

Engineering Design In ECE

Beth VanMeeteren - Carrie Lynne Draper - Peggy Ashbrook



Supporting young children's creative thinking using problems **they** care about.

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POLL

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Young children as engineers?



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Goals for webinar
Use the lens of DAP to:
1. Examine Early Engineering
2. Analyze Examples

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Flipping Perspectives



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Practicing Engineers:

- **Need to know science**
- Create designs for:
 - structures
 - machines
 - processes
- Understand & Predict how a design works
- Are respectful



http://news.cornell.edu/sites/default/files/styles/full_size/public/2018-08/0830_engineering4.jpg?itok=-3j7CKQr

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Focus of Many Early Engineering Curricula

- Need to know science
- **Create designs for:**
 - structures
 - machines
 - processes
- Understand & Predict how a design works
- Are respectful



Engineering Design Process

- Define a problem
- Imagine a solution
- Draw a plan
- Build your solution
- Test your solution
- Improve your solution

http://news.cornell.edu/sites/default/files/styles/full_size/public/2018-08/0830_engineering4.jpg?itok=-3g7CKOr

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Practicing Engineers



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Engineering Habits of Mind

1. Systems Thinking
2. Creativity
3. Optimism
4. Collaboration
5. Communication
6. Attention to Ethical Considerations



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Developmental Engineering



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Engineering Habits of Mind

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Practicing Engineers vs Developing Engineers

Practicing Engineers:

- Engineer for others' purpose
- Use science to engineer
- Design under constraints

Developing Engineers:

- Engineer for their own purpose
- Use engineering to learn science
- Design under constraints



<https://www.carnier.com/carnieruniversity/en-us/>



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Flipping Perspectives



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Flipping Perspectives



Developmental
Engineering

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Noticing and Naming
Developmental Engineering



A novel way to use ordinary materials as tools to solve a problem that is important to them



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Noticing and Naming
Developmental Engineering



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Noticing and Naming
Developmental Engineering



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Noticing and Naming
Developmental Engineering



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Noticing and Naming
Developmental Engineering



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Noticing and Naming
Developmental Engineering



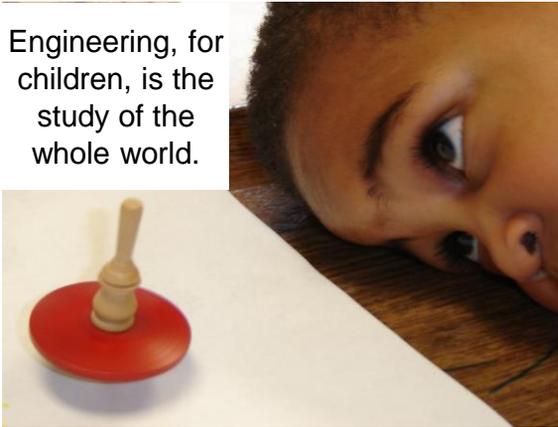
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Noticing and Naming Developmental Engineering



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Engineering, for children, is the study of the whole world.



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Supporting Children's Engineering



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Developmental Engineering

Designing a process to safely make tops is also engineering.



What is a good length for a spindle for a top?

How can I get the body where I want it on the spindle?

I want to change and test the length of the spindle, and where the wheel is placed on the spindle to figure out what works best...

I need to use safety practices if I want to use tools to cut a dowel to make a spindle.

Where is the best place to strike the wheel with a hammer to get it to move up or down a spindle?

How can I record what I am trying?

How can I use my records as evidence to make a claim?

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Developmental Engineering

Designing a process to safely make tops is also engineering.



Systems thinking

Creativity

Optimism

Communication

Collaboration

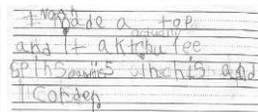
Attention to Ethical Considerations

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Spontaneously writing a reflection on the experience



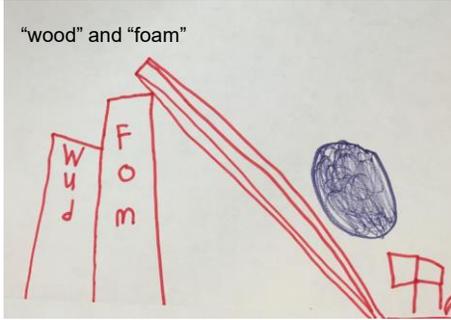
Noah
Age 6



I made a top and it actually spins and it is 5 inches and 1 quarter.

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Planning and Documenting Designs



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Planning and Documenting Designs

Try making a quick sketch of a block structure you would make using just these four blocks:



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Planning and Documenting Designs



Photography, rather than drawing, is another way to document children's designs.

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POLL

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Creating an environment to support engineering
Materials



Systems thinking Creativity Optimism
Communication Collaboration Attention to
Ethical Considerations

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Creating an environment to support engineering
Materials



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Creating an environment to support engineering

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Systems thinking
Communication

Creativity
Collaboration

Optimism
Attention to Ethical Considerations

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Creating an environment to support engineering

Materials



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Creating an environment to support engineering

Materials



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Begin with the child's idea



- 1. Producible
- 2. Immediate
- 3. Observable
- 4. Variable ← Developmental Engineering

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Creating an environment to support engineering Materials and Child-Set Challenges



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Creating an environment to support engineering Materials



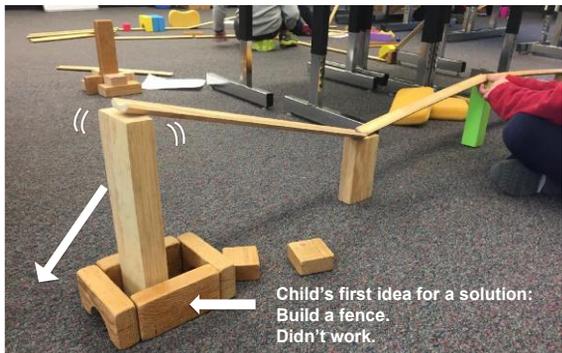
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How do you help children benefit from failure?



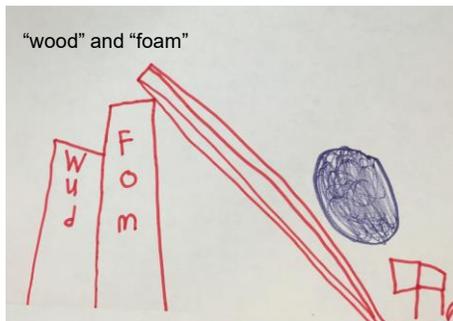
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How do you help children benefit from failure?



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Observing Differences, Benefits, and Drawbacks of Materials



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A Child Who Acted Out



In School:

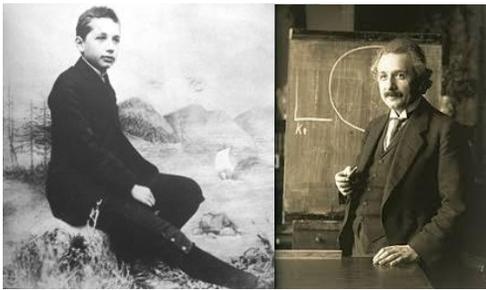
- Slow verbal development
- Hated strict rules and rote learning

Out of School:

- Curious about ordinary things
- Loved to build & construct
- Loved to figure things out

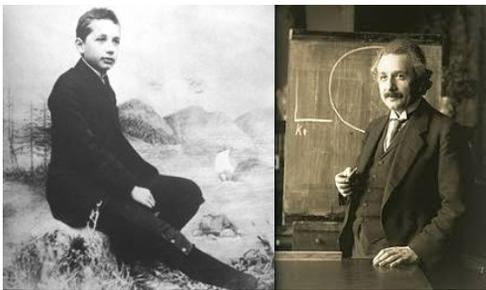
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Albert Einstein



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“It’s not that I’m so smart. It’s just that I stay with problems longer.”



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Executive Functions

Inhibitory Control (self-control)

- resisting temptations, distractions

Working Memory

- mentally holding and using information

Cognitive Flexibility

- adjusting to change



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What helps develop executive functions?

Experiences that require

- a challenge to hold in mind previous beliefs while they develop and discard potential theories
- strategy and reflection
- logic and reasoning
- problem-solving
- think about categorization



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Engineering experiences that start with us!

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Young Engineers at Work



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Adults need to experience engineering design work to best understand how to support children.

End Effector



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Two other designs of an end effector

See link to video in handout



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Explore Math and Science Experiences to Promote Engineering Habits of Mind



- **Obstacle Course**
- **Geometric & Spatial Hunt**
- **Direction Mission**
 - *Across* the bars
 - *Up* the ladder
 - *Down* the slide
 - *Through* the tunnel
 - *Under* the jungle gym

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Explore Math and Science Experiences to Promote Engineering Habits of Mind



Child-Designed Play Spaces

Photo by Rachelle Doorley, <https://tinkerlab.com/fridge-box-imaginative-play/>

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Documenting



- Print outs of children's work for discussion
- Slow motion feature on cell phones for action

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Trusted resources for more in-depth learning about STEM in early childhood.



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Thank you for supporting children's
engineering design thinking!

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