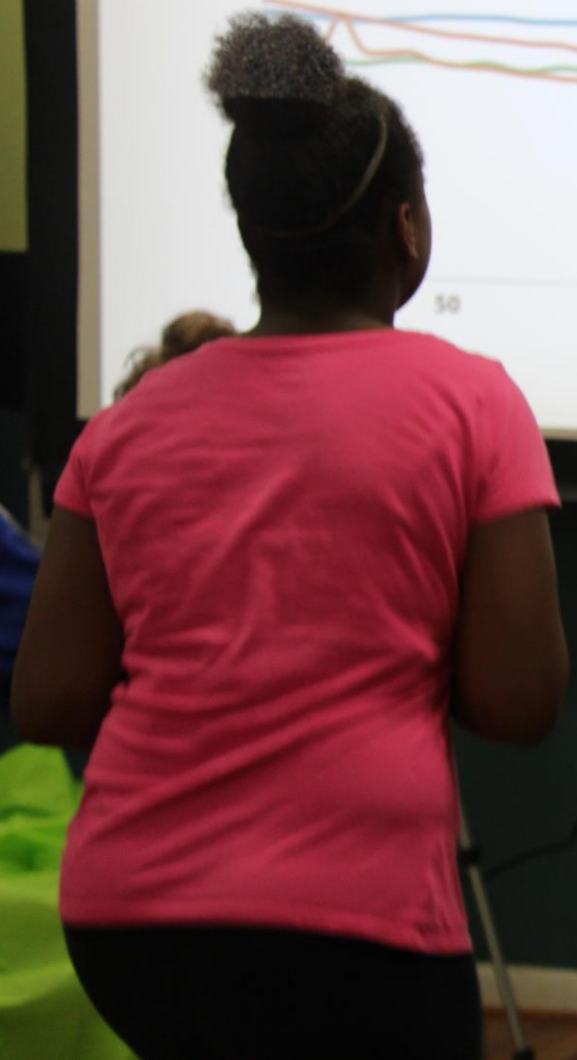
Conversational collaboration between non-wearers



Collaboration through physical action







A young woman with long brown hair and a pink shirt is looking at a mannequin wearing a green long-sleeved shirt. A young man with dark hair and a blue shirt is also looking at the mannequin. The background shows a window with a view of a building and some indoor plants. The text is overlaid on the image.

How can **LPSV tools** support **life-relevant, collaborative** STEM learning experiences for youth?



# Personal Relevance



# Personal Relevance

Connecting **everyday physical activities** to organ function





# Personal Relevance

Connecting **everyday physical activities** to organ function



# Personal Relevance

Connecting **everyday physical activities** to organ function

Connecting **social & emotional** factors





# Personal Relevance

Connecting **everyday physical activities** to organ function

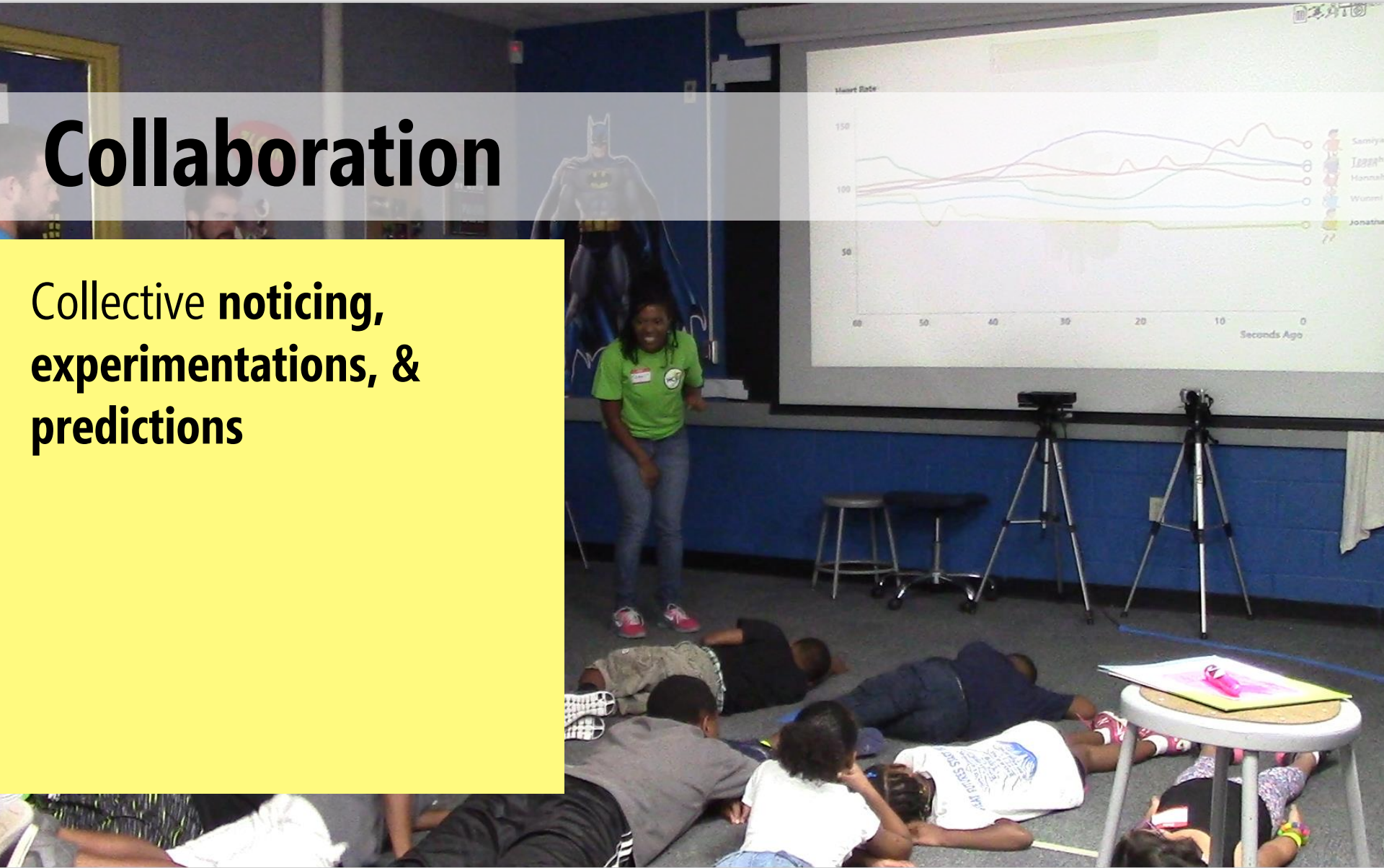
Connecting **social & emotional** factors

**Real-time visualizations**



# Collaboration

Collective **noticing,**  
**experimentations, &**  
**predictions**





# Collaboration

Collective noticing,  
experimentations, &  
predictions

Lee, 2015 &  
Lui et al., 2014



# Collaboration

Collective **noticing**,  
**experimentations**, &  
**predictions**

Collective **discussion**

*Lee, 2015 &  
Lui et al., 2014*





# Collaboration

Collective **noticing**,  
**experimentations**, &  
**predictions**

Collective **discussion**

Collective **physical activity**





# Social & Emotional Experiences





# Social & Emotional Experiences

Deeper understanding  
**beyond physiological  
concepts**



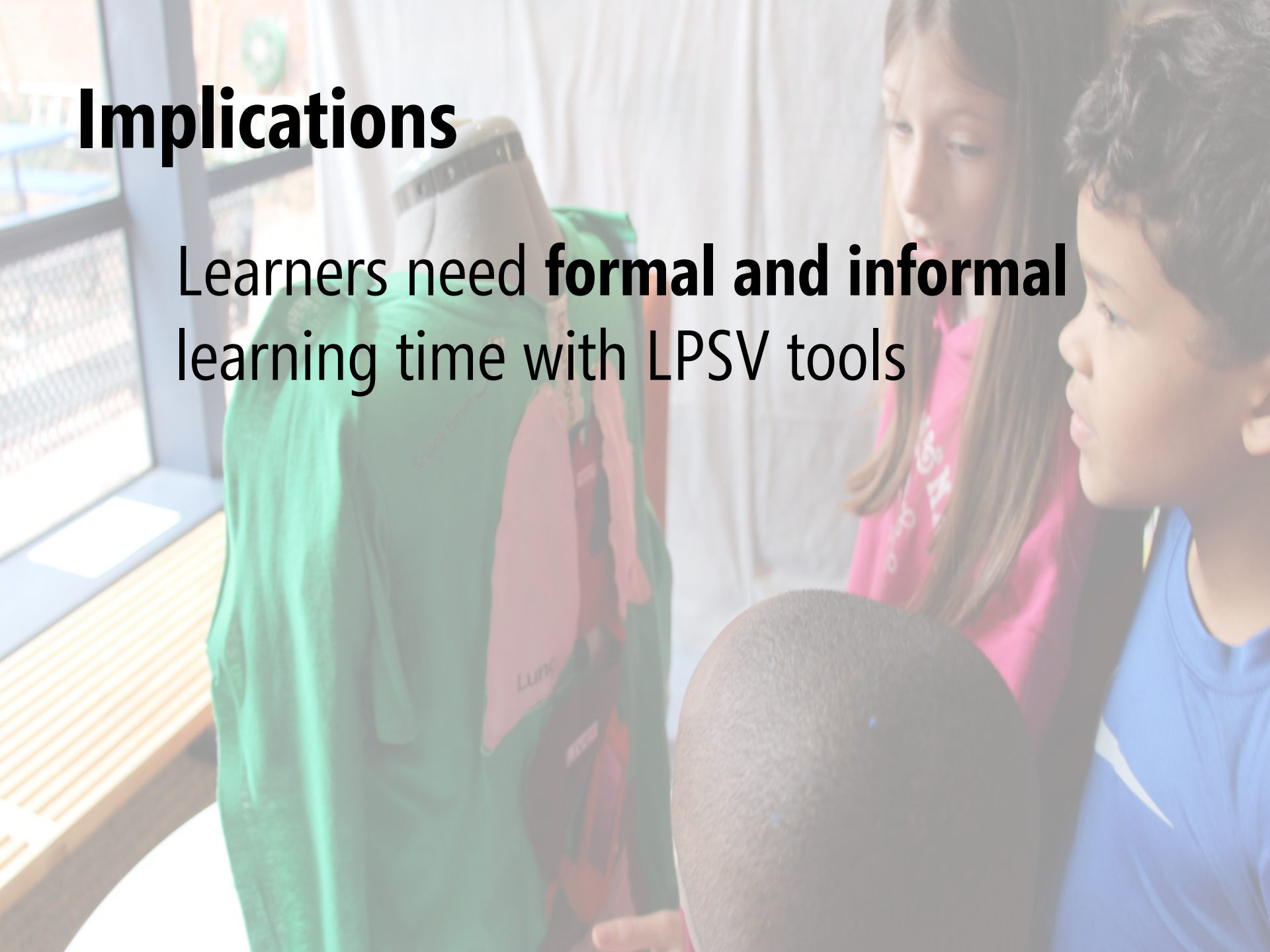
# Implications





# Implications

Learners need **formal and informal** learning time with LPSV tools



# Implications



Learners need **formal and informal** learning time with LPSV tools

Need opportunities to **wear & observe**



# Implications

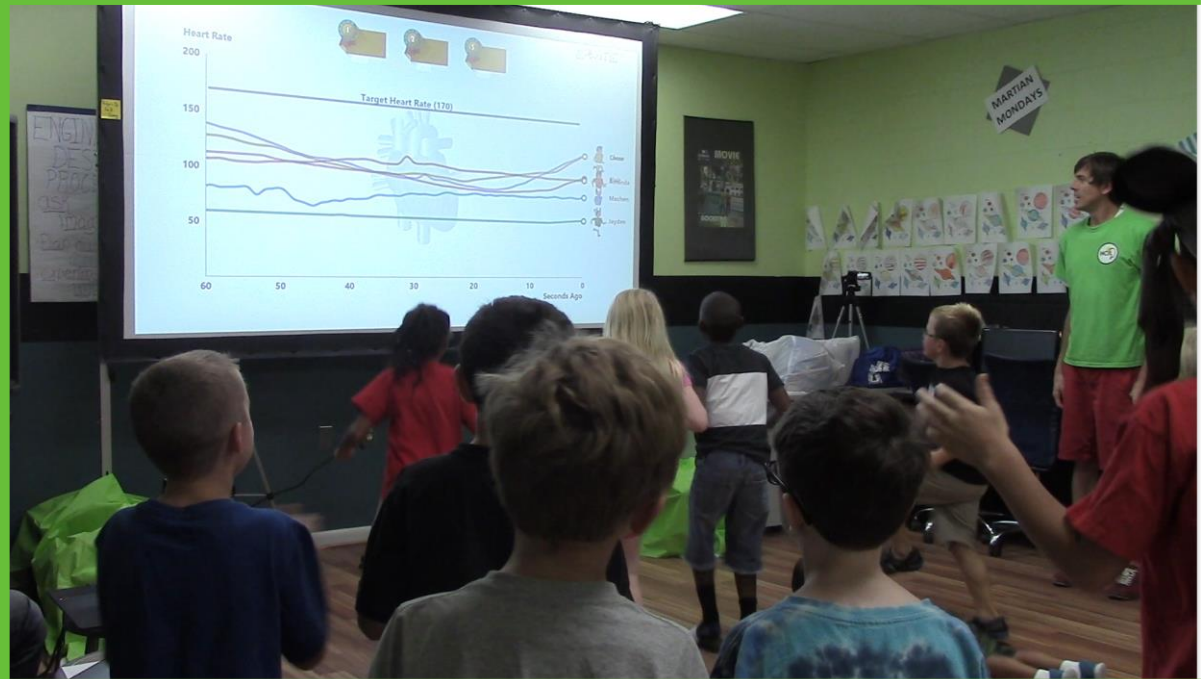


Learners need **formal and informal** learning time with LPSV tools

Need opportunities to **wear & observe**

Learning contexts should be **flexible**

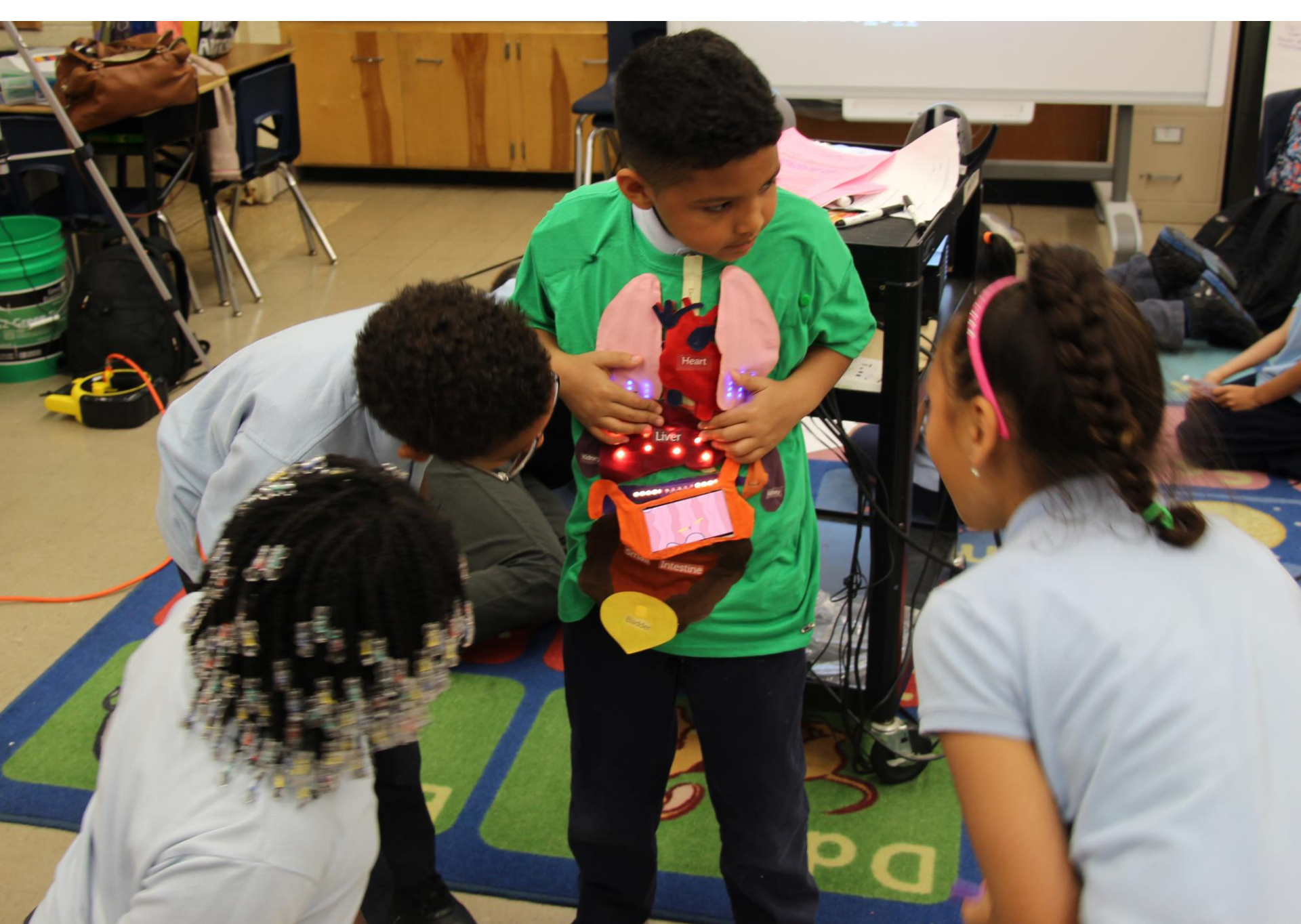




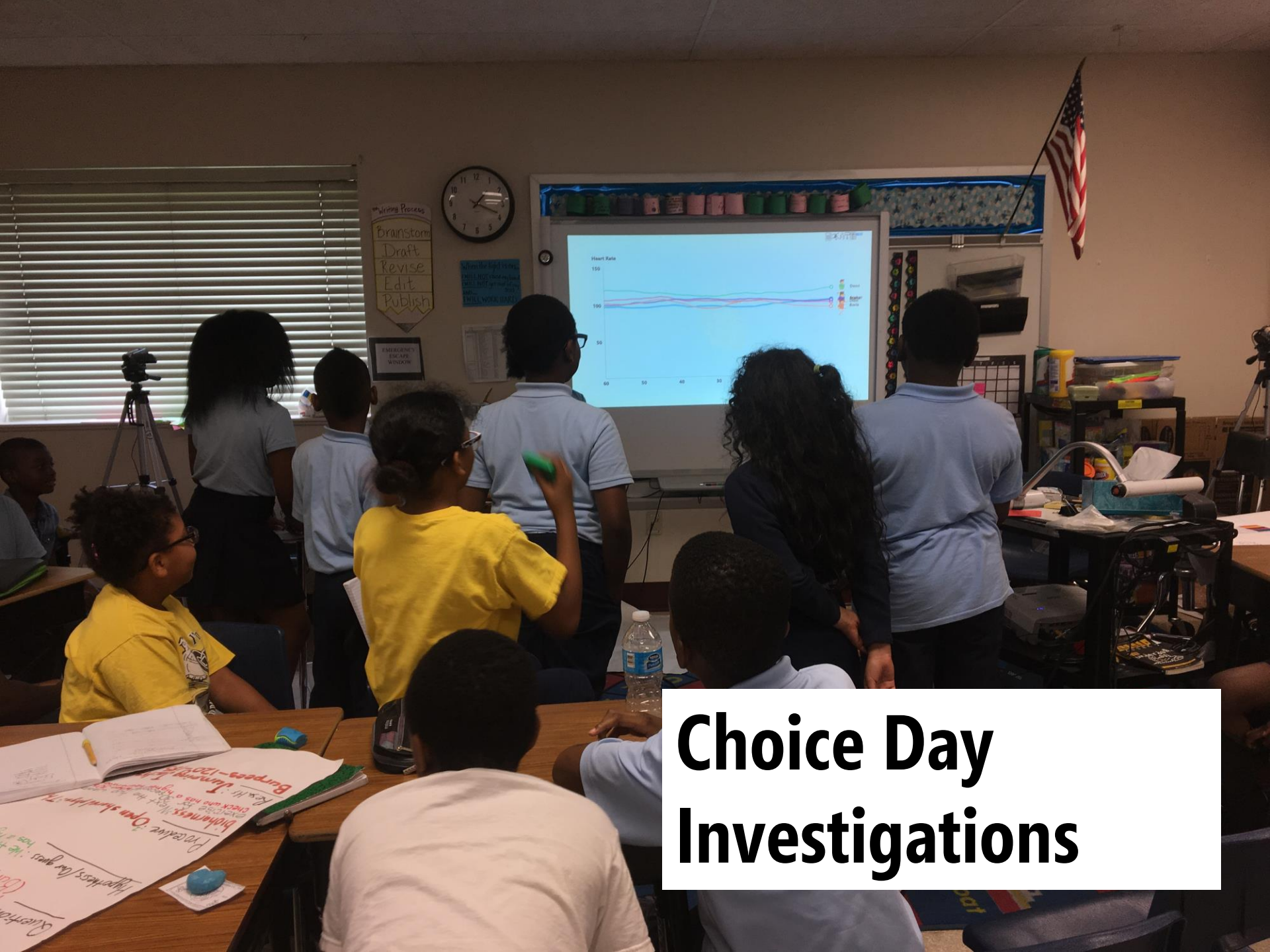
Multiple Session Deployment

Integrated use of tools

**Current Work**







# Choice Day Investigations

Scientific  
Hypothesis: As you...  
Procedure: Open...  
Hypothesis: ...  
Check who has a...  
Barbers-120...  
Know: ...



# Seeing the World through Scientific Lenses



Finding **practical**  
applications

Using Science to Achieve  
**goals**

**Scientizing** daily life activities

Church



POST



ADMIN



ME



I learned about the heart inside my body. The heart helps you pick up blood. I wonder if the heart helps you breathe



8 bumps



1 comment

# Complimenting Strengths

▼ Solid Rock

POST ADMIN ME



Watching the nba summer league second game brought my heart rate down after running because less blood must be pumped when I am just sitting down and not stressing my muscles and lungs by breathing hard and also the fact that the game was just summer league and not nba didn't stress me for my team to win.

5 bumps

1 comment



Solid Rock

POST ADMIN ME



Watching the nba summer league second game brought my heart rate down after running because less blood must be pumped when I am just sitting down and not stressing my muscles and lungs by breathing hard and also the fact that the game was just summer league and not nba didn't stress me for my team to win.

5 bumps 1 comment



Watching the NBA summer league second game brought my heart rate down after running because less blood must be pumped when I am just sitting down and not stressing my muscles and...



▼ Solid Rock

POST ADMIN ME



Watching the nba summer league second game brought my heart rate down after running because less blood must be pumped when I am just sitting down and not stressing my muscles and lungs by breathing hard and also the fact that the game was just summer league and not nba didn't stress me for my team to win.

5 bumps 1 comment

“

...lungs by breathing hard and also the fact that the game was just summer league and not NBA didn't stress me for my team to win.

”



**Science Everywhere**

NSF #1441523





# BodyVis Team

NSF #1441184

# Questions?







Participatory Design  
Method: Cooperative Inquiry





# Connecting Entire Neighborhoods



**Home**



**Middle School**



**Community**

# Participants

BodyVis

6-13

Ages



34 Male

61

Participants



27 Female

SharedPhys



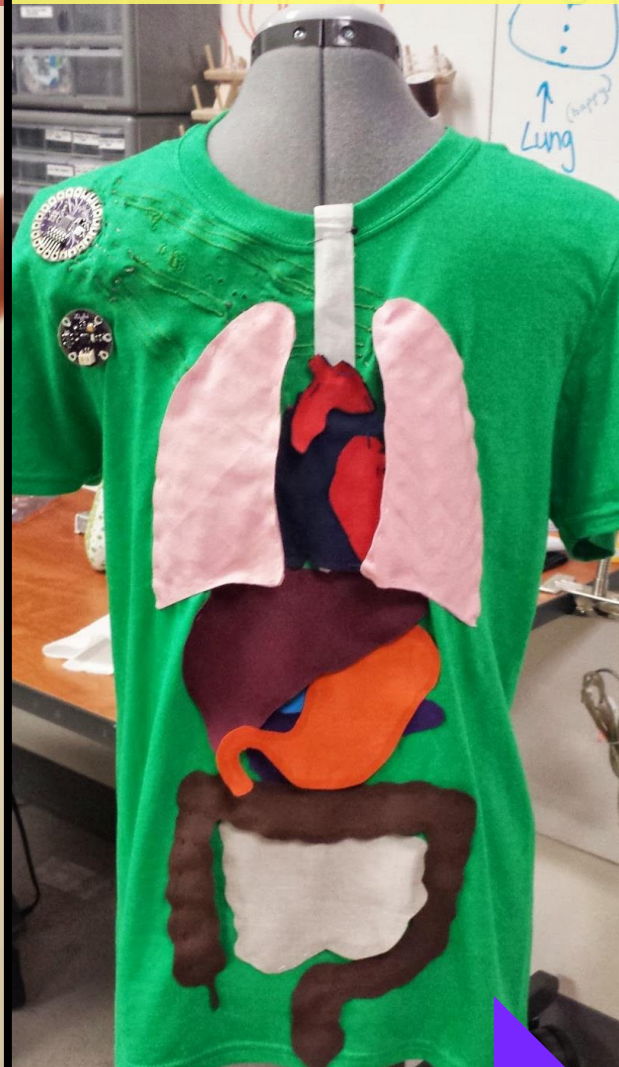
## Prototype 1

Plush, Colorful, Interactive



## Prototype 2

A New Lightweight Design



## Prototype 3

The Current Design



BodyVis: *Design & Evaluation*