Boosting STEM Engagement Through Play

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University of Michigan School of Information

Booklist | March 27, 2018

Find today's slides at http://bit.ly/fontblog

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Today

- A Foundation for Play: Defining Play and Articulating STEM Goals
- A Culture of Play: Ambient STEM
- A Mindset of Play: Mantle of the Expert
- Planning for Play: Designing Events
- Recommended Read: *Roots of STEM Success*
- Q & A

BHAG

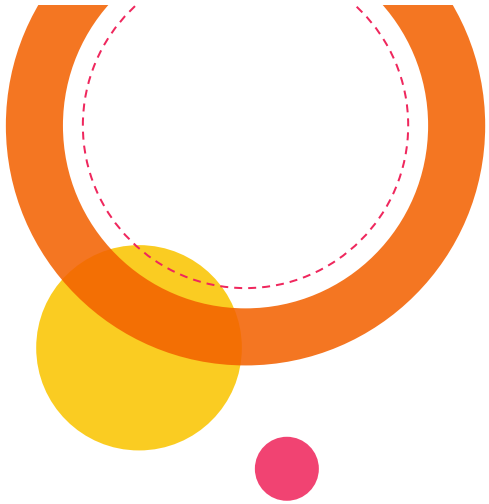
Playful learning can give *context* to STEM tools.

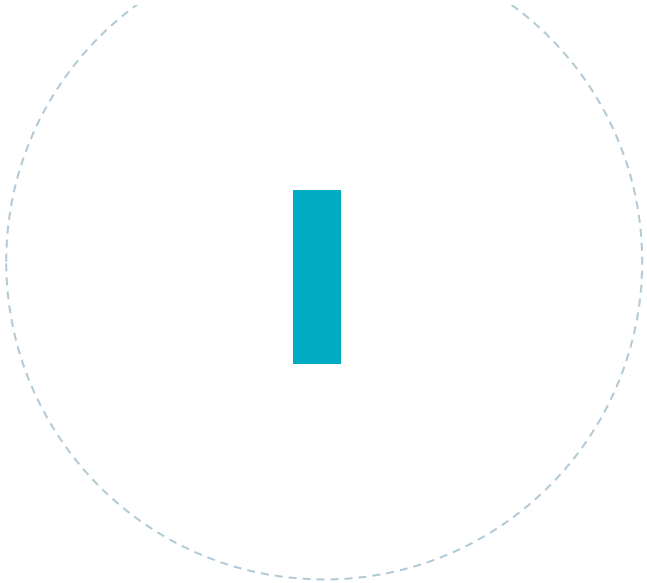
Context builds engagement.

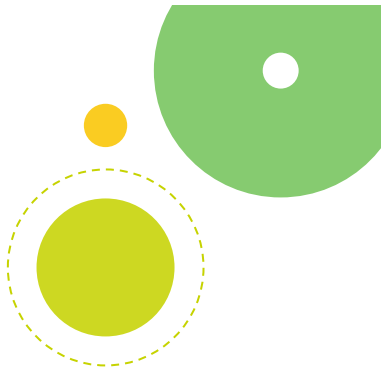
Engagement fuels stamina.

Stamina is needed to develop skill.

Skill supports opportunity.

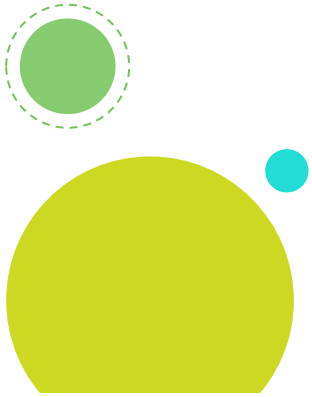


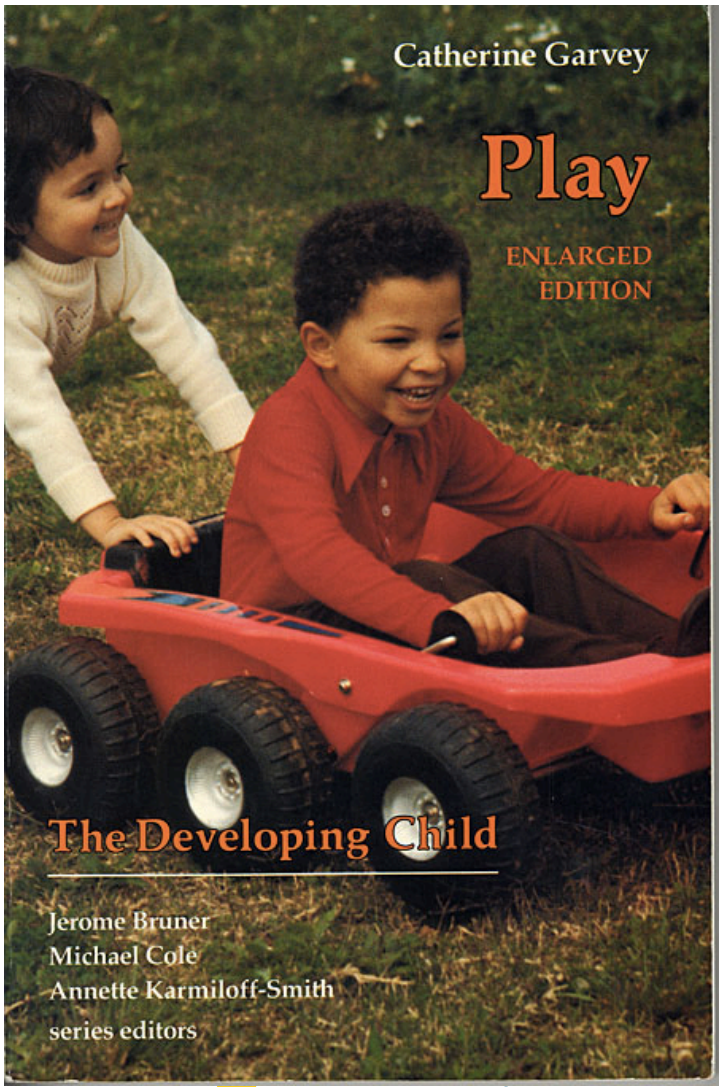




A Foundation for Play

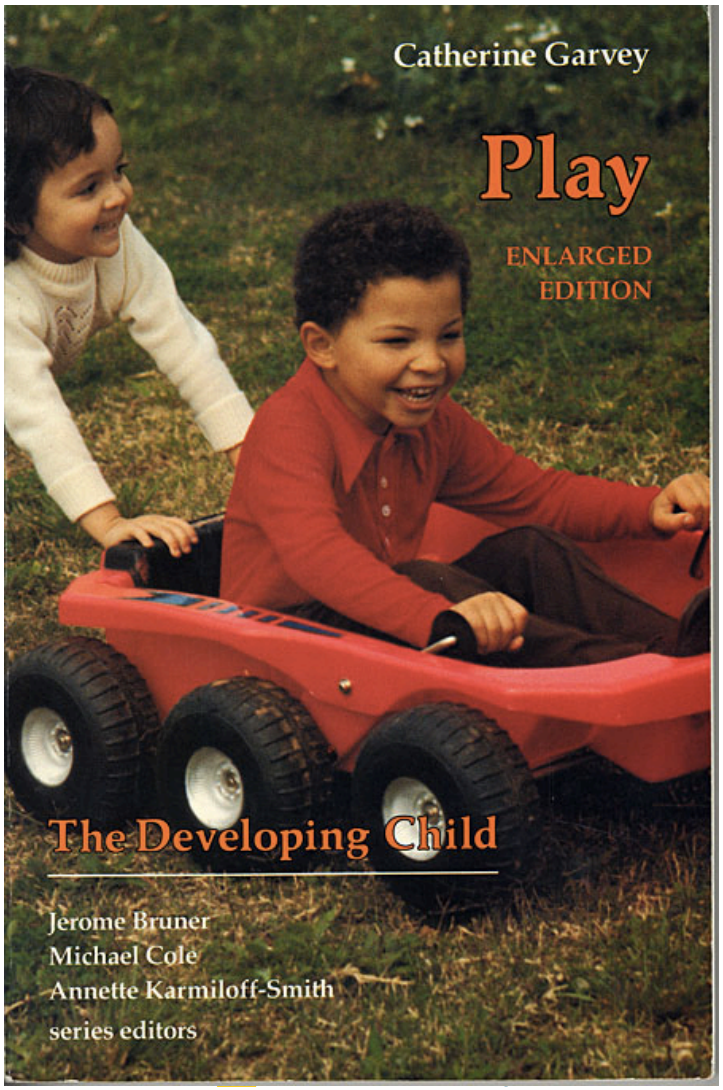
Defining Play and Articulating STEM Goals



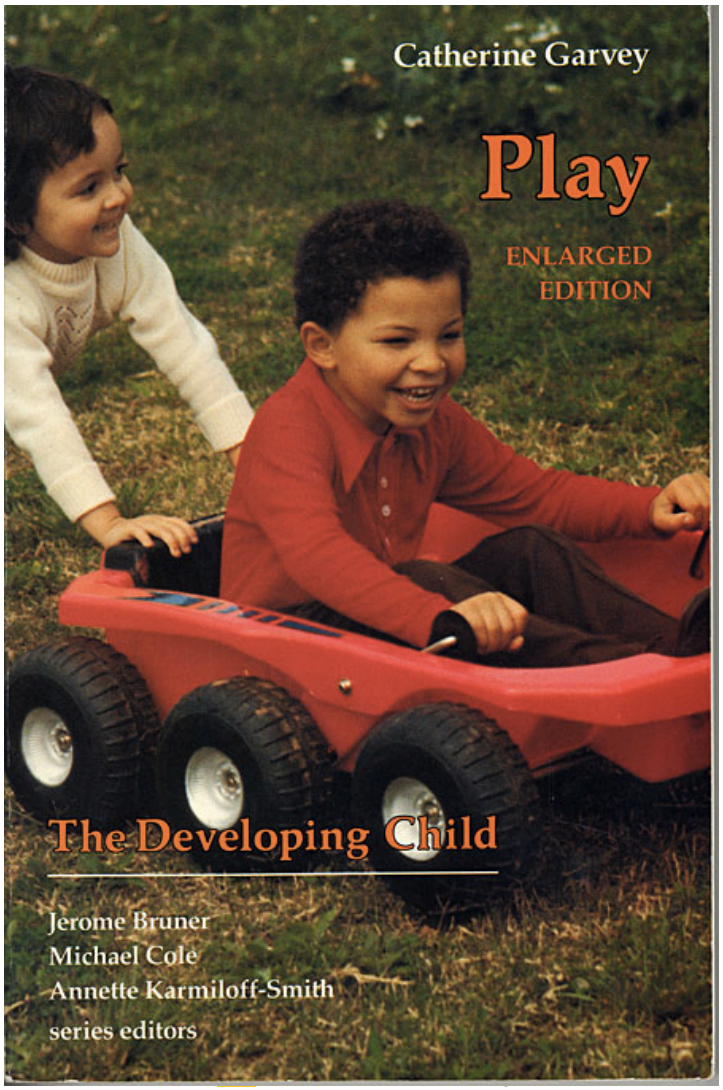


1. Play is pleasurable, enjoyable. Even when not accompanied by signs of mirth, it is still **positively valued by the player**.

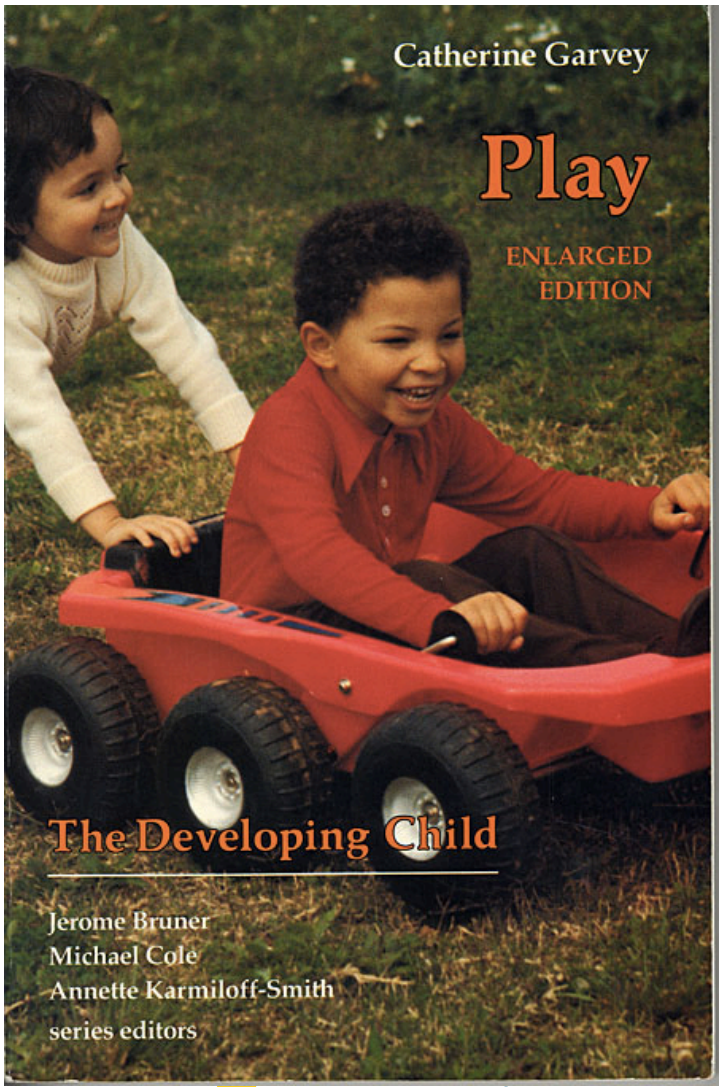
Garvey, Catherine. 1990. *Play*. Enlarged edition. Cambridge, MA: Harvard University Press. ISBN 9780674673656.



2. Play has no extrinsic goals. Its motivations are **intrinsic** and serve no other objectives. In fact, it is more an enjoyment of means than an effort devoted to some particular end. In utilitarian terms, it is **inherently unproductive**.



3. Play is spontaneous and voluntary. It is **not obligatory** but is **freely chosen** by the player.



4. Play involves some **active engagement** on the part of the player.

Garvey, Catherine. 1990. *Play*. Enlarged edition. Cambridge, MA: Harvard University Press. ISBN 9780674673656.

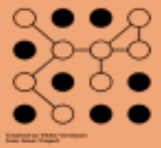
Playfulness

Adopting the spirit of play into other activities

1. Asking **questions** (for science) and **defining problems** (for engineering)

2. Developing and using **models.**

3. Planning and carrying out **investigations.**



4. Analyzing and interpreting **data.**

SCIENTIFIC AND ENGINEERING PRACTICES

National Research Council. 2012. A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas. National Academies Press, p. 49. http://nap.edu/catalog/13165. Images from TheNounProject.com and used with a Creative Commons license.

5. Using **mathematics** and **computational thinking.**

6. Constructing **explanations** (science) & **designing solutions** (for engineering).

7. Engaging in **argument** from **evidence.**

8. **Obtaining, evaluating,** and **communicating** information

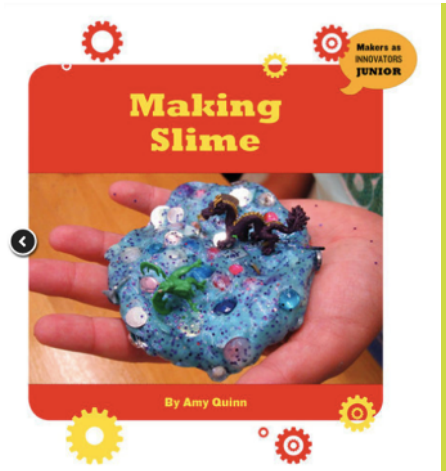
2

A Culture of Play

Ambient STEM

Ambient STEM

Passive programming that encourages children to engage with science around them in unstructured or minimally-structured ways (Fontichiaro 2016)



Ambient STEM Tools

Things to measure and measure with

Things to see and see with

Things to weigh and weigh with

Things to touch and touch with

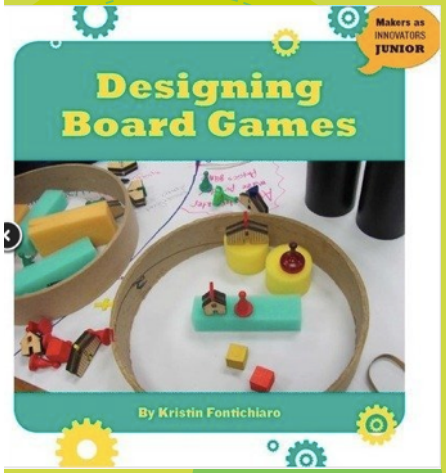
Things to observe and observe with

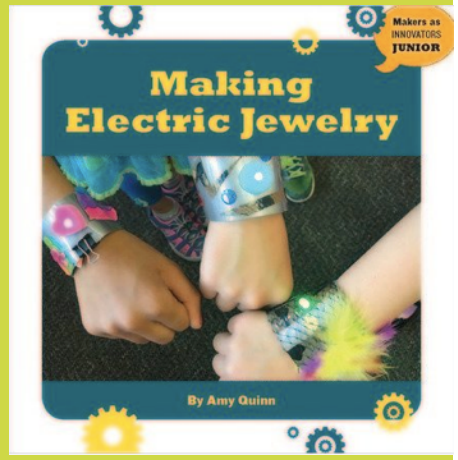
Things to document and document with

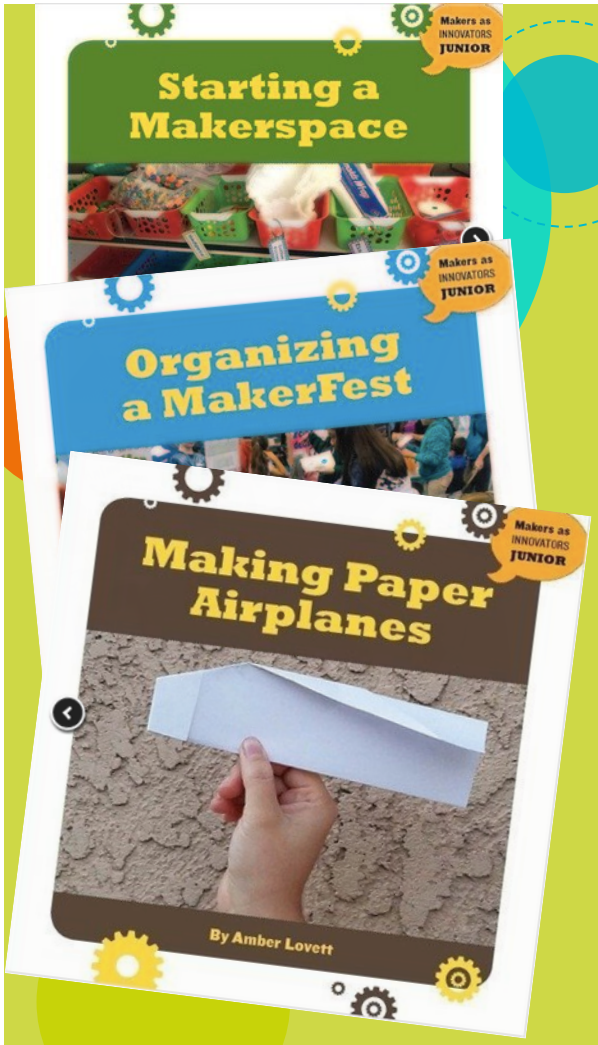
Things to move and move with

Things to build and build with

Etc.







Culture where it is OK to …

Measure

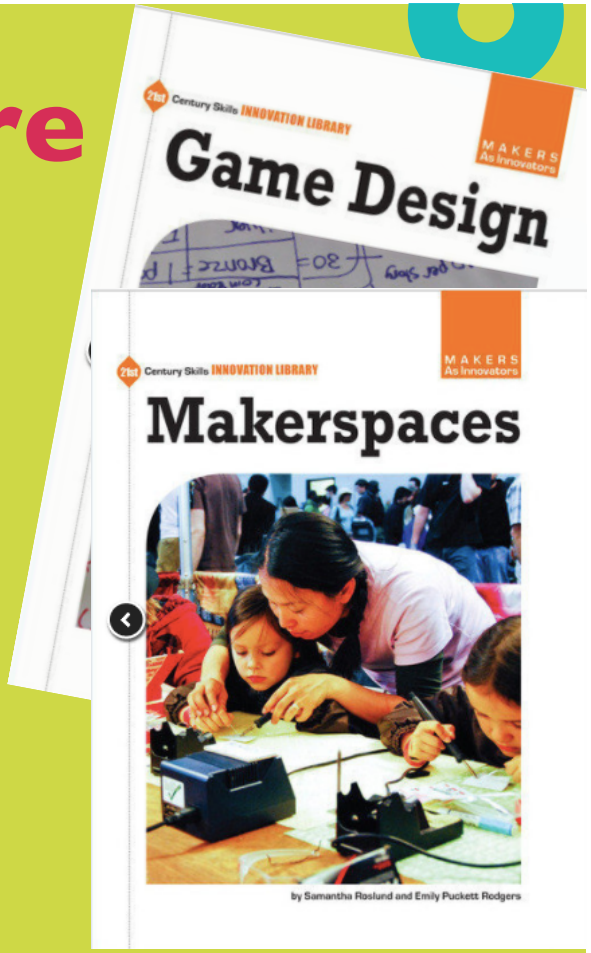
See

Weigh

Touch

Observe

Document



… without being in a program or asking first

Not just robotics and engineering

- Botany
- Zoology
- Anatomy
- Agriculture
- Medicine
- Math
- Scientific phenomena (gravity, magnetism, shadow)
- Project Management
- Executive Function practice

http://bit.ly/ambientstem

AMBIENT STEM IN YOUR LIBRARY

Low-cost strategies for making STEM part of the daily fabric of children's lives

MEASUREMENT AND COUNTING TOOLS

- Measuring sticks
- Yard sticks
- Rulers
- Tape measures
- Height charts on wall
- Balance scale
- Postage scale
- Human scale
- Adding machine
- Play cash register with coins and bills
- Calculators
- Set of measuring cups and a lidded plastic bin with soda bottle tops to scoop up and measure
- Thermometer hanging outside window and another hanging inside

DATA AND COMMUNICATION TOOLS

- Graph paper (download at printfreegraphpaper.com)
- Handheld-sized dry erase boards and markers
- Presentation software
- Excel & Google Sheets for crunching data by youth
- Google Forms for collecting survey data by youth

MODELING, PROTOTYPING, AND ENGINEERING MATERIALS

- LEGO, K'nex, Tinkertoys, Lincoln Logs
- 3-D Modeling
- Buildwithchrome.com (online LEGOs)
- LEGO WeDo
- LEGO Mindstorm
- Junk box for one of a kind creations
- Empty boxes for stacking
- 2x4s cut into various lengths – have kids sand and paint them
- Cardboard
- Playdough

CONTINUED ON PAGE 2

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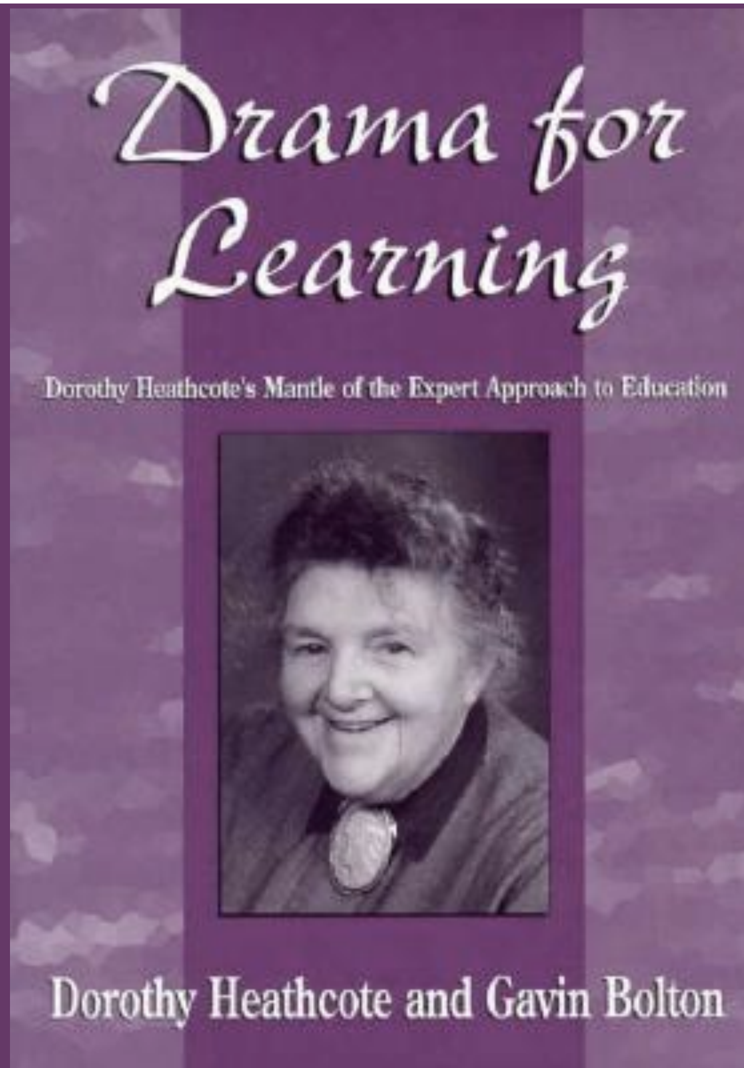
3

A Mindset of Play

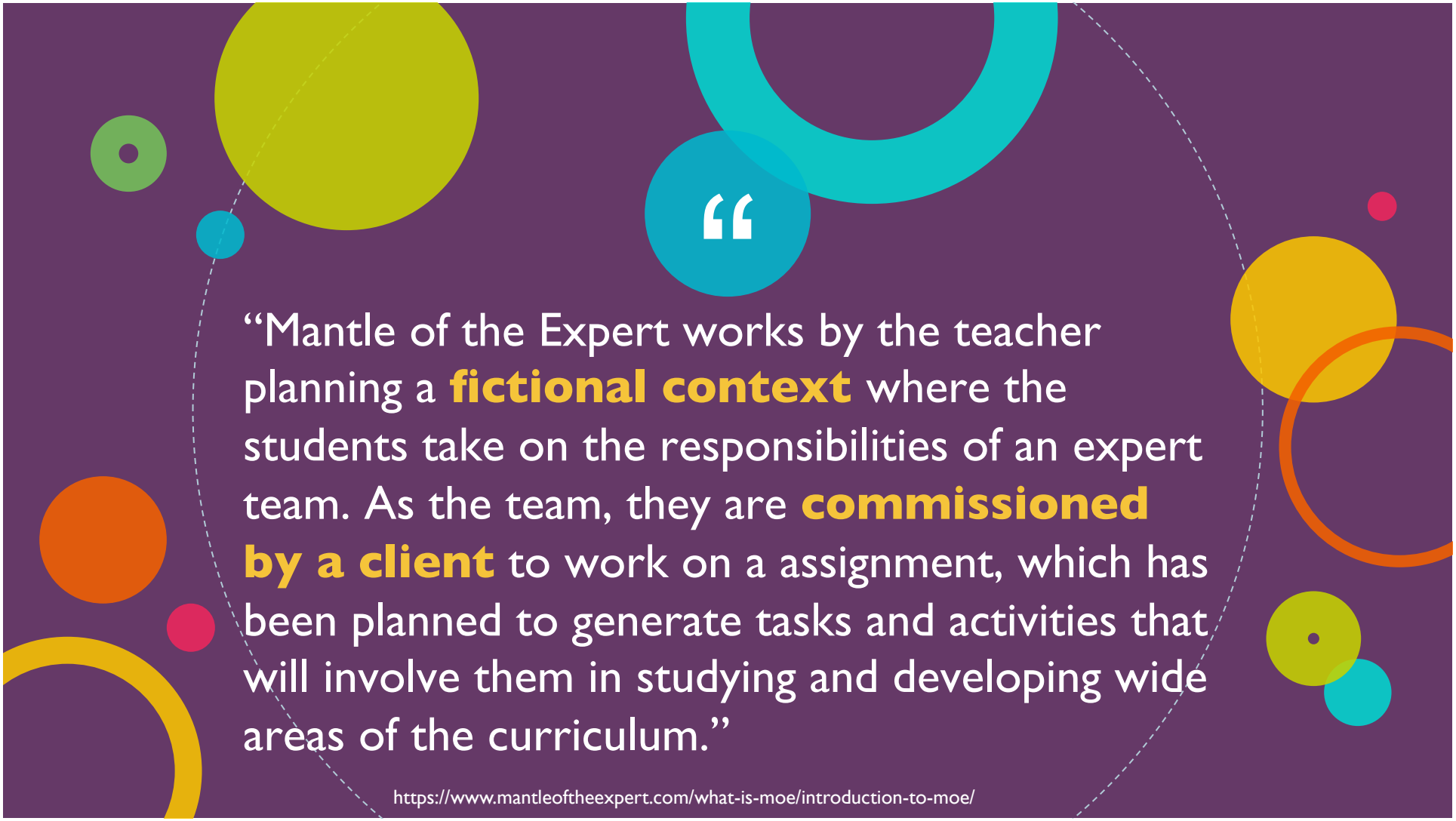
Mantle of the Expert



Heathcote, Dorothy, and Gavin M. Bolton. 2010. Drama for learning Dorothy Heathcote's mantle of the expert approach to education. Portmouth, NH: Heinemann. ISBN 9780435086435

“Mantle of the Expert is an education approach that uses **imaginary contexts** to generate **purposeful** and **engaging activities** for **learning**.

https://www.mantleoftheexpert.com/what-is-moe/introduction-to-moe/


“Mantle of the Expert works by the teacher planning a fictional context where the students take on the responsibilities of an expert team. As the team, they are commissioned by a client to work on a assignment, which has been planned to generate tasks and activities that will involve them in studying and developing wide areas of the curriculum.”
https://www.mantleoftheexpert.com/what-is-moe/introduction-to-moe/

MoE: Clothes Make the (Wo-)Man”

Lab Coats

Goggles

Gloves

Clipboards

Lab Notebooks

Magnifying Glasses

Solving Problems in Role

See selves as professionals

Adds a theatrical tension

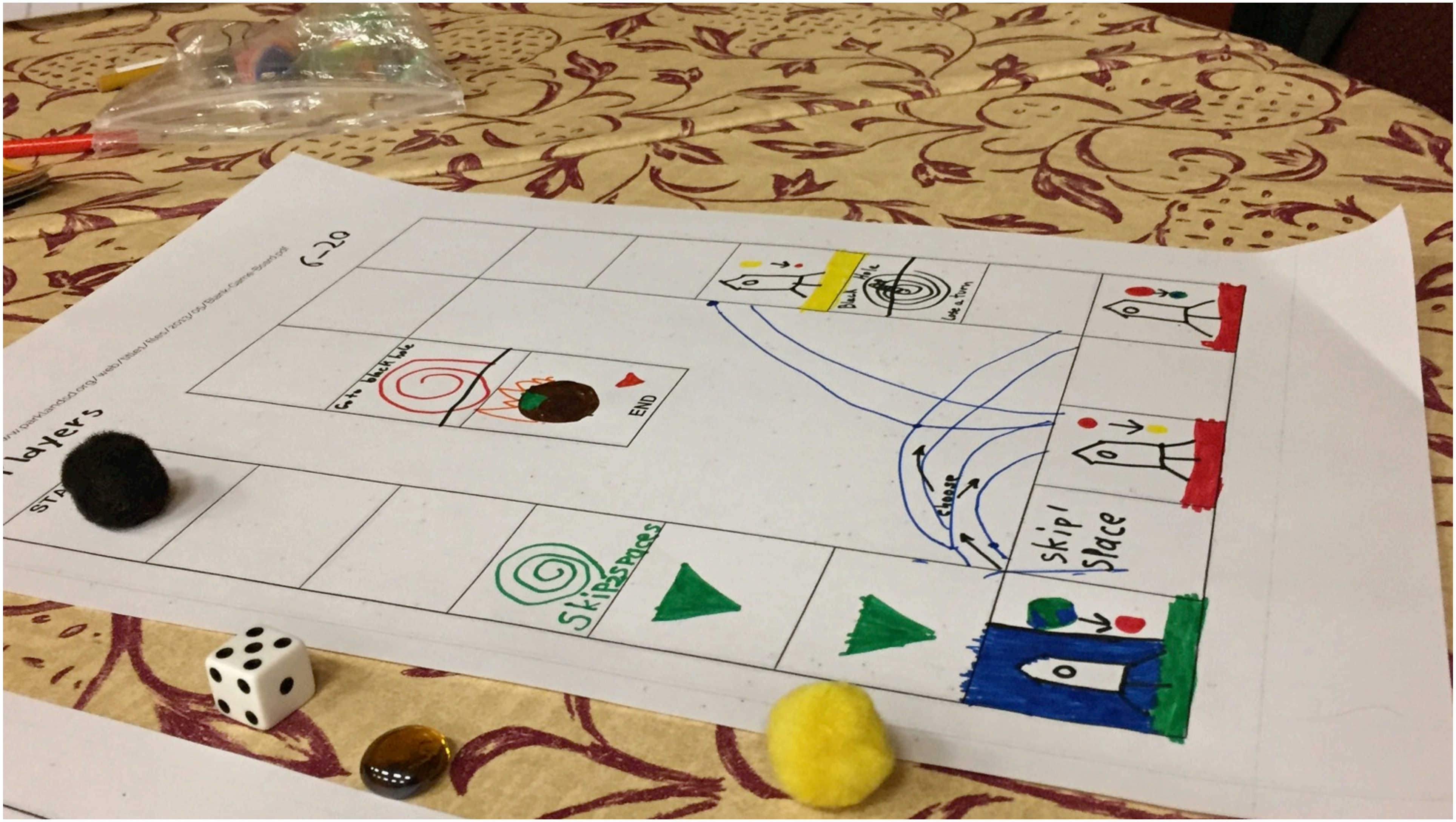
Turns STEM toys into problem-solving tools

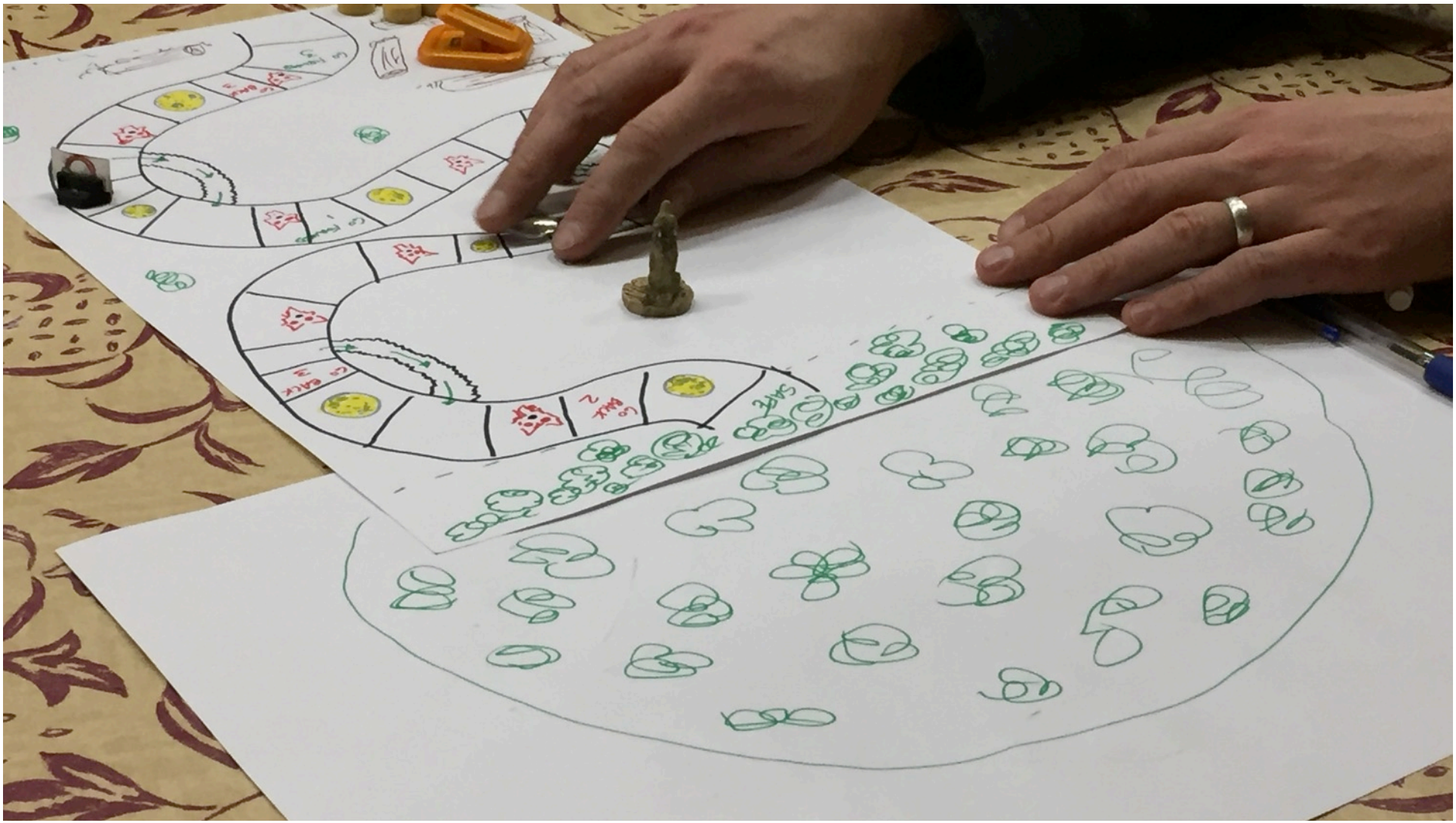
4

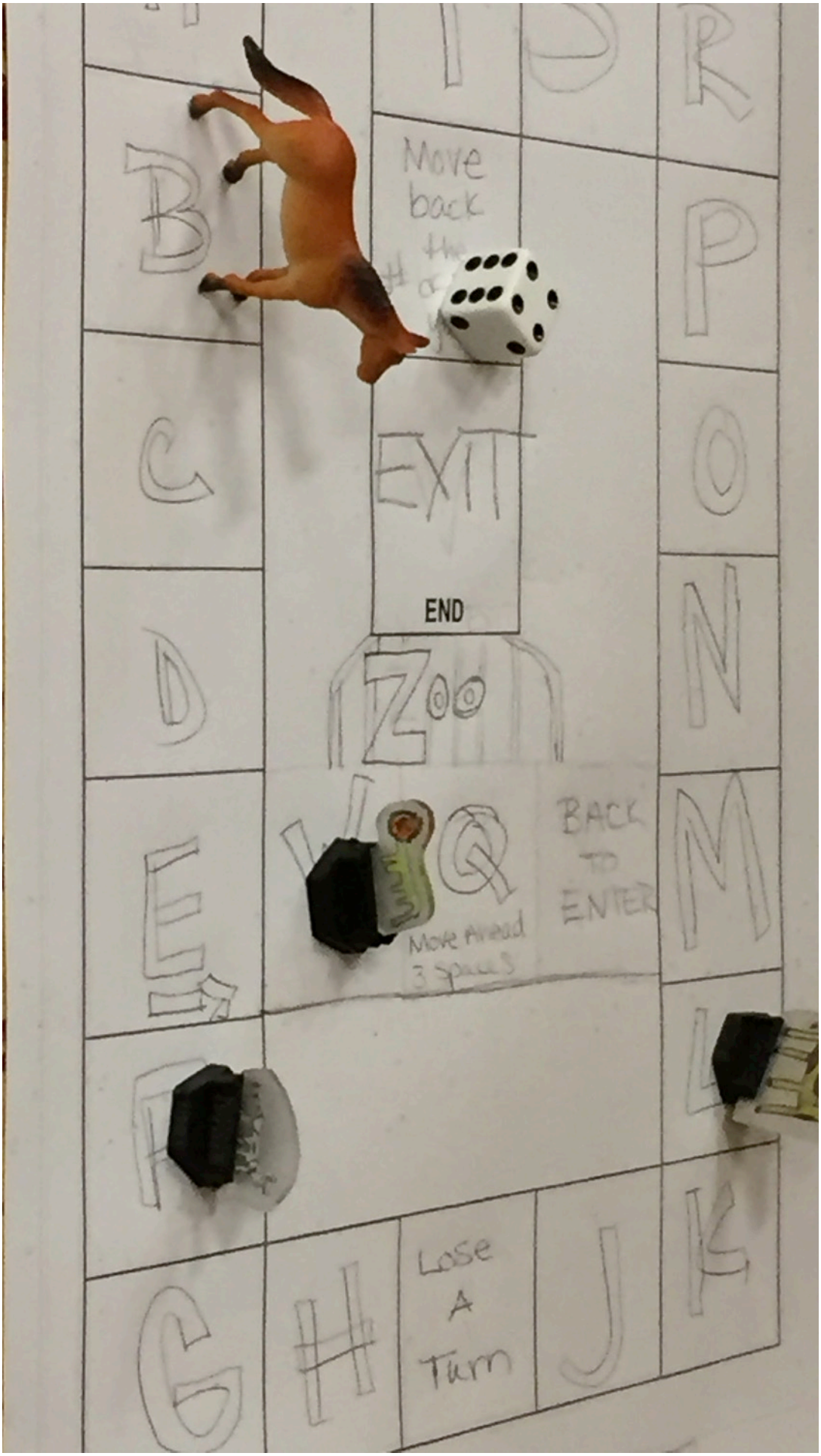
Planning for Play

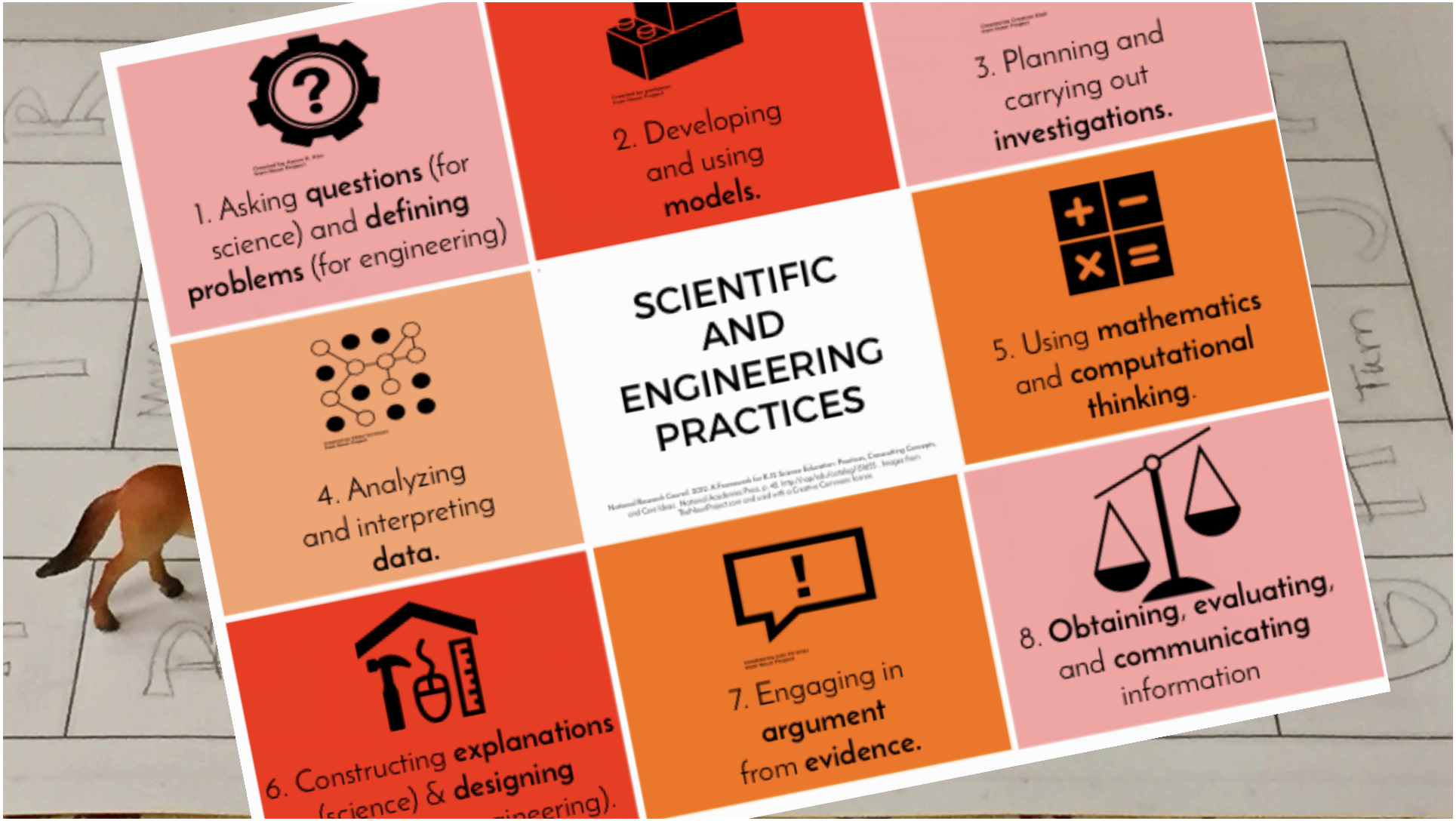
Designing Playful STEM Events

Community Board Game Design


6-20
Go to black hole
END




Move back
EXIT
END
Zoo
BACK TO ENTER
Move Ahead 3 spaces
Lose A Turn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Pizza, Prototype, and Pitch

Holiday Toy of the Year*

*But the factory can't afford new materials

Video Game Company

Robot Theatre Company

Design Thinking Game

Design Thinking Game

makinglibraries.si.umich.edu/handbook/

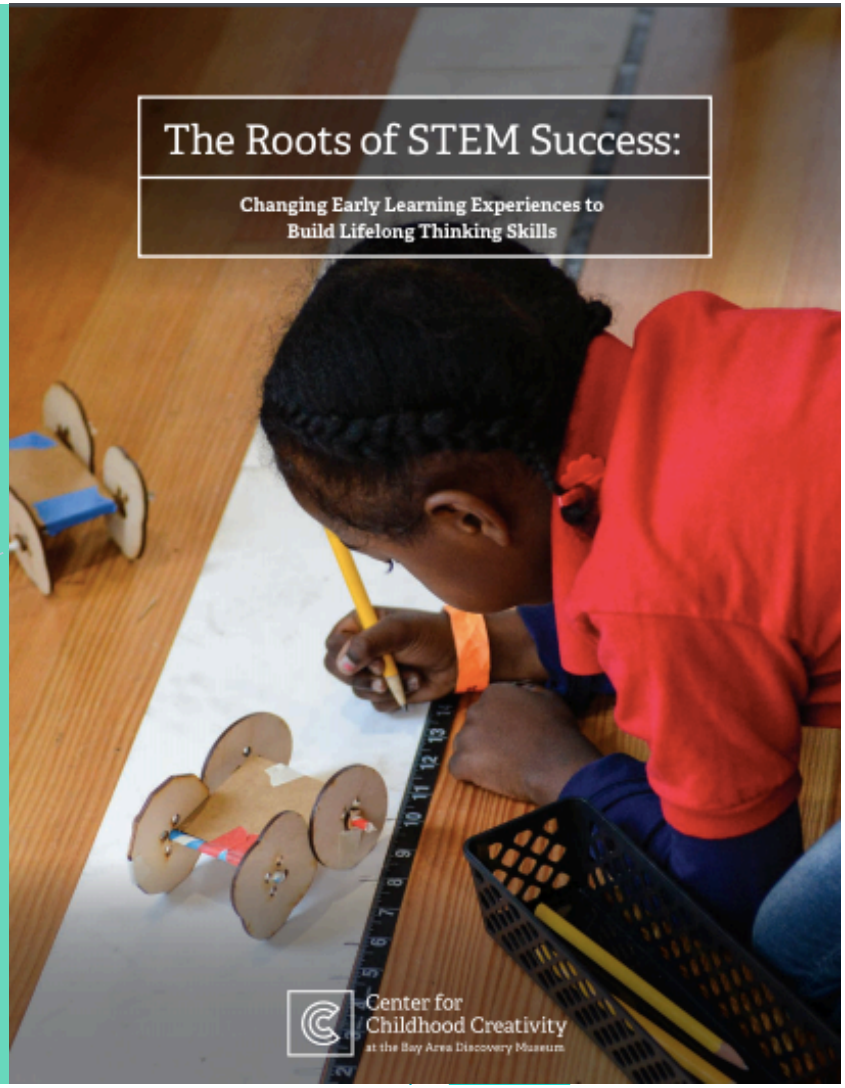
5

Recommended Reading

The Roots of STEM Success

1. STEM thinking begins in infancy.
2. To become strong STEM thinkers, children need more play.
3. STEM amplifies language development; language enables STEM thinking.
4. Active, self-directed learning builds STEM skills and interest.
5. Mindset matters to STEM success.
6. Children's abstract thinking potential can be unlocked through both adult support and executive function skill development.

http://bit.ly/roots-stem

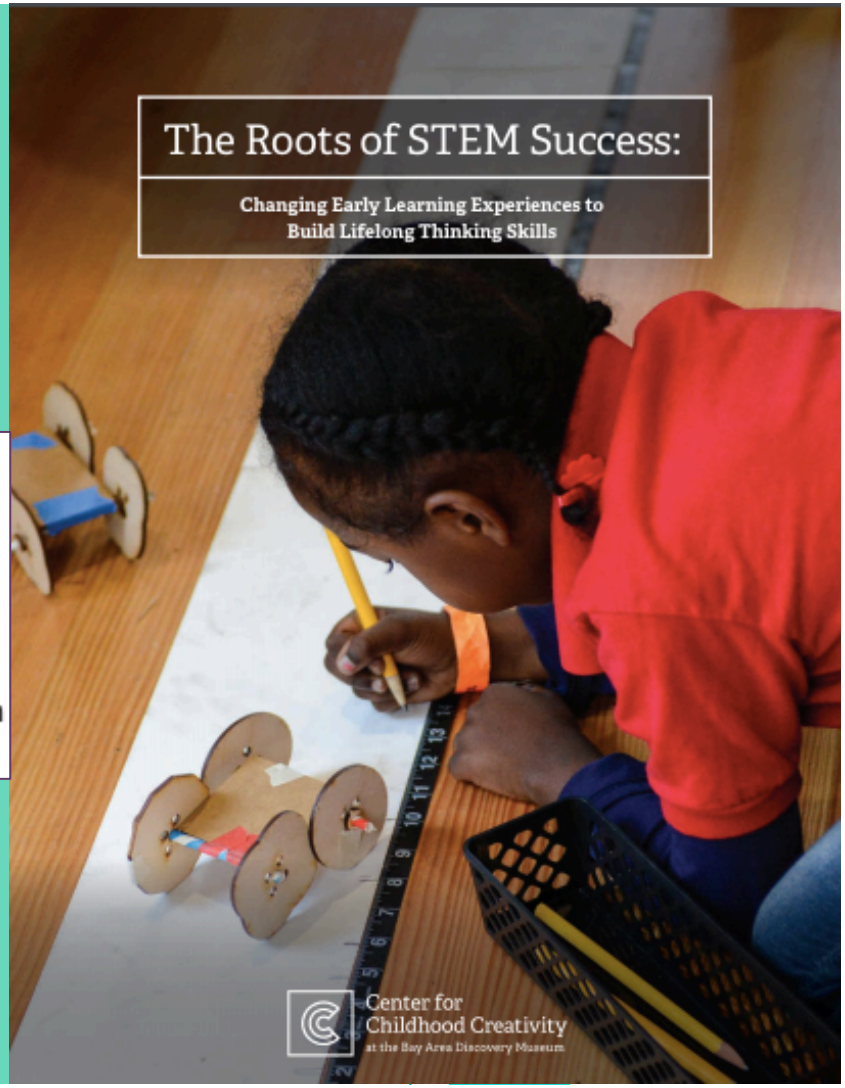


Develop children's executive function skills by providing opportunities to make plans, execute them, and reflect on their plans. Record a plan together and refer to it while completing each step. After the plan is finished, ask your child to notice if they accomplished what they set out to do, and where and how they deviated from their plan. Are they satisfied with the final project? What would they change?

Invite children to investigate the simple machines and functional tools around your house (e.g., kitchen tools like can openers; parts of your home that move or have variable functions like doors/ hinges and adjustable shower heads; everyday tools like scissors and pencils). Ask them to explain to you how these objects work.

Teach children about the concept of brain plasticity: the brain is a muscle they can shape and grow, and they will improve skills with practice. Teach them to say "I can't do this yet."

http://bit.ly/roots-stem



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Your Turn ...
Questions?

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