

Making the Maker: A Pathway to STEM for Elementary School Students

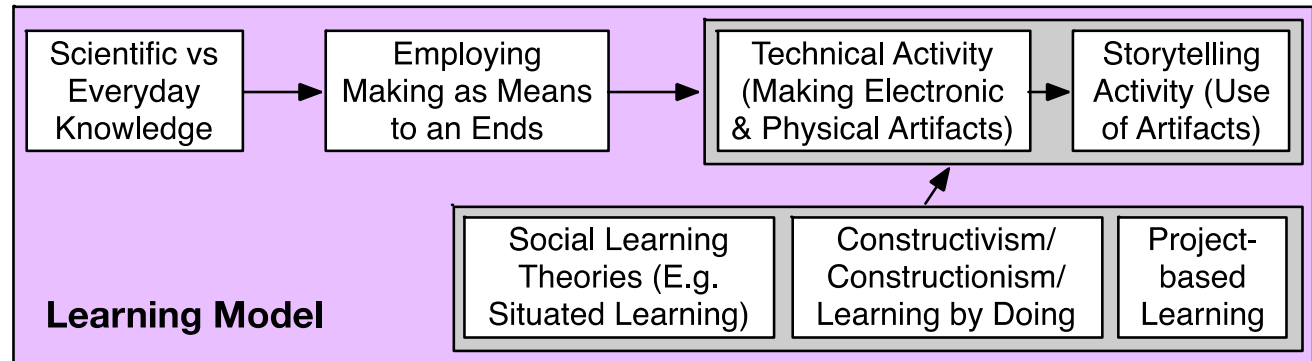
FRANCIS QUEK

TEXAS A&M UNIVERSITY

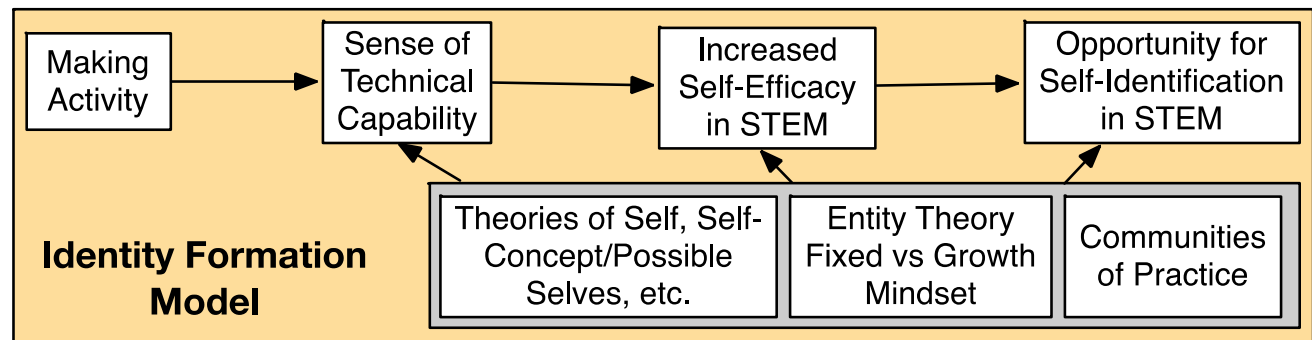


Dual Goals of Learning: Process & Person

Process:



Person:



Interdisciplinary Research Team



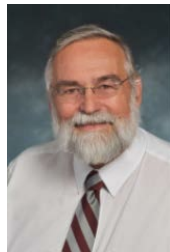
Francis Quek (HCI,
Embodied & Situated
Learning, Electrical
Engineering &
Computer Science)



Sharon Chu (Child-
Computer
Interaction,
Interaction Design)



Rebecca Schlegel
(Social Psychology,
Identity)



Lynn Burlbaw
(Teacher Education,
Curriculum
Development)



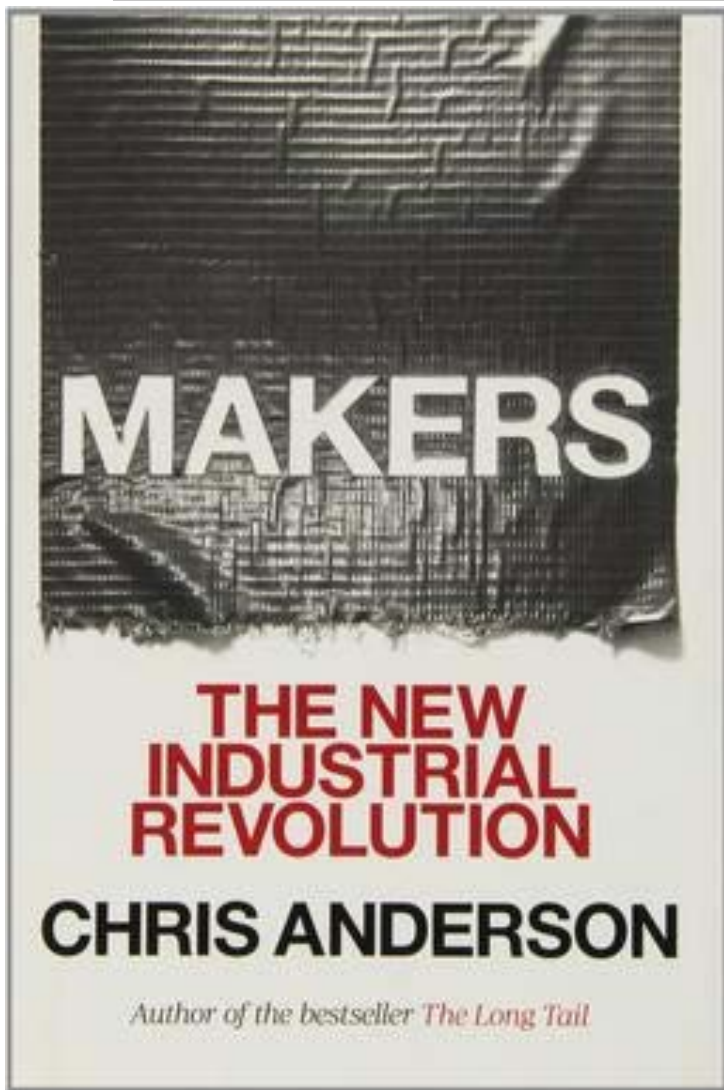
Patricia Larke
(Teacher Education,
Culturally Responsive
Teaching)

Making as Part of a New Economy



Promise for new industries and economies

Danger of a New Digital (STEM) Divide



Typical Maker: male, has advanced degree, and comes of higher SES

Integrating into Universal Education



School Integration is Necessary



Neal Elementary School Project Site

- Representation:
72% Latino, 26%
African American,
2% White or Asian
- 96% on reduced
lunch programs
- Over 50% Bi-
Lingual

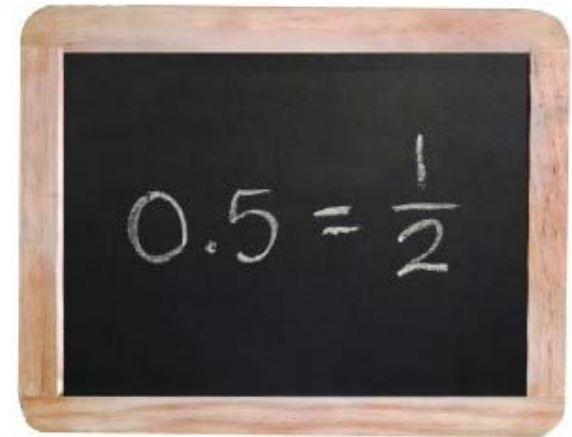


Why Grades 3-5: Addressing Learning

Concrete modes of thinking



Conceptual Modes of Thinking



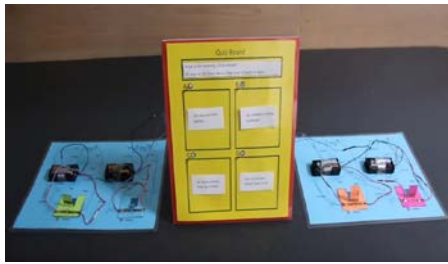
Critical Period of Transition

Why Grades 3-5: Addressing the Person



**Identity formation takes place in
early adolescence**

Integrating Making with Science, Mathematics, and Language-Arts



Integration of Knowledge and Ideas:

[CCSS.ELA-LITERACY.RI.5.7](#)

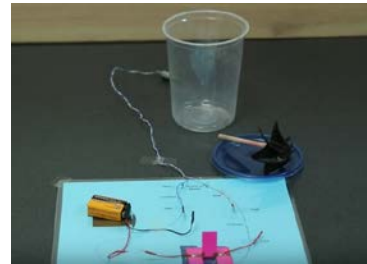
Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently.

[CCSS.ELA-LITERACY.RI.5.8](#)

Explain how an author uses reasons and evidence to support particular points in a text, identifying which reasons and evidence support which point(s).

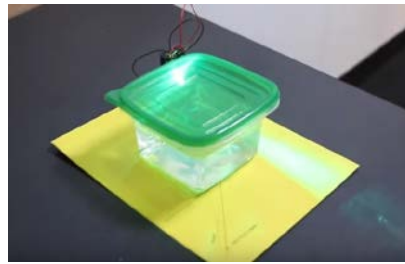
[CCSS.ELA-LITERACY.RI.5.9](#)

Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably.



Matter and Energy: *Properties of Light*

TEK 4.5C: The student knows that matter has measurable physical properties and those properties determine how matter is classified, changed, and used. The student is expected to compare and contrast a variety of mixtures and solutions such as rocks in sand, sand in water, or sugar in water.



Force, Motion, and Energy: *Properties of Light*

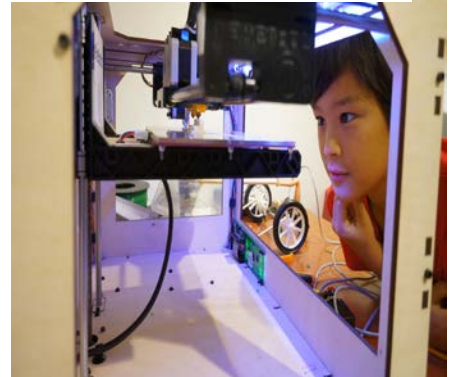
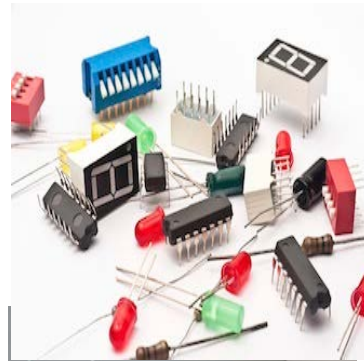
TEK 5.6C: The student knows that energy occurs in many forms and can be observed in cycles, patterns, and systems. The student is expected to demonstrate that light travels in a straight line until it strikes an object or travels through one medium to another.



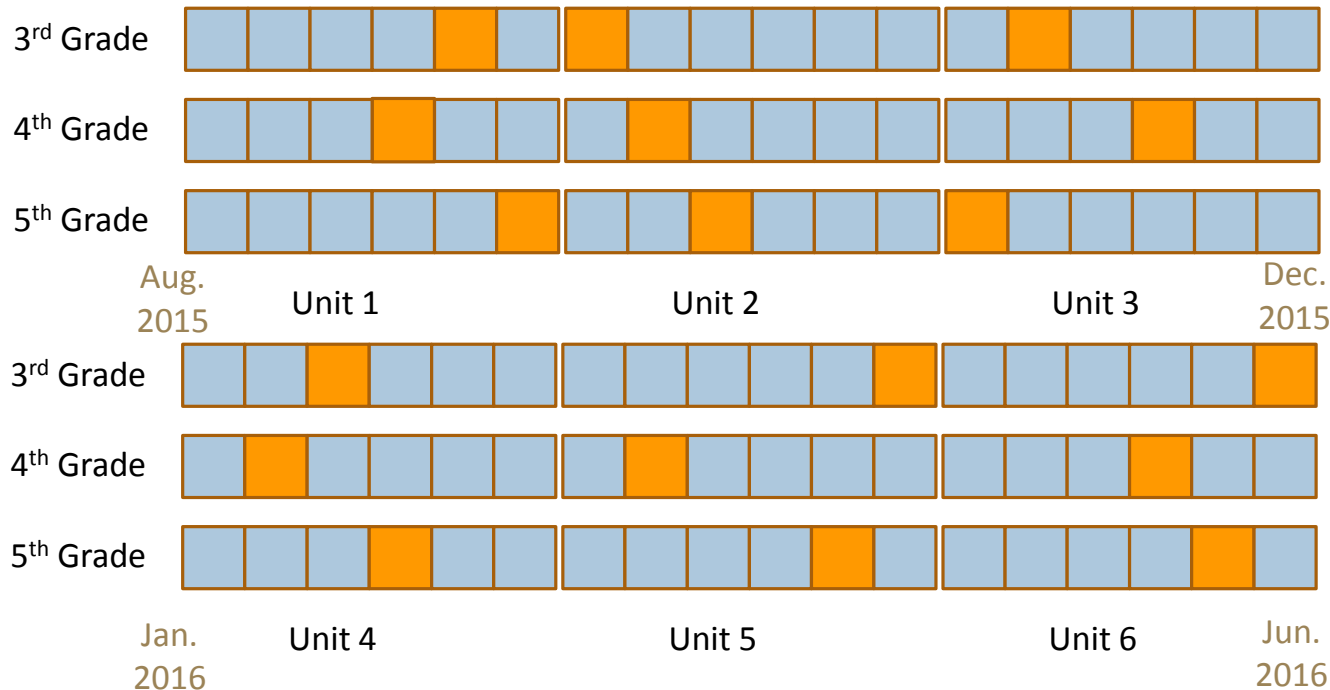
Earth and Space: *Rapid Changes*

TEK 3.7B: The student knows Earth consists of natural resources and its surface is constantly changing. The student is expected to investigate rapid changes in the Earth's surface such as volcanic eruptions, earthquakes, and landslides.

Making as the New Colored Pencil

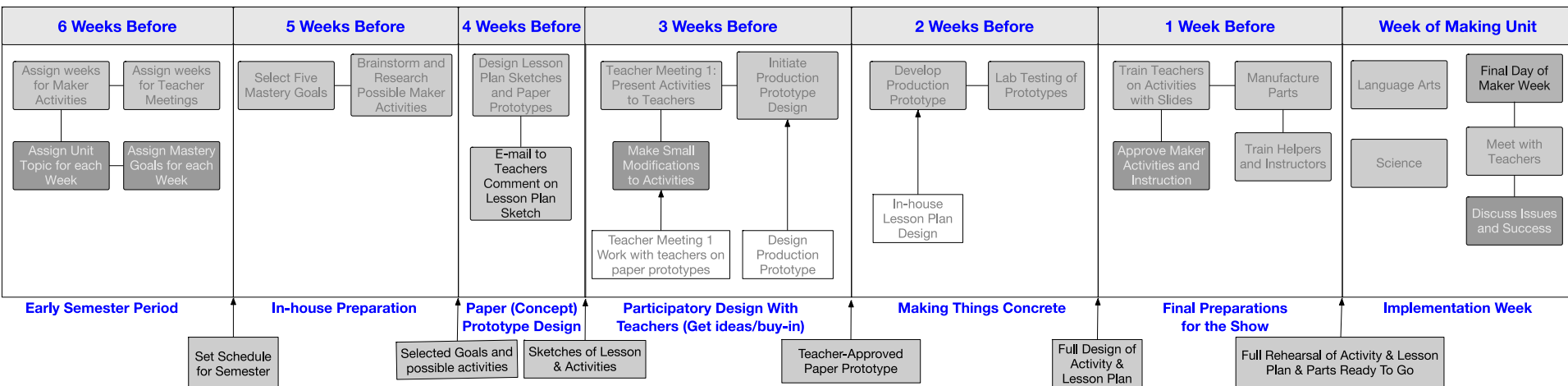


Schedule of Maker-Curriculum in Classroom



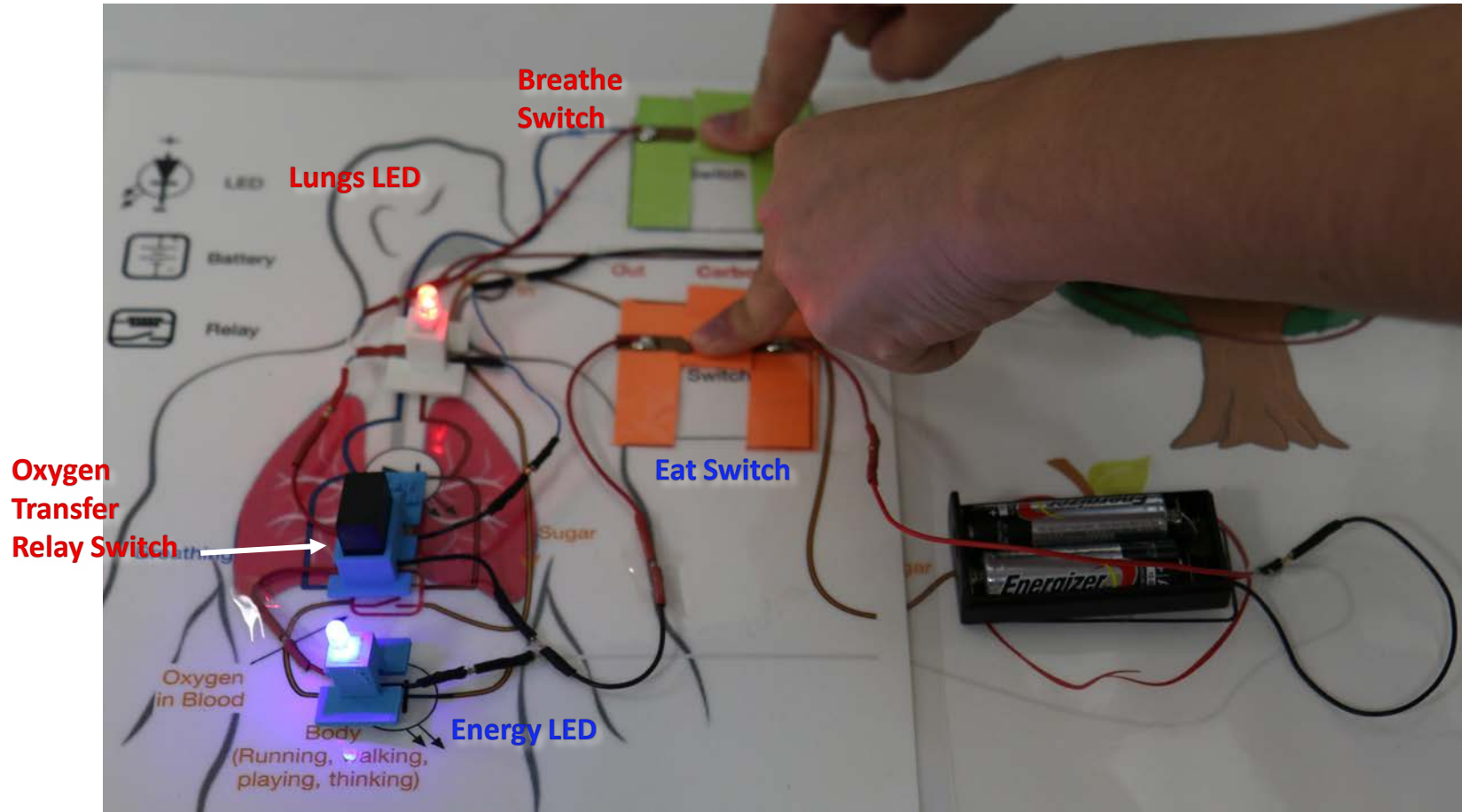
- School Year divided into six 6-week units
- Each unit addresses a TEKS/Common Core Topic Area
- Our activity is integrated into one week per unit

Curriculum-Based Maker Planning for One Making Unit



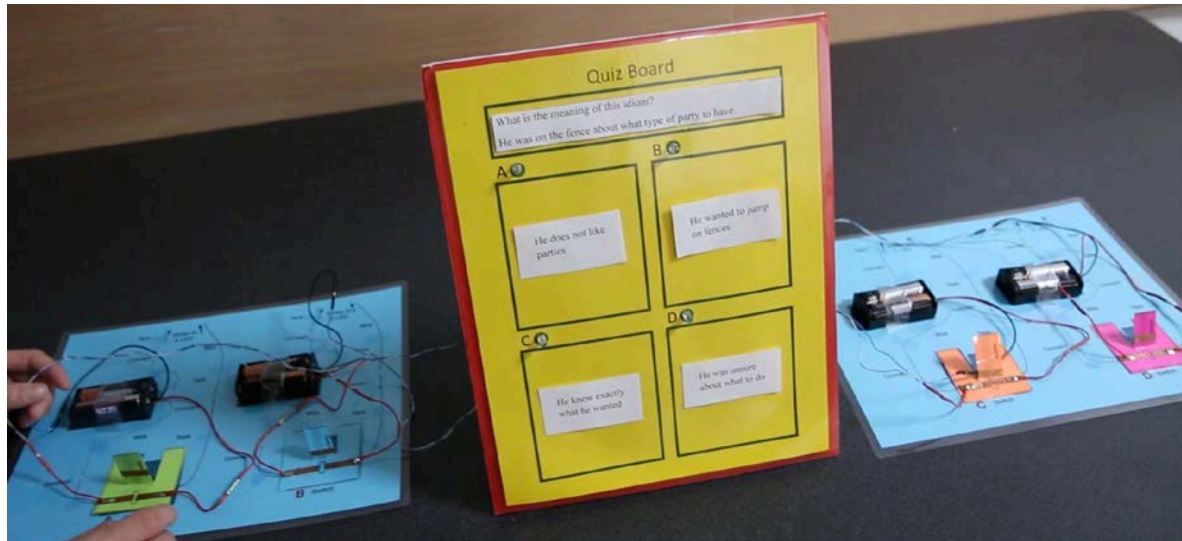
Involved Process Across the Team and Teachers

Human Body Model for 5th Grade



Dioramas and Quiz Boards for Language-Arts

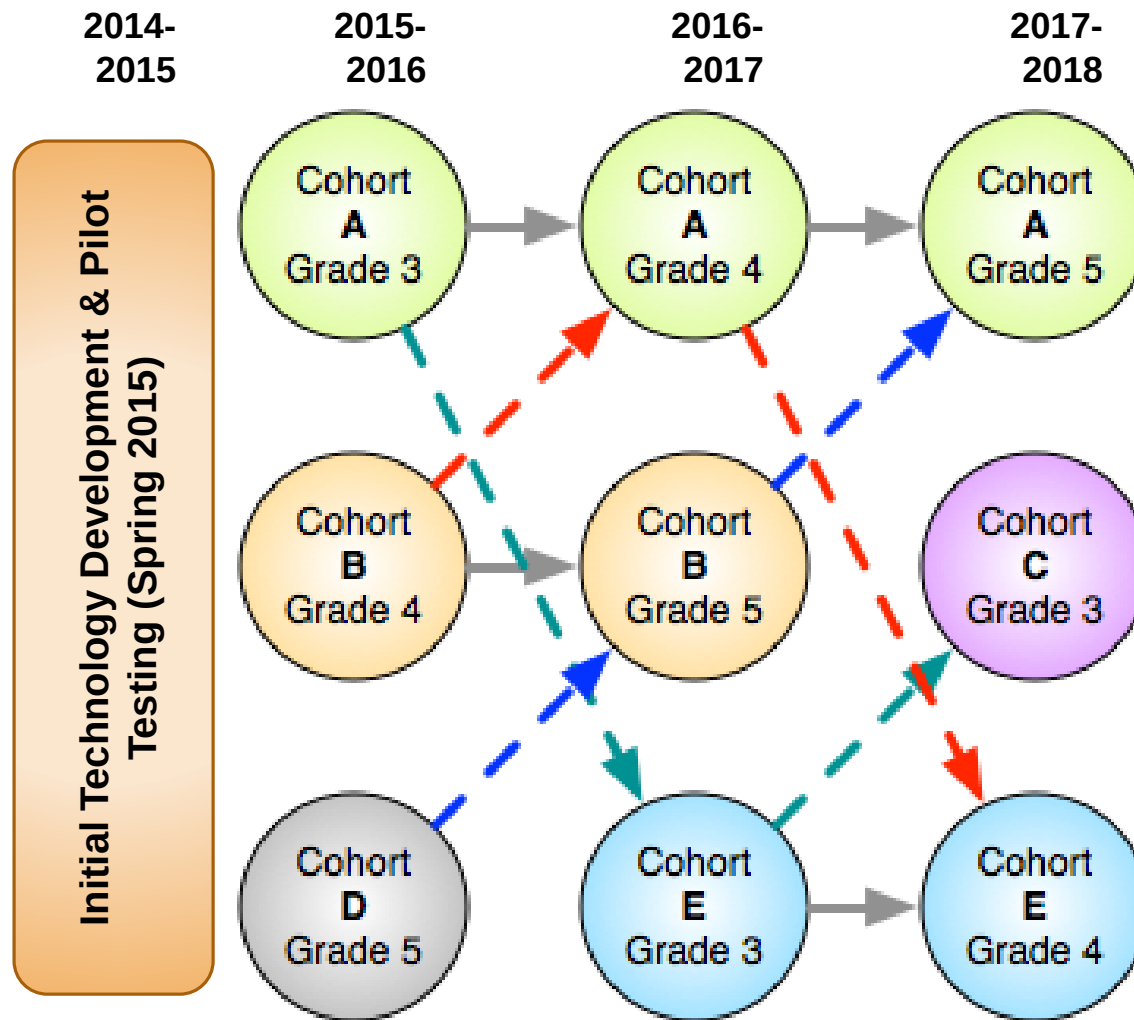
Quiz Boards



Story
Dioramas



Multi-year Longitudinal Design



Practice & Identity Formation are Long Term Effects

Summary Results and Findings

Maker workshops leading to school study

- the **utility of Making for storytelling** through instrumental/remote interaction,
- **how to design Maker kits, and analyze children's behaviors** for mindset formation,
- the **importance of motor skills** when designing Maker kit components (e.g., connectors) for children



INTERNATIONAL JOURNAL OF
CHILD-COMPUTER
INTERACTION

First year of school study

- affordances and challenges of **introducing Making in the elementary school science curriculum**,
- structure, component, and agency **requirements in the curriculum-based Making as an activity system**
- **the operationalization of positive and negative affect** in children during Making in the classroom



STEM Interest & Self-Efficacy

First semester of school study

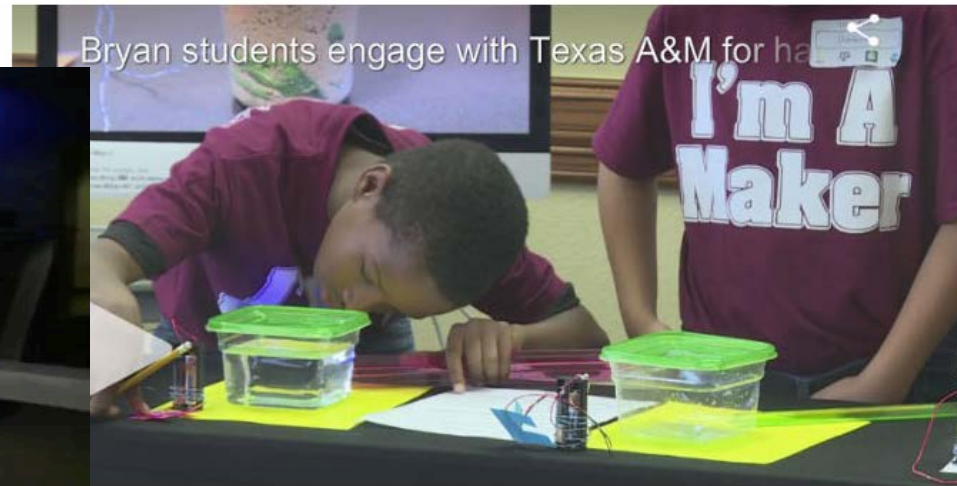
- Statistically significant upward trajectories **especially in students' interest and self-efficacy in Making, and desire to have a STEM career when they grow up**

Dependent Variable	b	SE	t	p-value
Maker Interest and efficacy	.27	.04	7.20	<.001**
STEM career interest	.08	.04	2.39	.02**
STEM and language arts Self-efficacy	.10	.05	1.92	.06*

Empowering Elementary School Students in Science



Bryan students engage with Texas A&M for hands-on learning



Wellborn | Posted: Thu 10:10 PM, Apr 21, 2016 | Updated: Thu 10:44 PM, Apr 21, 2016



Texas - Students at Neal Elementary [School](#) in Bryan have teamed up with Texas A&M with the hands-on learning in science, technology, engineering and mathematics, or STEM.

Open house at Texas A&M by Elementary School Students

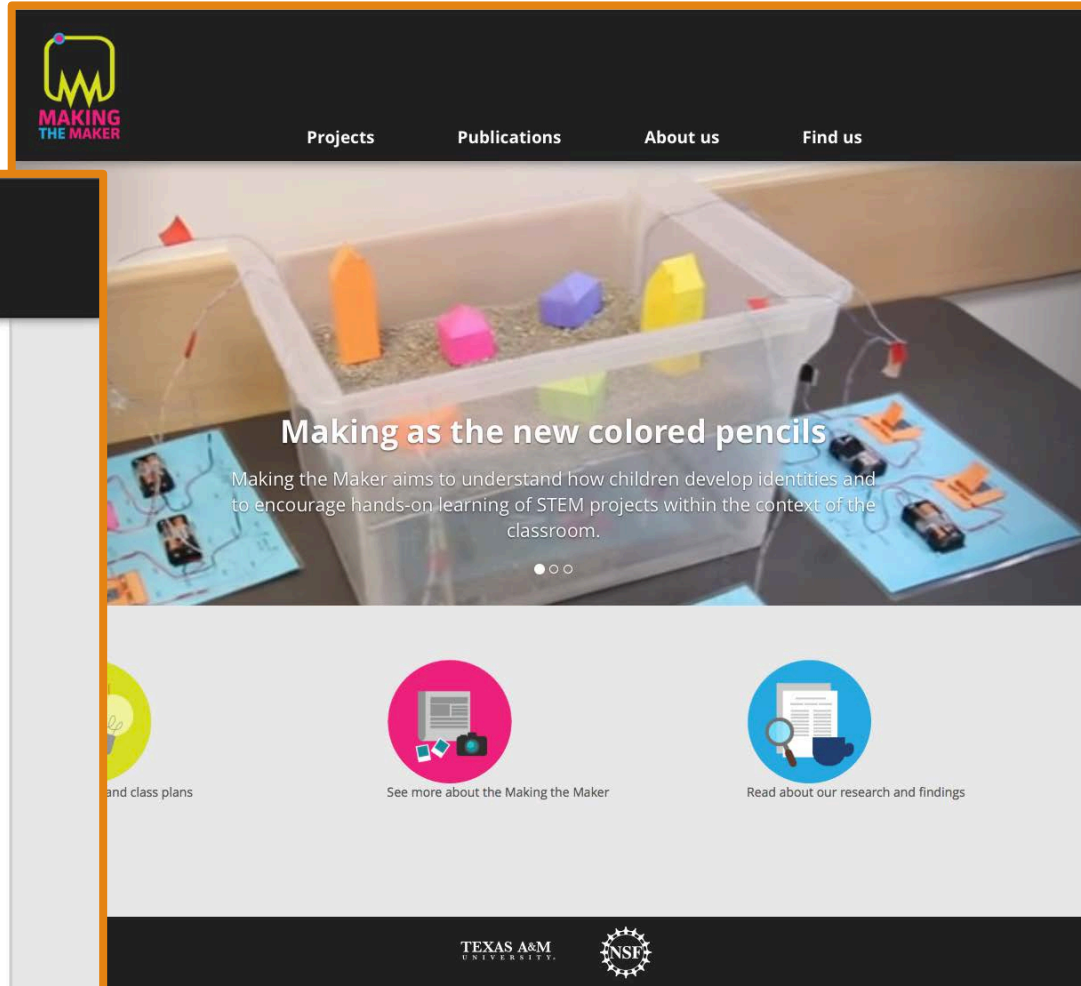
The students presented their projects Friday to A&M students and faculty from the Colleges of Education and Human Development, Architecture, [Engineering](#), and Liberal Arts.

For Neal [student](#) Angel Salinas, his favorite part of this collaboration: "I get to work with circuits."

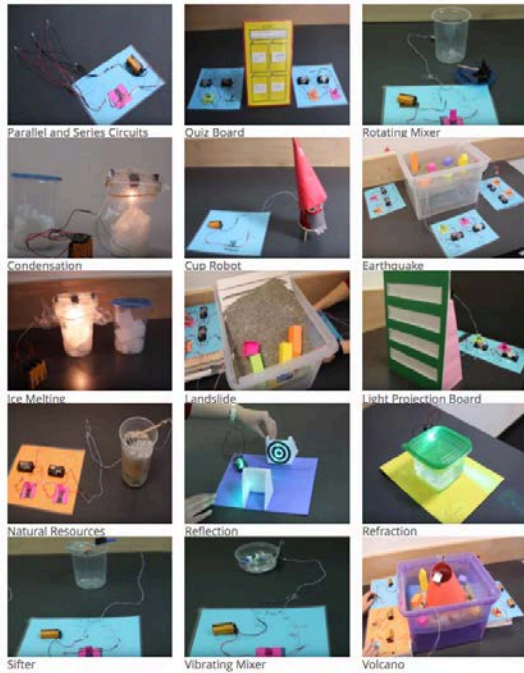
It's helping him and others develop skills in those STEM fields. The hope is to keep kids engaged in these subjects now so they keep working in them and further their [education](#).



Conclusion



Projects



Dissemination Website released
(<http://MakingtheMaker.tamu.edu>)