Preschool Engineering

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STEM experiences are naturally part of what children experience every day through play and interactions with others. Many of the materials we need to involve students in STEM activities are already used in early childhood classrooms. Our mission as teachers is to provide a learning environment that encourages children to engage in scientific and engineering practices with these materials. In this session, you will learn about and experience ways to help young children participate in engineering activities. This will include having students:

1. Ask questions and identify problems
2. Construct models
3. Test and evaluate designs
4. Redesign
5. Talk, draw, and write about their investigations

Improving STEM education is a high priority for our region, state, and nation and is critical for our future related to scientific discovery and innovation, job preparation, and a STEM-literate society. You can get students off to a great start in your work as early childhood educators.

Engaging Students in Engineering

- Provide materials and time
- Sequence explorations intentionally
    - Provide opportunities to explore in open-ended ways
    - Move onto focused exploration
        - Encourage kids to problem solve and invent multiple solutions
        - Give regular building and design challenges
        - Focus on the iterative process
- Encourage collaboration
- Integrate talk, drawing, writing, reading, and math
- Consider an Engineering Center, Inventor Lab, or Maker Space

Recommended Engineering-Related Resources

Boyarshinov, A., & Hand, J. (2014). *STEAM: Preschool activities for STEM enrichment.*

Chalufour, I., & Worth, K. (2004). *Building structures with young children.* Red Leaf Press: St. Paul, MN.

DiscoverE. http://www.discovere.org/ (Engineering activities and resources)

Hoisington, C., & Winokur, J. (2015). GIMME AN "E"! Seven strategies for supporting the "E" in young children's STEM Learning. *Science & Children*, *53*(1), 44-51.

NAEYC Early Childhood Science Interest Forum Blog (ECSIF). http://ecsif.blogspot.com/

NAEYC Early Childhood Science Interest Forum Facebook Page. https://www.facebook.com/Early-Childhood-Science-Interest-Forum-naeyc-140431919391071/

Next Generation Science Standards. http://nextgenscience.org

NSTA Early Years Blog. Tips and classroom resources for early childhood school science educators. http://nstacommunities.org/blog/category/earlyyears/

Worth, K. & Grollman, S. (2003). *Worms, shadows, and whirlpools: Science in the early childhood classroom.* Portsmouth, NH: Heinemann.

*Follow me on Pinterest. See Engineering board.

Sample Engineering Challenges

Marshmallow Challenge
http://marshmallowchallenge.com
"The Marshmallow Challenge is a remarkably fun and instructive design exercise that encourages teams to *experience* simple but profound lessons in collaboration, innovation and creativity. The task is simple: in eighteen minutes, teams must build the tallest free-standing structure out of 20 sticks of spaghetti, one yard of tape, one yard of string, and one marshmallow. The marshmallow needs to be on top."

Marble Runs
"Gather some toilet paper and paper towel rolls, painter's tape, and marbles. Find an open wall or sliding glad door that you can tape the cardboard tubes to. Tilt the tubes to create ramps and tape them in place. Test and experiment until you find a flow that works. Challenge your child to create a super tall marble run or a long and winding marble run. This experience is filled with lots of trial and error that teaches iteration and how to overcome small failures." (Boyarshinov & Hand, 2014)

Gutters and Balls
"This is a fun one to take outdoors. Offer your child a few pool noodles that have been sliced in half (vertically) or storm gutters and invite him to prop them against various surface to create ramps. How fast can he get marbles, balls, or toy cars to scoot down the ramps?" (Boyarshinov & Hand, 2014)

Designing and Building Bridges
http://theimaginationtree.com/2013/04/designing-and-building-bridges-activity.html
Challenge: Can you design and build a bridge using every day and recycled materials? Your bridge needs to hold a 1kg (approximately 2 lb.) weight. Supplies: Many drinking straws, tape, 2 building blocks for bridge support, and a 1 kg bag of sugar as a weight to test.

Balancing Bottle Boat
The challenge is for students to build a bottle boat that will float across a pool. Gather recycled materials such as empty water bottles, containers, lids, and painters tape. Try to choose materials that will be water resistant. When the boat is ready, test it out and talk about what happened. Did the boat stay balanced? What worked well? How could you change the design so the boat would be better balanced? Try out new ideas. Build-Test-Play! (Boyarshinov & Hand, 2014)

Portable Water Wall
Gather upcycled materials such as funnels, hoses, tubes, and plastic bottles. You will also need tape and a long shallow Tupperware container with a lid. Students will tape the upcycled materials to the lid for water to go through. You may need to help them get started by taping a funnel or funnel-like object for the start of the water run. Show how you can reinforce the tape by crossing the tape and making a +. Let the students assemble the hoses, bottles, and containers where they want. Set the bottom on the container underneath your water wall to collect water and try to water wall out. Dry it off and re-tape and move pieces around as needed. Possible extension: Create as many zig-zags as you can. (Boyarshinov & Hand, 2014)

Build a Rain Shelter
Layout different building materials. The students are challenged to create a shelter to keep a toy dry. Once the shelter is complete, test it out by squirting with water simulating rain. Check to see if the shelter kept the toy dry. If not, redesign and rebuild. Extensions: Use a fan to see if your shelter can withstand wind. Test your shelter in real rain. (Boyarshinov & Hand, 2014)

Classroom Materials to Support Engineering and Invention

Building materials
- Blocks
- Legos and Duplos
- Tinker Toys
- Lincoln Logs

Sand and water tables
Toy cars and trucks
Wheels
Toy parts
Broken toys (that are still safe)
Pool noodles
Boxes
Cardboard
Cardboard Tubes
Cups
Bottles and jugs
Egg cartons
Bottle tops
Buttons
Beads
Bubble wrap
Styrofoam
Cotton balls
Craft sticks
Empty spools of thread
Tape, tape, tape (Scotch, masking, painter's, duck, packing)
Rubber bands
Glue
String
Clips
Scissors
All kinds of paper

Supplies for STEM Challenges: Sample Parent Letter

http://www.theeducatorsspinonit.com/2015/07/create-inventor-supply-lab-with.html

Dear Parents,

I am so very excited to learn and grow with your child this year. In addition to our traditional curriculum, we are going to be adding in some STEM challenges throughout the year. We could use your help in collecting and sending in clean materials for the children to use. These materials will be shared and will not be returned to you.

The students will be responsible for organizing and using our Inventor Supply Lab. If you are interested in volunteering to help with the Inventor Supply Lab or during our STEM explorations, please e-mail me at awesometeacher@email.com

We are currently accepting.

- empty and dry water bottles
- cardboard tubes
- wheels of any kind
- tape, tape, and more tape
- cereal boxes
- packing supplies such as foam and bubble wrap
- rubber bands
- plastic cups
- craft supplies such as paper clips and ribbons

Thank you so much for your help!

Make sure to ask your child about their inventions throughout the year.

From,
Awesome Teacher

Preschool Engineering

DIGGING DEEPER: EXPLORING SCIENCE WITH YOUNG CHILDREN
DR. PATRICIA BRICKER
BRICKER@EMAIL.WCU.EDU

Western Carolina University

Our Agenda

1. Introductions
2. Our Own Design Experience: Marshmallow Challenge
3. The Bigger Picture
   a. What is Engineering?
   b. Engineering-related Standards
   c. Engaging Students in Engineering
   d. Quality Criteria
4. Explore and Share Engineering Activities

The Challenge

- ✦ Build the Tallest Freestanding Structure
- ✦The Entire Marshmallow Must be on Top
- ✦Use as Much or as Little of the Kit (Cannot use bag)
- ✦Can break up the Spaghetti, String or Tape
- ✦The Challenge Lasts 18 minutes

http://www.lessoncast.com/lesson/marshmallow-challenge-intro-to-engineering-design-process/

http://marshmallowchallenge.com

Sample Building Challenges

How tall can you make it?

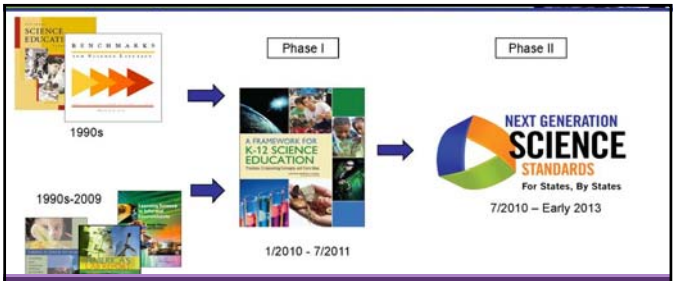
How strong can you make it?

Build a tunnel you can crawl through.

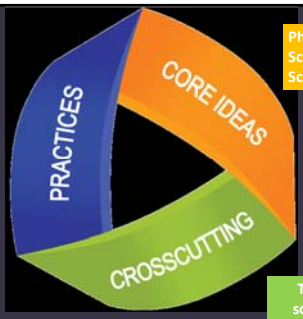
Build something as a team.

Build something in 5 minutes.

Unbuild. Slowly take apart a tower until it tumbles down.



The Big Picture of Science Education
https://www.youtube.com/watch?v=SEc1ENq3FSs



Science and Engineering Practices

1. Asking questions and defining problems
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics, information and computer technology, and computational thinking
6. Constructing explanations and designing solutions
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

Framework pp.41-82

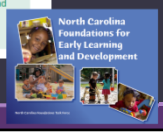
Cognitive Development (CD) (continued)

Mathematical Thinking and Expression

- Goal CD-10: Children show understanding of numbers and quantities during play and other activities.
- Goal CD-11: Children compare, sort, group, organize, and measure objects and create patterns in their everyday environment.
- Goal CD-12: Children identify and use common shapes and concepts about position during play and other activities.
- Goal CD-13: Children use mathematical thinking to solve problems in their everyday environment.

Scientific Exploration and Knowledge

- Goal CD-14: Children observe and describe characteristics of living things and the physical world.
- Goal CD -15: Children explore the natural world by observing, manipulating objects, asking questions, making predictions, and developing generalizations.



Cognitive Development (CD)

Construction of Knowledge: Thinking and Reasoning

- Goal CD-1: Children use their senses to construct knowledge about the world around them.
- Goal CD-2: Children recall information and use it for new situations and problems.
- Goal CD-3: Children demonstrate the ability to think about their own thinking: reasoning, taking perspectives, and making decisions.

Creative Expression

- Goal CD-4: Children demonstrate appreciation for different forms of artistic expression.
- Goal CD-5: Children demonstrate self-expression and creativity in a variety of forms and contexts, including play, visual arts, music, drama, and dance.

Social Connections

- Goal CD-6: Children demonstrate knowledge of relationships and roles within their own families, homes, classrooms, and communities.
- Goal CD-7: Children recognize that they are members of different groups (e.g. family, preschool class, cultural group).
- Goal CD-8: Children identify and demonstrate acceptance of similarities and differences between themselves and others.
- Goal CD-9: Children explore concepts connected with their daily experiences in their community.

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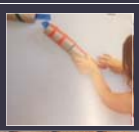
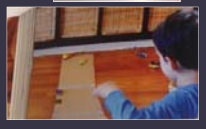
Criteria for Quality Preschool Engineering Activities

- Engages students in:
  - Solving problems
  - Constructing models
  - Testing and evaluating designs
  - Redesigning
  - Talking, drawing, and writing
- Developmentally appropriate
- Realistic





Exploring Engineering Challenges

Read the activity description.

Consider:

- In what ways does it engage kids in engineering?
- Is it developmentally appropriate? Why or why not?
- Is it realistically do-able?
- How might you use this activity?

Be prepared to share.