MakerWear

EARLY EXPLORATIONS OF WEARABLE CONSTRUCTION KITS FOR CHILDREN

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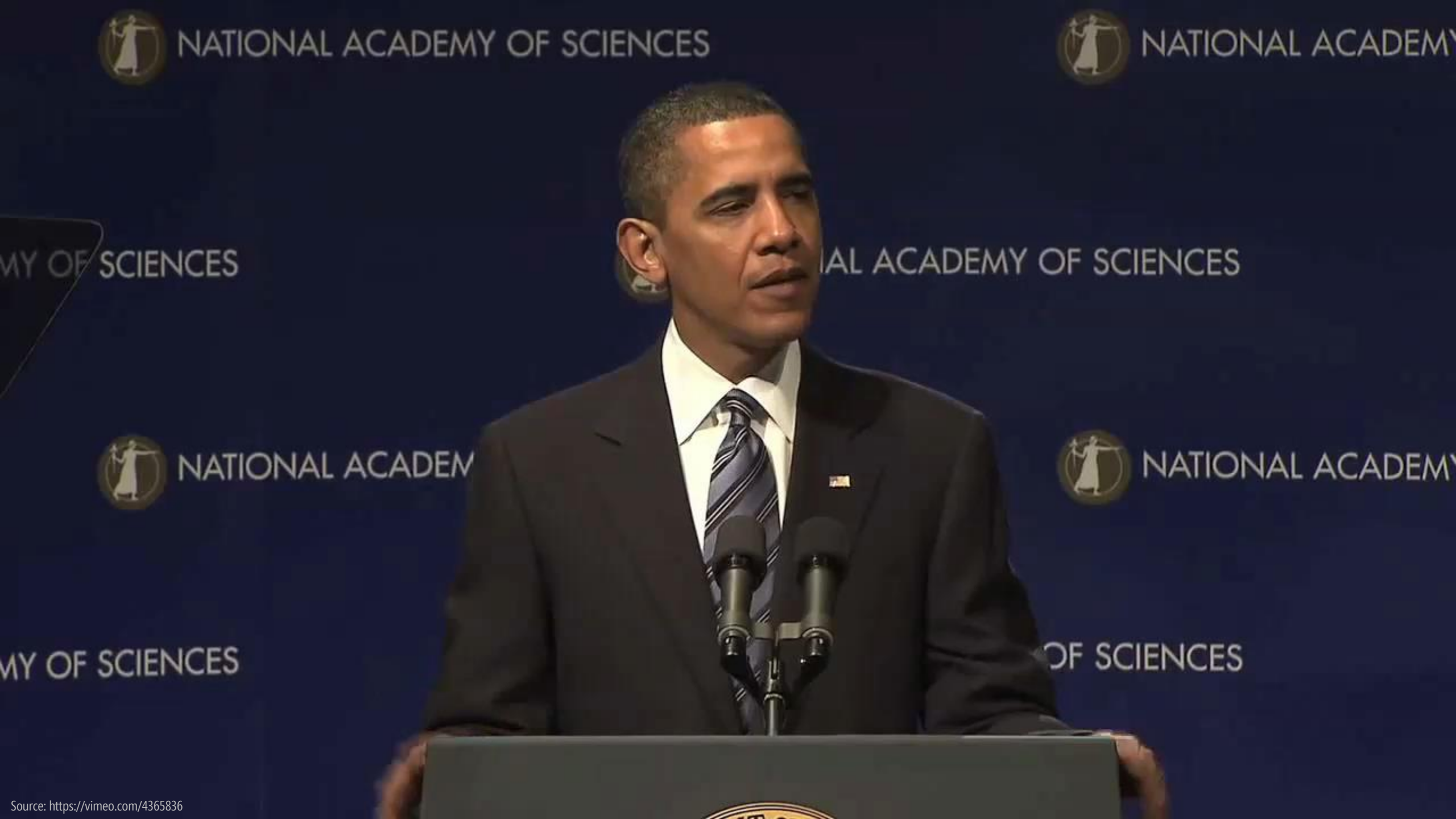


Source: https://vimeo.com/4365836

"...to be **makers of things**, not just consumers of things."

President Barack Obama

Remarks to the National Academy of Sciences, 2009

Source: https://www.whitehouse.gov/the-press-office/remarks-president-national-academy-sciences-annual-meeting

Research Vision

MakerWear

A new construction kit aimed at **enabling children** to **design** and build their own **interactive wearables**.

Research Vision

MakerWear

A new construction kit aimed at **enabling children** to **design** and build their own **interactive wearables**.

With only a **few components**, children can build a **wide range of designs**...

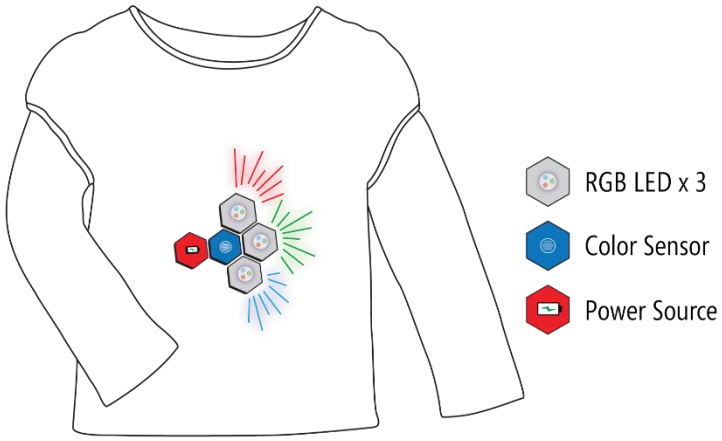






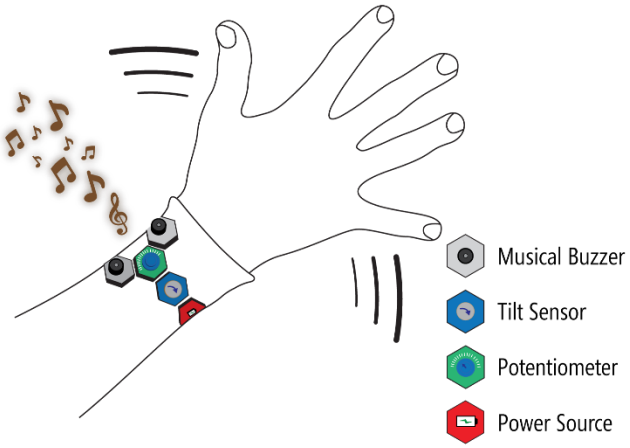
3 Simple MakerWear Examples

All built without the creation of code



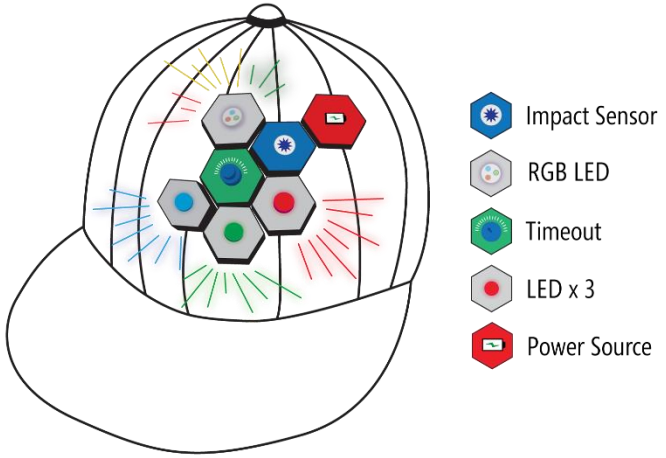
"Chameleon" Shirt

Shirt changes color based on color in environment



Musical Bracelet

Bracelet plays different tones based on arm movement



Light-Up Hat

Hat flashes various lights when wearer moves

Research Questions

How can we support **young children** and a **wide-age span** (ages 4-12) in the **creative design** of **interactive wearables**?

What do children **want to build** if given the opportunity?

Can MakerWear be an **introductory pathway to STEAM-related activities** like engineering, design, and computational thinking?

How can we design MakerWear to allow children to build designs that **integrate into their everyday life** (*e.g.,* soccer, theatre)?

Constructionism

Our research is rooted in **Papert's theory of constructionism**, which suggests a **strong connection between design and learning**.

Seymour Papert
MIT Professor
Pioneer of AI & new learning theories

Constructionism

Our research is rooted in **Papert's theory of constructionism**, which suggests a **strong connection between design and learning**.

The theory posits that '**remarkable learning**' occurs when **children** are **working** with **materials** to **design**, **create**, and **invent** external and **shareable artifacts**.

Seymour Papert
MIT Professor
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Design Inspirations

Design Inspiration

Light-Up Shoes

Children love light-up shoes

Interactive

Responsive

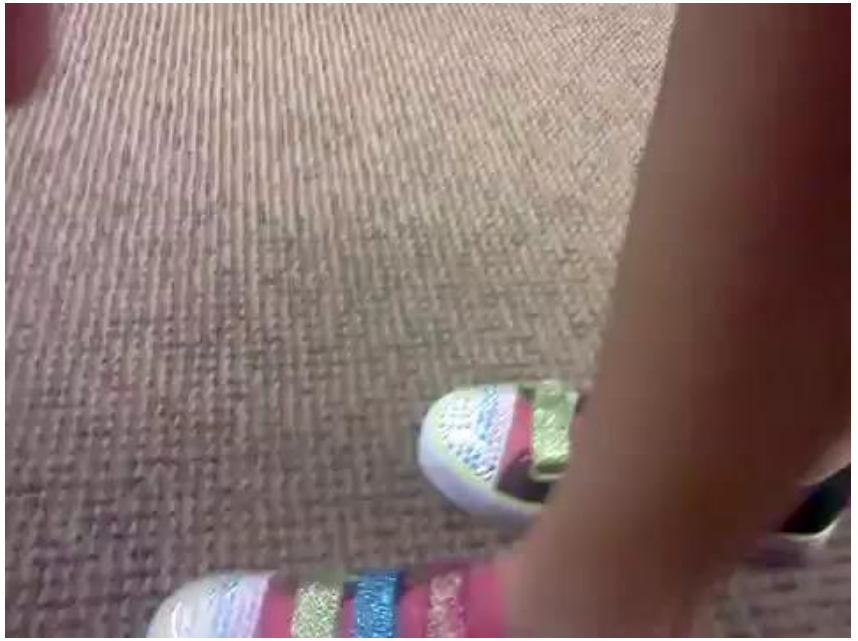
Expressive

Fun

Not modifiable

Not extensible

Not programmable



Design Inspiration

Fashion Customization

Children enjoy customizing their clothing, & collecting and sharing designs

Not interactive

Not electronic

Not programmable

Design Inspiration

Legos

Approachable

Interconnecting parts

Open-ended

Design Inspiration

Legos

Approachable

Interconnecting parts

Open-ended

Age target: 4-99 ☺

Design Inspiration

LilyPad Arduino

Incredibly successful e-textile microcontroller platform.

Open-ended

Programmable

Wearable

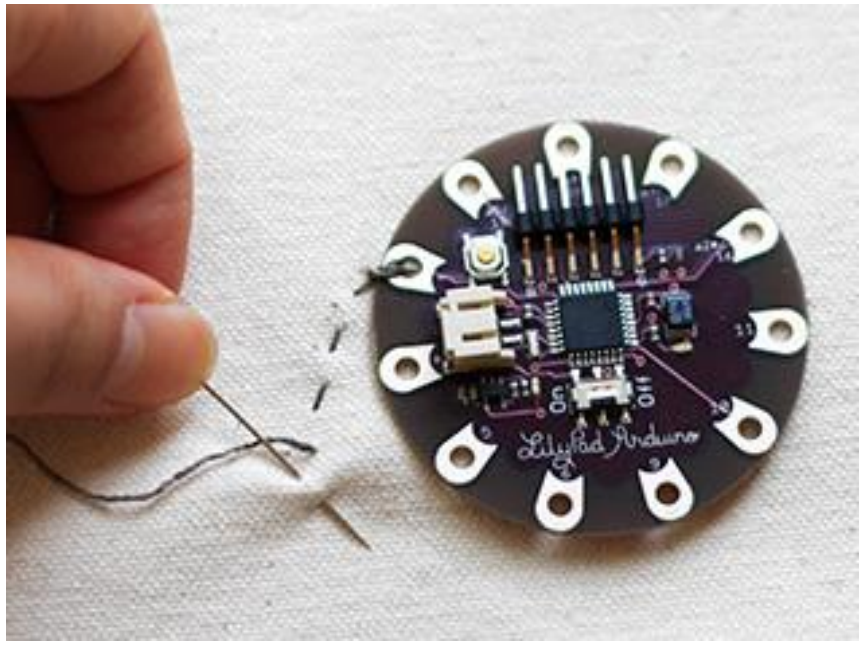
Broadens perceptions of computing

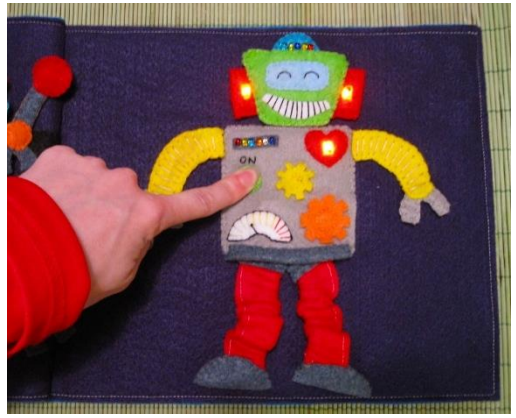
High barrier of entry

Not designed for children

Requires sewing

Hard to rapidly prototype & iterate





Source: Buechley *et al., CHI'08, DIS'10*

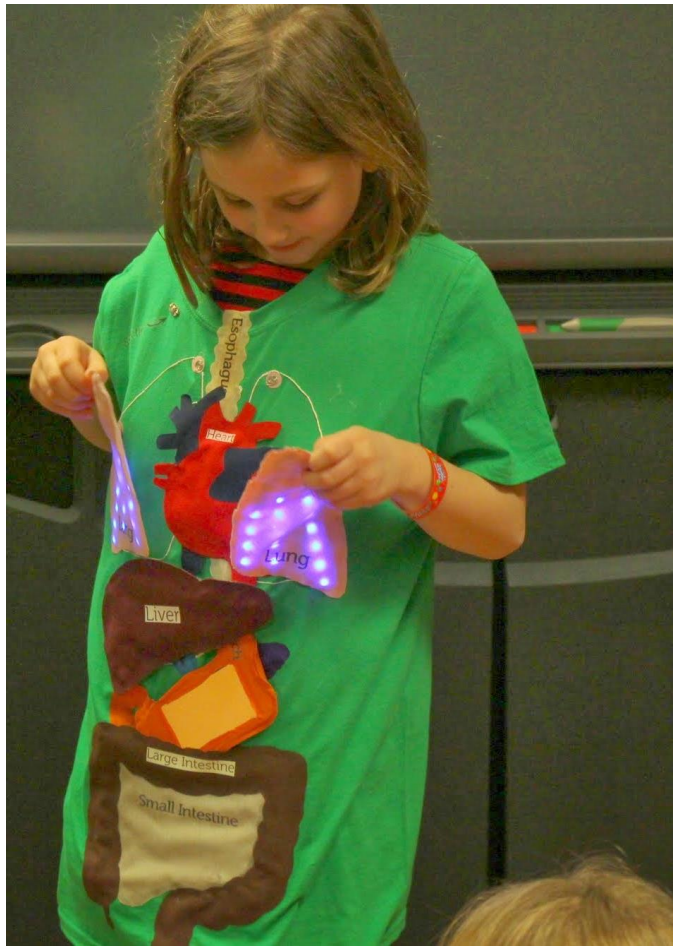
Design Inspiration

BodyVis

E-textile shirt for visualizing live physiological data

New platform for health and science learning

Fully responsive and interactive



Source: Norooz *et al., IDC'13, CHI'15*

Design Inspiration

BodyVis Provoked Curiosity

Children constantly asked "**how does it work**" and wanted to **explore the "insides"** of the BodyVis shirt. This was unexpected!

Construction Kits

Construction Kit Definition

> Construction kits—like LEGO or Erector Sets—are **creative platforms** that enable users to **design** and **create things** through **interworking components**.

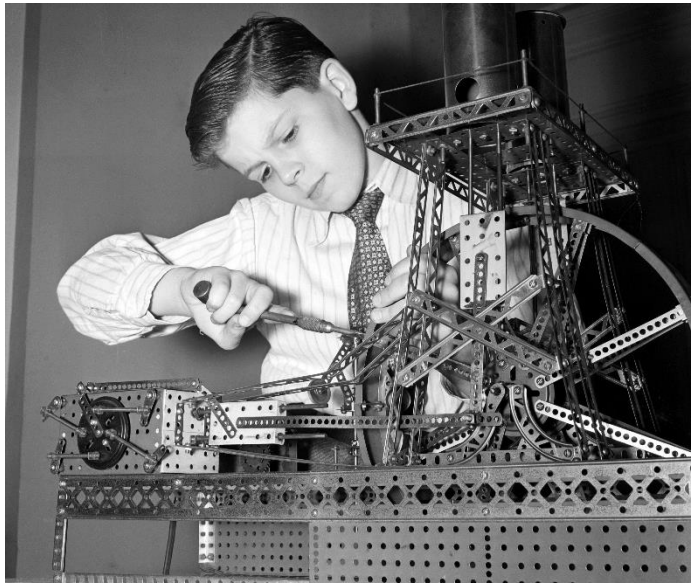
Based on definition by: Resnick, M., & Silverman, B. Some reflections on designing construction kits for kids, *IDC'05*

Construction Kit History

Source: Resnick, M. Behavior Construction Kits. *Commun. ACM '93*

Construction Kit History

1st Generation Kits
Allowed children to build structures (*e.g.,* towers, buildings)



2nd Generation Kits
Allowed children to build mechanisms (*e.g.,* pulleys, working ferris wheels, cars with gears)

3rd Generation Kits
So-called digital-physical kits allow children to build interactive behaviors (*e.g.,* a car that follows a light)

Source: Resnick, M. Behavior Construction Kits. *Commun. ACM '93*

Digital-Physical Construction Kits

Robotics (*e.g.*, Cubelets)

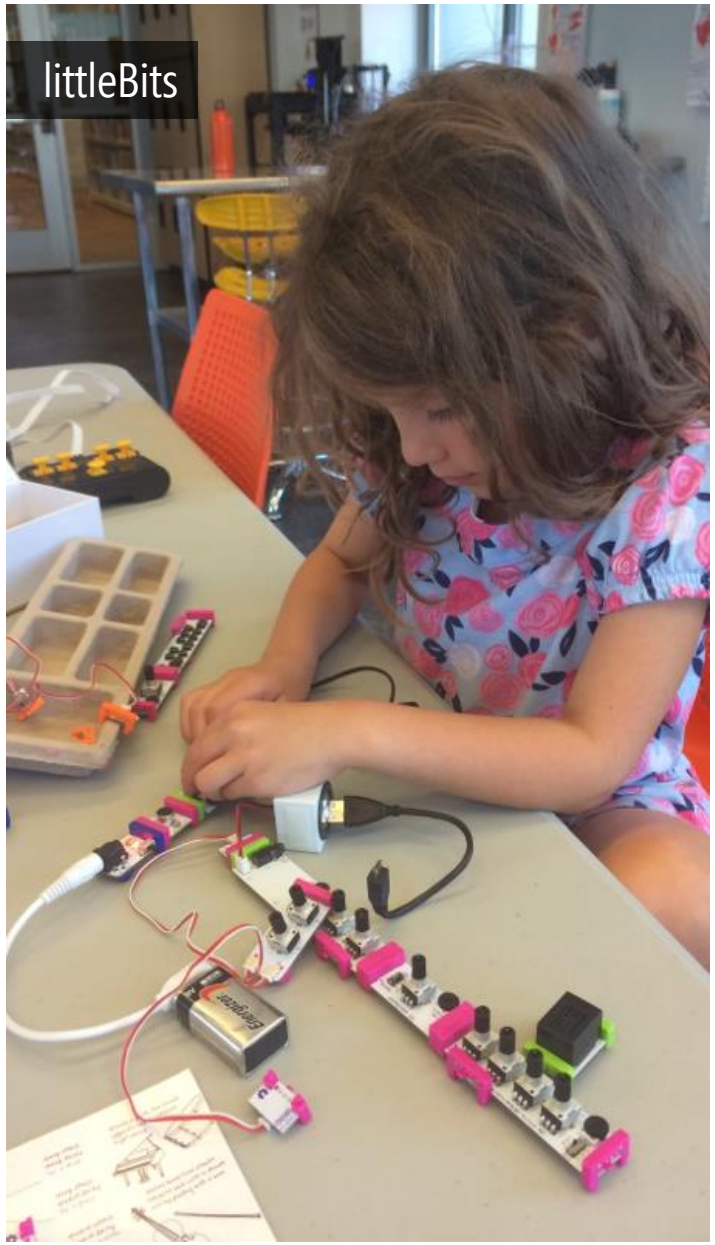
Electronics (*e.g.*, littleBits, SAM)

Circuits (*e.g.*, LightUp)

Often programmable

Modular

Snappable (typically magnetic)



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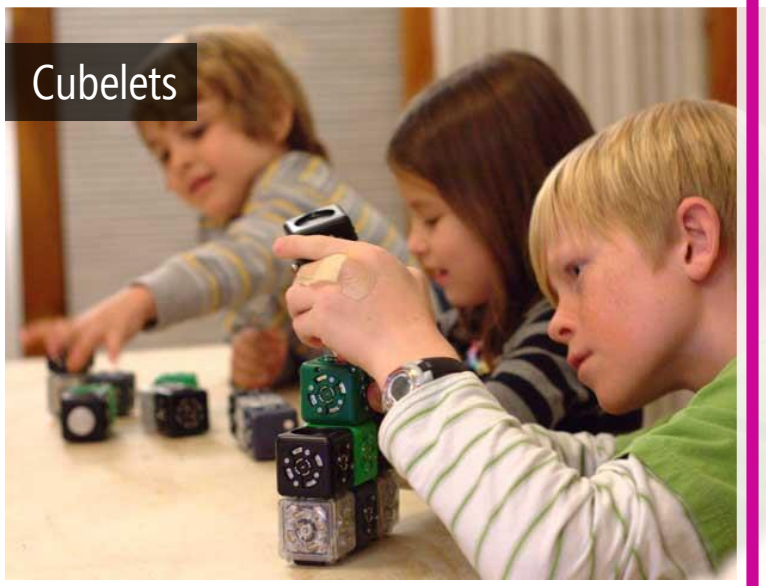


Construction Kits

Modular Robotics Cubelets

Sensors

Light Sensor

Distance Sensor

Temperature Sensor

Actions

Rotating Wheels

Flashlight

Speaker

"Think"

Inverse

Maximum

Threshold

Other

Battery

Pass Through

Blocker

Cubelets

Modular
Snappable
Emergent behavior
Rapid prototyping
Highly iterative

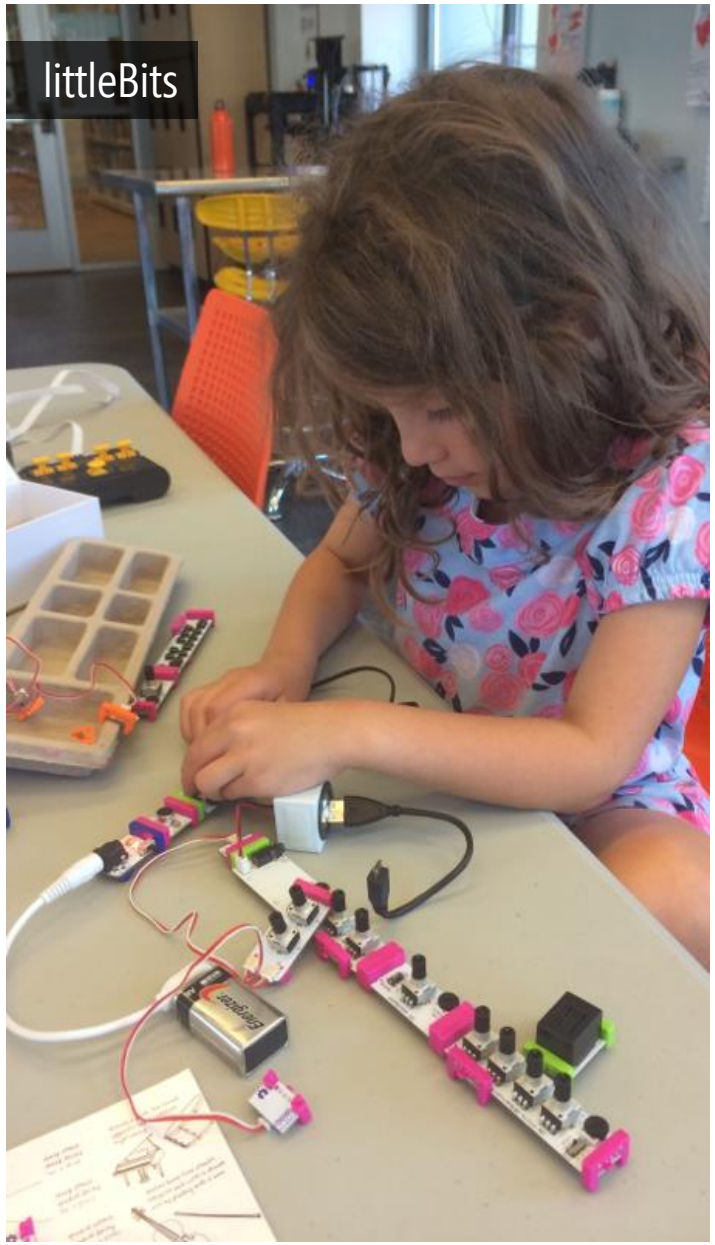
Digital-Physical Construction Kits

Designed & used in static spaces

Not wearable

Not intrinsically shareable

Children not designing for the self, their changing contexts



Clothing is a Unique Design Context

Constructions are wearable &, thus, inherently social, mobile, & always available

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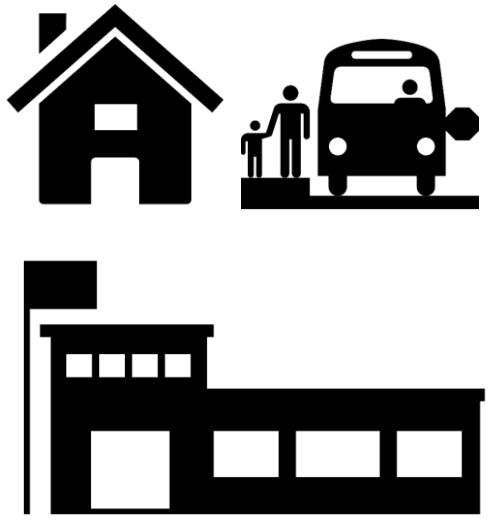
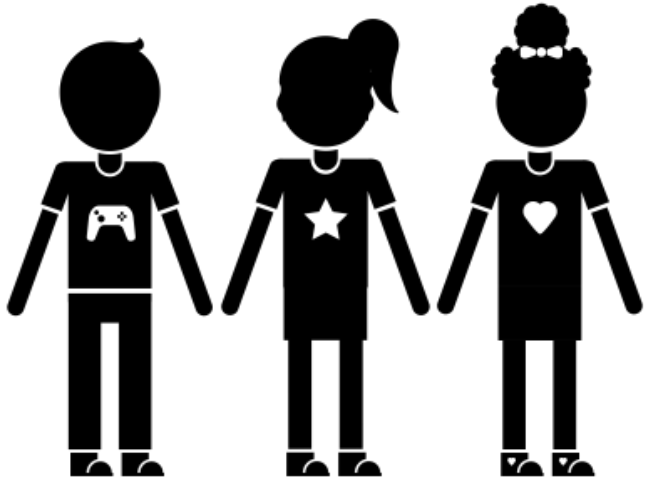


Changing environments



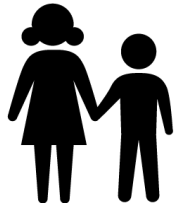
Social Interactions

Daily Life

MakerWear Design

Design Goals

Responsiveness

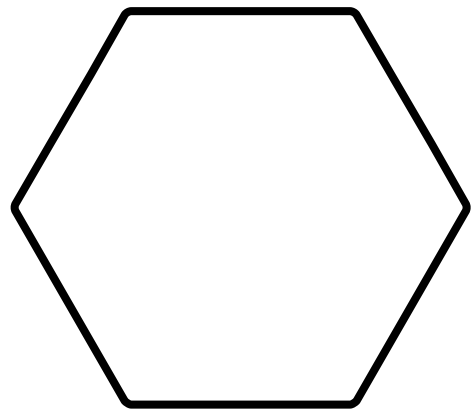


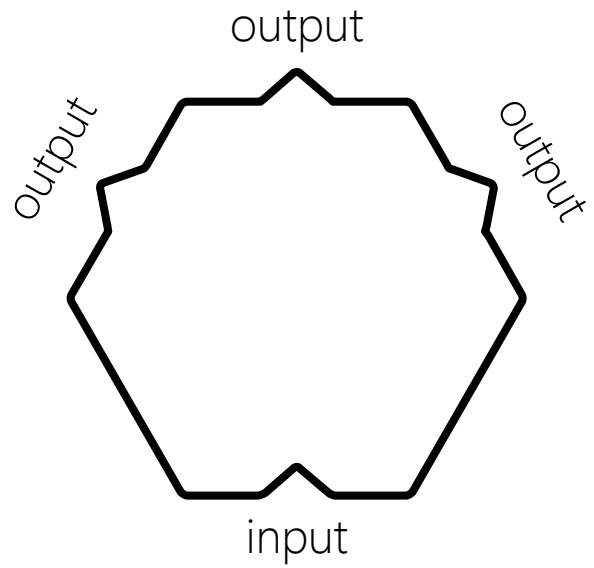
Easy & Accessible

Self-Expression

Programmable

Fun & Playfulness

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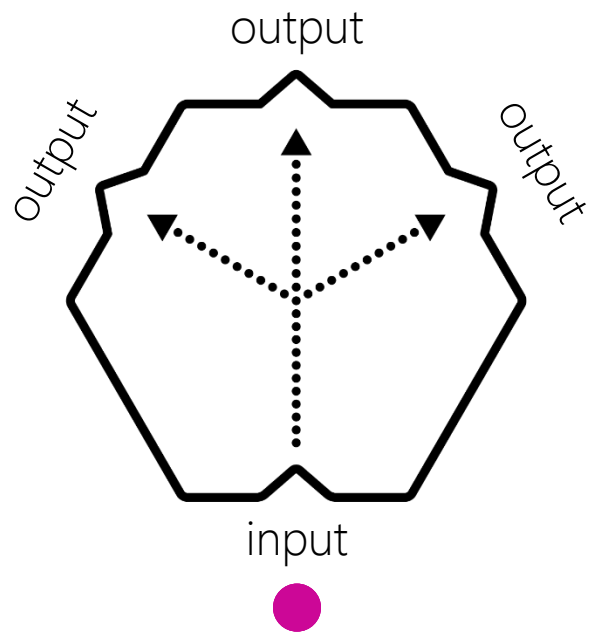
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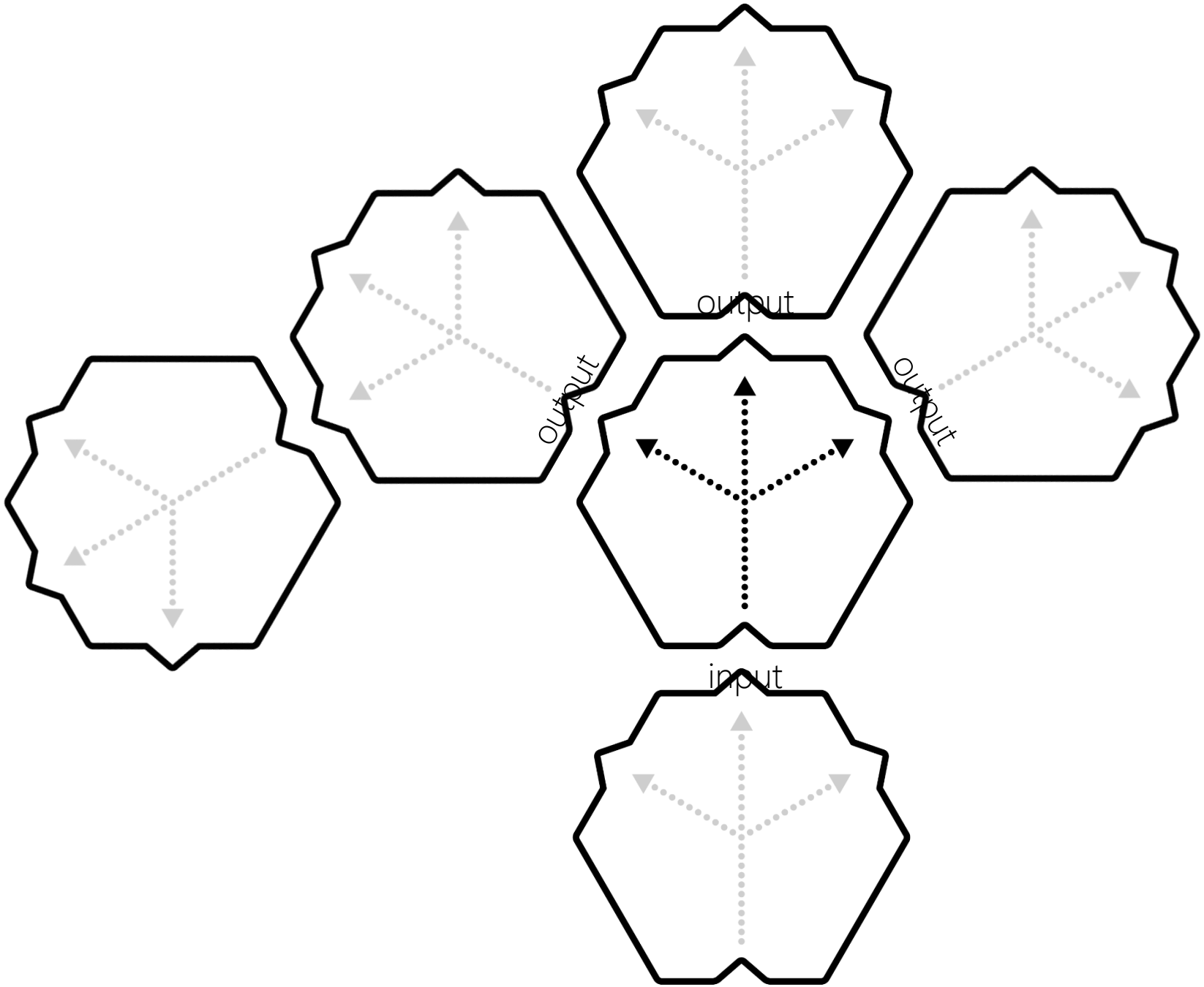
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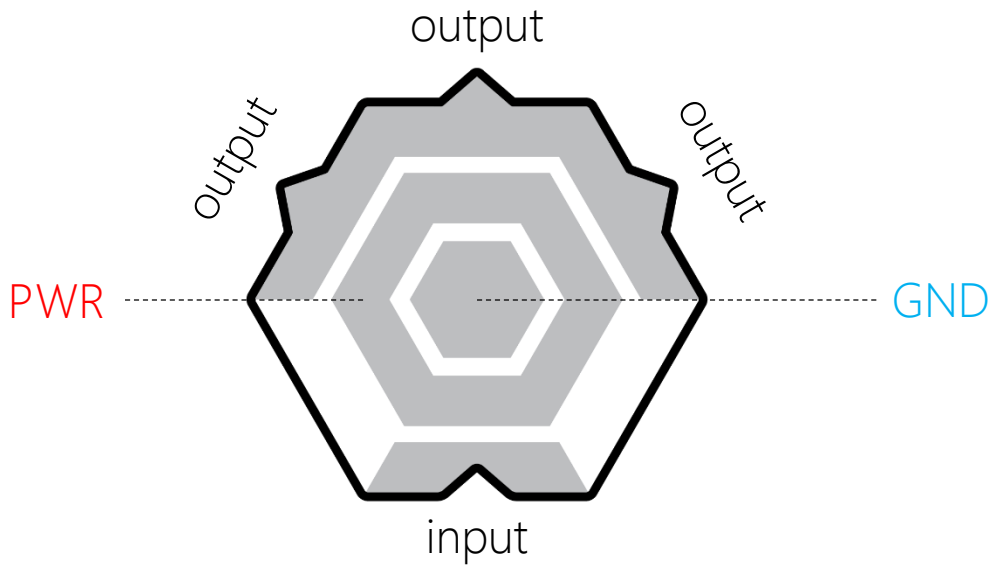
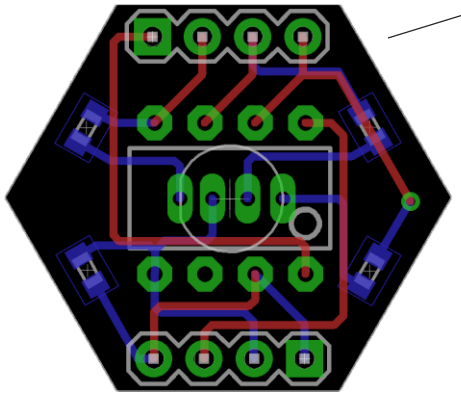
Module Layer One



Module Layer Two



Custom PCB with pre-programmed electronics for given module

Module Layer Three

Laser cut top shows iconography & label representing module behavior

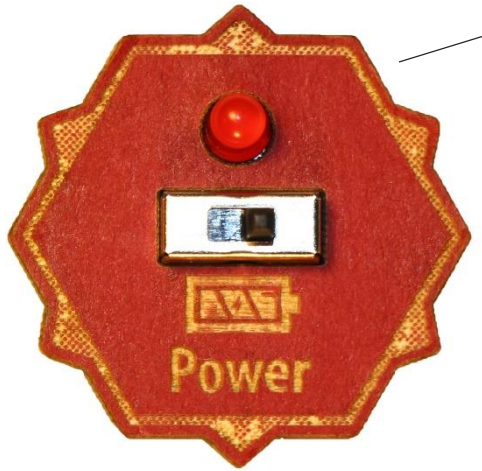
Example Module: Rainbow Light

Example Module: Inverter

Example Module: Distance Sensor

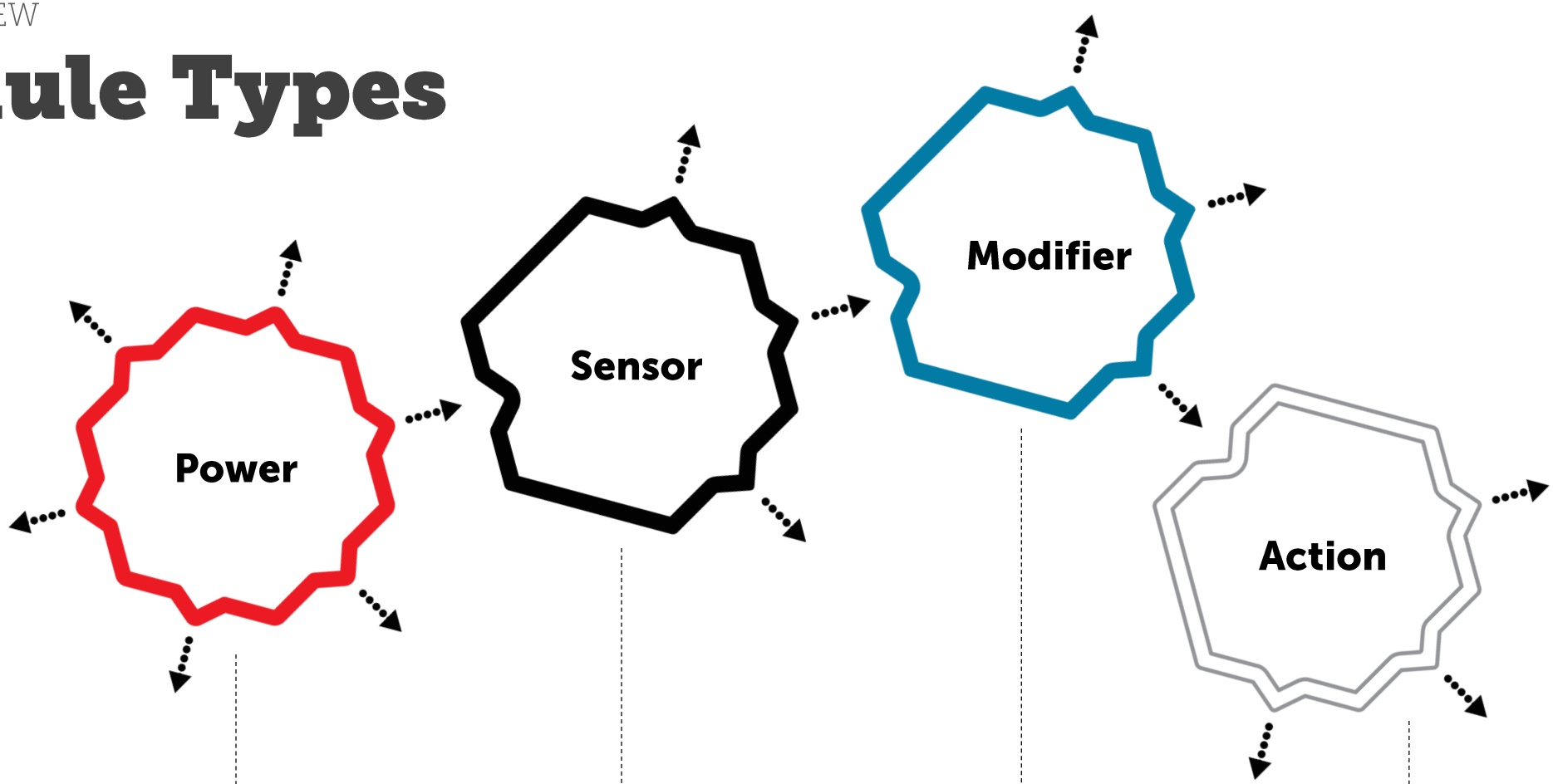
Example Module: Power

Example Module: Power



Power module is only current module that has **six outputs** instead of three

4 Module Types



provides power to all connected modules

Senses and translates physical phenomena into analog signals

Transforms analog signals into other types of analog signals

Translates analog signals into perceptual forms

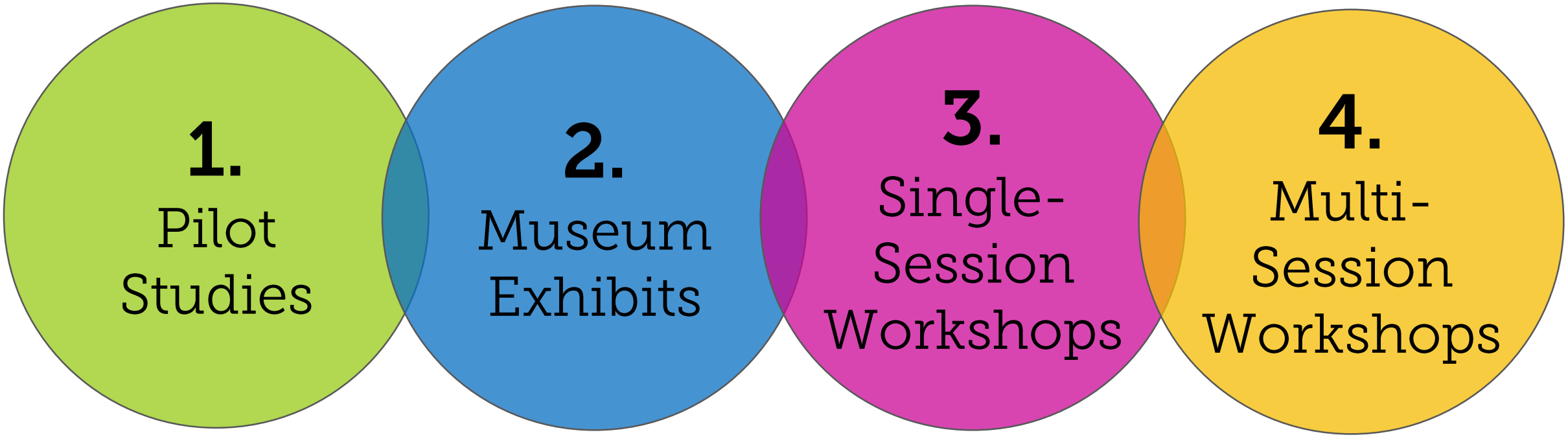
Module Library

Power **Sensors** **Modifiers** **Actions**

Live Demo!

Evaluation

MakerWear Studies



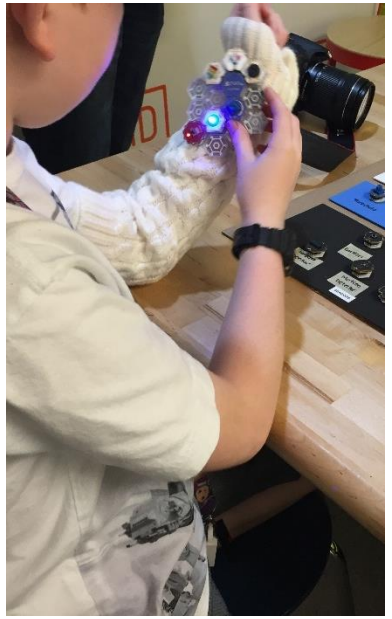
Preliminary Findings

MakerWear Design Process

How do children build with MakerWear?

How Children Make With MakerWear

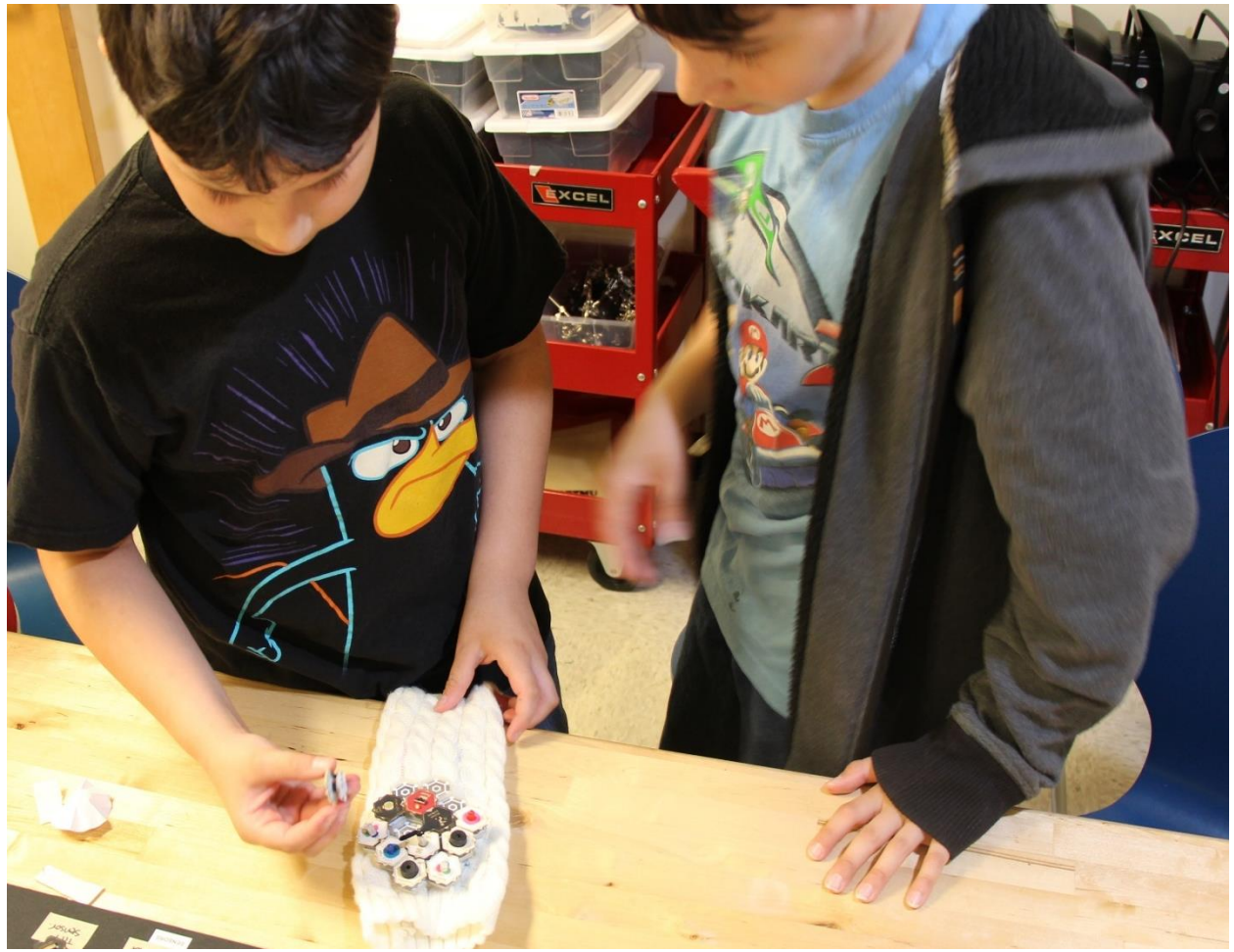
Two styles: (i) work on **table or floor** and switch to wearing for testing; (ii) **build** & **test** while **wearing**



How Children Make With MakerWear

Two styles: (i) work on **table or floor** and switch to wearing for testing; (ii) **build** & **test** while **wearing**

In museum exhibit, about **half worked collaboratively** with a friend, collectively brainstorming and designing.



How Children Make With MakerWear

Two styles: (i) work on **table or floor** and switch to wearing for testing; (ii) **build** & **test** while **wearing**

In museum exhibit, about **half worked collaboratively** with a friend, collectively brainstorming and designing.

In some cases, parents would **co-make** with child.

MakerWear Creations

Movement-Based Music

Wrist Theremin

11 yr old female maker

Wrist Theremin

11 yr old female maker

Movement-Based Instrument w/Lights

2 brothers

Movement-Based Instrument w/Lights

2 brothers

MakerWear Creations

Games!

Red-Light, Green-Light Game

Museum employee

Red-Light, Green-Light Game

Museum employee

Red-Light, Green-Light Game Now W/Tilt Sensor

Museum employee

Red-Light, Green-Light Game Now W/Tilt Sensor

Museum employee

Go-Away Scarf Alarm

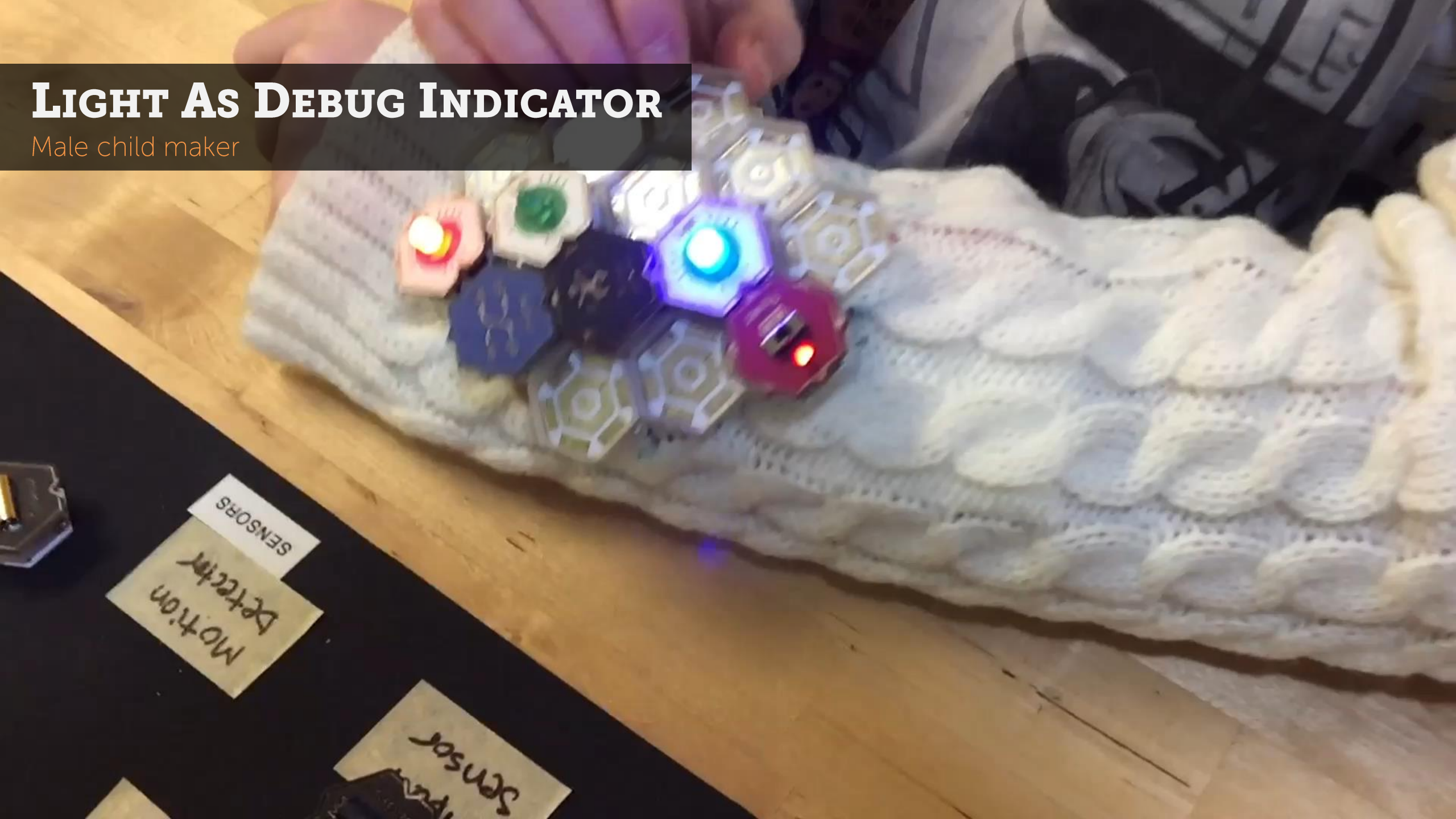
Museum employee

MakerWear Creations

Unexpected Things!

Light As Debug Indicator

Male child maker



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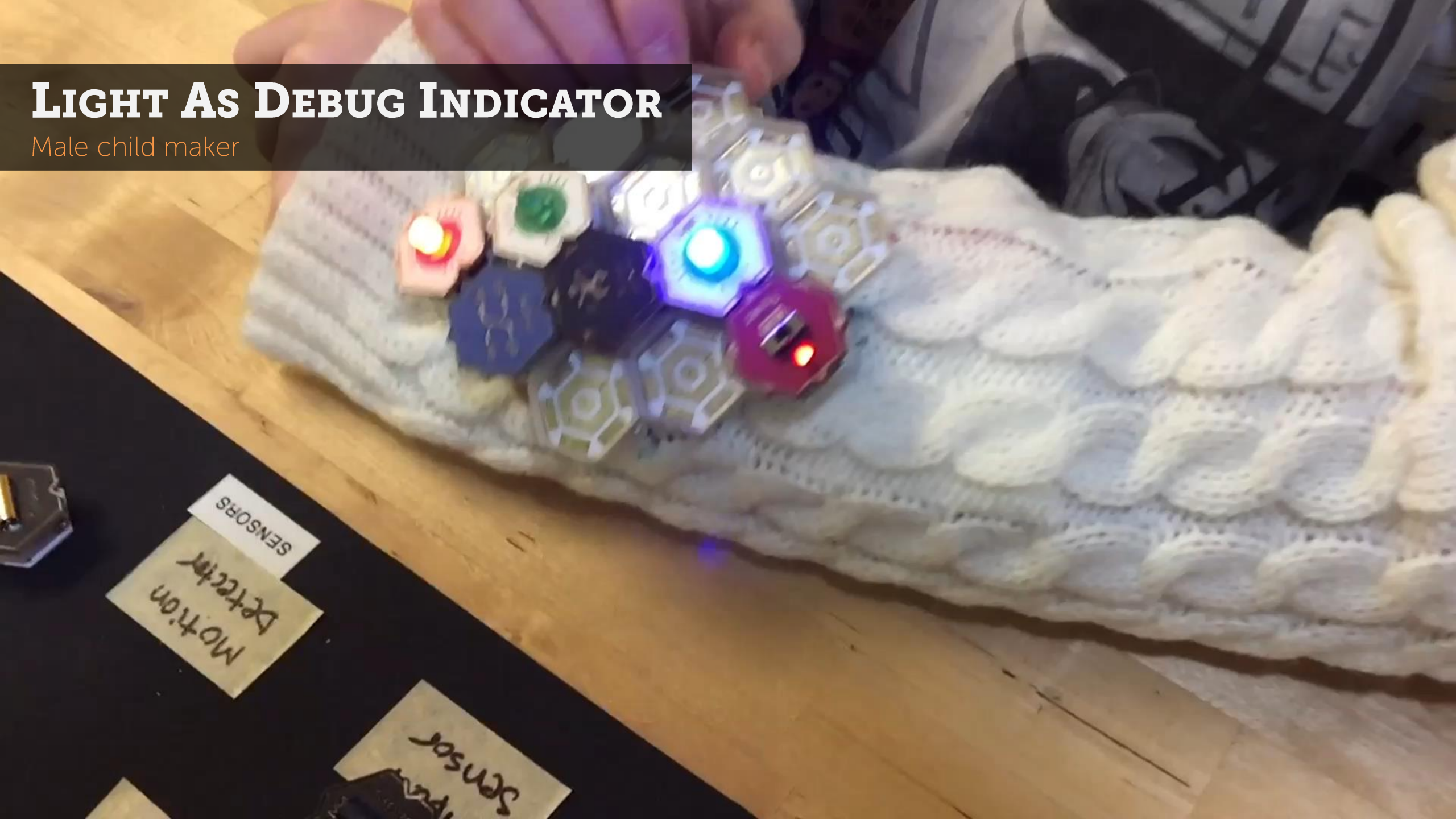


Custom Light Oscillator

Male child maker (~8 yrs old)

Custom Light Oscillator

Male child maker (~8 yrs old)

MakerWear Creations

Children Explanations

Explaining Threshold Modifier

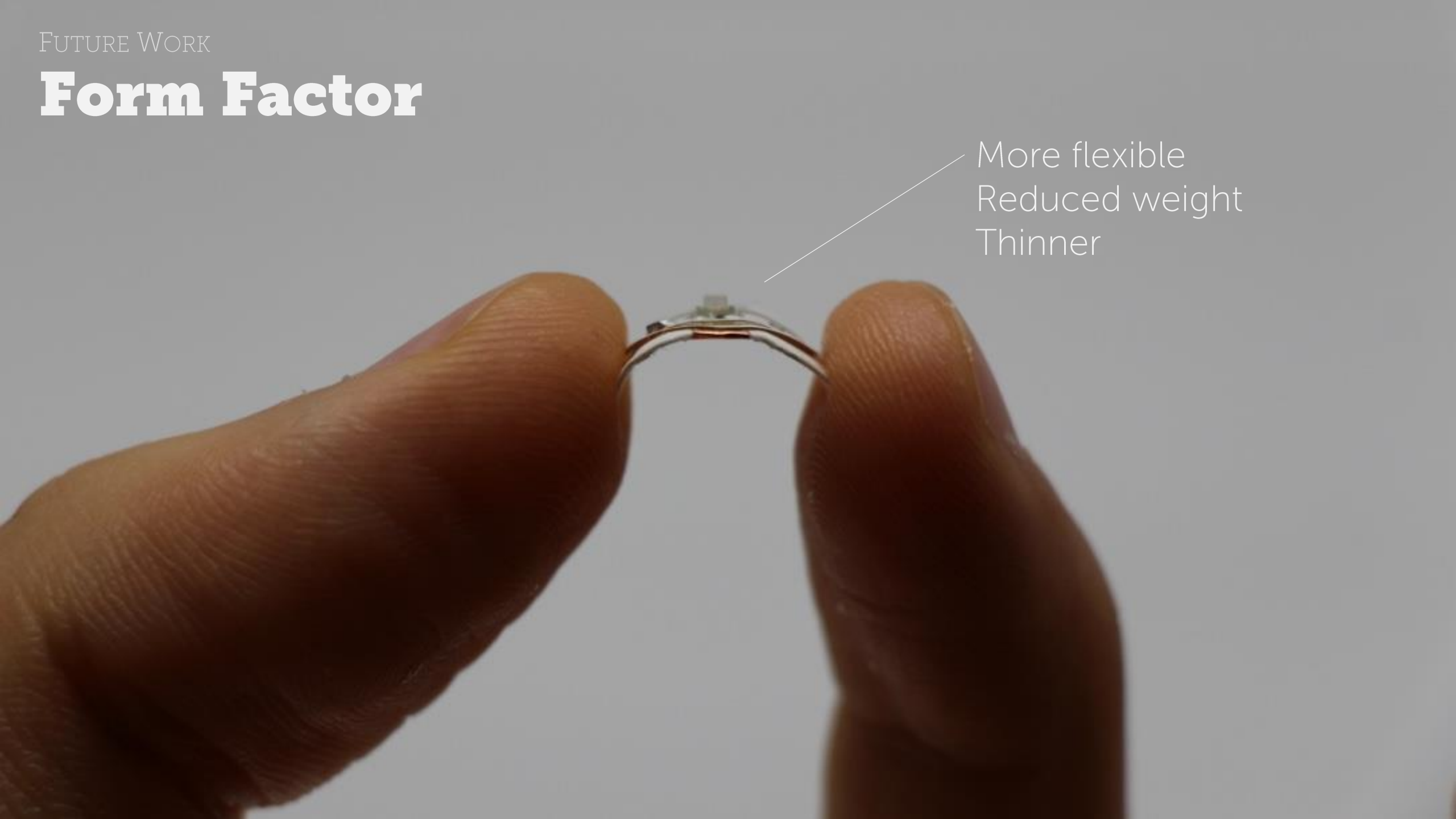
Male child maker (8 yrs old)

Explaining Threshold Modifier

Male child maker (8 yrs old)

Future Work

Form Factor



Future Work

Expand Module Library

Future Work

Expand Module Library

Greater emphasis on unique aspects of wearability: social, environmental, movement

Wireless Programming Interface

Modules will be wirelessly programmable via a custom tablet programming interface

Tickle
https://tickleapp.com/

SAM Labs
https://samlabs.com

Interactive Machine Learning

Children can program complex behavior via a novel interaction machine learning interface

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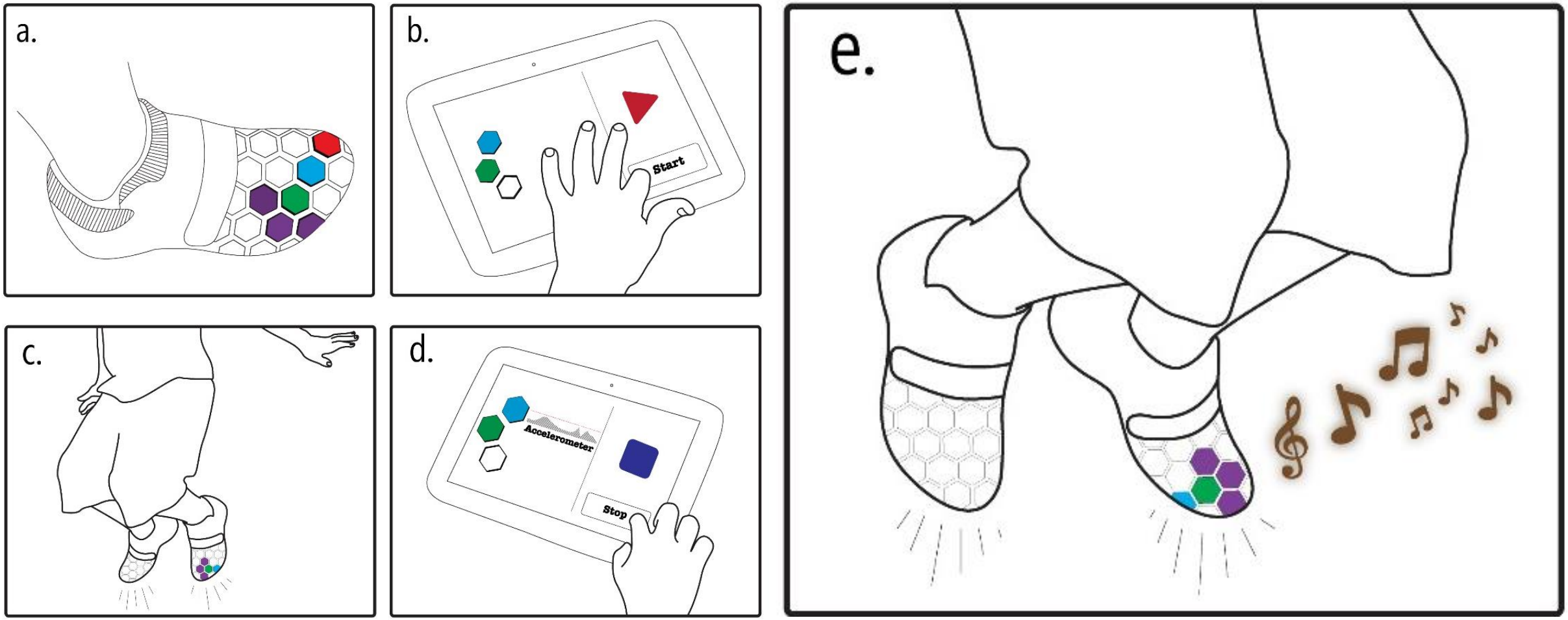
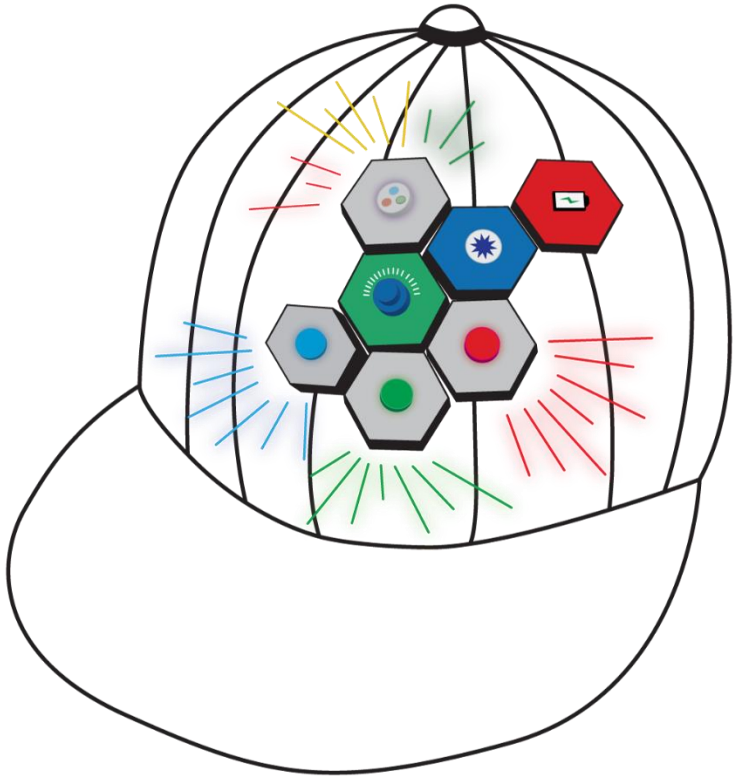


Designs for Scientific Inquiry

Children can build their own scientific instruments that allow them to investigate and compare phenomena over time and across contexts.



In Summary

MakerWear

A new construction kit aimed at **enabling children** to **design** and build their own **interactive wearables**.

A compelling pathway to engage children in **STEAM-related** activities

A new way for children to **think about** and **develop electronics/code**

Media Acknowledgements

Dancer
By James Keuning
https://thenounproject.com/term/dancer/373924/

House
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School
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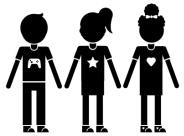
https://thenounproject.com/term/school/23692

Bus Stop
By Iconathon
https://thenounproject.com/term/school-bus-stop/731/



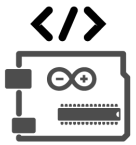
Friends
By Marie Van den Broeck
https://thenounproject.com/term/friends/235419/

Boy
By Carlos Gonzalez
https://thenounproject.com/term/boy/364826/

Painting
Juan Pablo Bravo
https://thenounproject.com/term/painting/17015

Trampoline
Juan Pablo Bravo
https://thenounproject.com/term/trampoline/16998

Children
OCHA Visual Information Unit
https://thenounproject.com/term/children/4283/



Arduino
uizin
https://thenounproject.com/term/arduino/34403

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