LAUSD Elementary Engineering

SINK THE WOOD CHALLENGE

Kindergarten – Physical Science

PURPOSE

IN THE <u>SINK THE WOOD CHALLENGE</u>, STUDENTS WILL:

- Design and execute a process for sinking wood using the least number of paperclips possible
- Exhibit understanding of relevant science content/concepts
- Construct relevant questions
- Use appropriate tools and materials to complete task
- Determine effective ness of their design/process
- Answer the Focus Question: <u>How can you find out exactly how many paperclips it takes to sink particleboard and redwood?</u>

NEXT GENERATION SCIENCE STANDARDS (NGSS)

Students who demonstrate understanding can:

K-2-ETS1-1. **Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.**

K-2-ETS1-2. **Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.**

K-2-ETS1-3. **Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.**

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Asking Questions and Defining Problems
Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions.
- Ask questions based on observations to find more information about the natural and/or designed world(s). (K-2-ETS1-1)
- Define a simple problem that can be solved through the development of a new or improved object or tool. (K-2-ETS1-1)

Developing and Using Models
Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions.
- Develop a simple model based on evidence to represent a proposed object or tool. (K-2-ETS1-2)

Analyzing and Interpreting Data
Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations.
- Analyze data from tests of an object or tool to determine if it works as intended. (K-2-ETS1-3)

Disciplinary Core Ideas

ETS1.A: Defining and Delimiting Engineering Problems
- A situation that people want to change or create can be approached as a problem to be solved through engineering. (K-2-ETS1-1)
- Asking questions, making observations, and gathering information are helpful in thinking about problems. (K-2-ETS1-1)
- Before beginning to design a solution, it is important to clearly understand the problem. (K-2-ETS1-1)

ETS1.B: Developing Possible Solutions
- Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. (K-2-ETS1-2)

ETS1.C: Optimizing the Design Solution
- Because there is always more than one possible solution to a problem, it is useful to compare and test designs. (K-2-ETS1-3)

Crosscutting Concepts

Structure and Function
- The shape and stability of structures of natural and designed objects are related to their function(s). (K-2-ETS1-2)

Connections to K-2-ETS1.A: Defining and Delimiting Engineering Problems include:
Kindergarten: K-PS2-2, K-ESS3-2
Connections to K-2-ETS1.B: Developing Possible Solutions to Problems include:
Kindergarten: K-ESS3-3, **First Grade:** 1-PS4-4, **Second Grade:** 2-LS2-2
Connections to K-2-ETS1.C: Optimizing the Design Solution include:
Second Grade: 2-ESS2-1

Articulation of DCIs across grade-levels:
3-5.ETS1.A (K-2-ETS1-1),(K-2-ETS1-2),(K-2-ETS1-3); **3-5.ETS1.B** (K-2-ETS1-2),(K-2-ETS1-3); **3-5.ETS1.C** (K-2-ETS1-1),(K-2-ETS1-2),(K-2-ETS1-3)

Common Core State Standards Connections:

ELA/Literacy —
RI.2.1 Ask and answer such questions as *who, what, where, when, why,* and *how* to demonstrate understanding of key details in a text. (K-2-ETS1-1)
W.2.6 With guidance and support from adults, use a variety of digital tools to produce and publish writing, including in collaboration with peers. *(K-2-ETS1-1),(K-2-ETS1-3)*
W.2.8 Recall information from experiences or gather information from provided sources to answer a question. (K-2-ETS1-1),*(K-2-ETS1-3)*
SL.2.5 Create audio recordings of stories or poems; add drawings or other visual displays to stories or recounts of experiences when appropriate to clarify ideas, thoughts, and feelings. *(K-2-ETS1-2)*

Mathematics —
MP.2 Reason abstractly and quantitatively. *(K-2-ETS1-1),(K-2-ETS1-3)*
MP.4 Model with mathematics. *(K-2-ETS1-1),(K-2-ETS1-3)*
MP.5 Use appropriate tools strategically. *(K-2-ETS1-1),(K-2-ETS1-3)*
2.MD.D.10 Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph. (K-2-ETS1-1),(K-2-ETS1-3)

CA ENGLISH LANGUAGE DEVELOPMENT CONNECTIONS

- **P1.K.A.1**: Exchanging information and ideas with others through oral collaborative conversations on a range of social and academic topics
- **P1.K.A.3**: Offering and supporting opinions and negotiating with others in communicative exchanges
- **P1.K.C.9**: Expressing information and ideas in formal oral presentations on academic topics
- **P1.K.C.11**: Supporting own opinions and evaluating others' opinions in speaking and writing

SPECIAL EDUCATION (SPED):

To make accommodations or modifications for students with special needs, provide simple directions, instructions, provide multiple opportunities for repetition, make frequent checks for understanding, use visuals to accompany all vocabulary, simplify questions, be specific with sequence and steps, provide opportunity for paraphrasing, and adjust time and pacing.

THE ENGINEERING DESIGN PROCESS (EDP)

ENGINEERING DESIGN PROCESS (EDP)

ASK

- What is the **problem** or **need**?
- What is already out there?
- What are the **requirements (criteria)** and **restrictions (constraints)**?

BRAINSTORM

- What are possible **solutions**?
- Choose your two best solutions.

CREATE - A - DESIGN

- **Draw** a diagram with labels.
- Have a critical design review (peer review & input).
- What materials are available?

DEVELOP - A - PROTOTYPE

- Follow your best diagram and **build** a prototype.
- **Test** the prototype!

EVALUATE

- **Improve** your prototype!
- Conduct more compatibility tests.

BACKGROUND FOR THE TEACHER

You may teach this lesson once students have completed:

FOSS CA – WOOD AND PAPER

- **Investigation 1, Parts 1-4**

In Investigation 1, Part 4, students have figured out how to sink wood using paper clips and rubber bands. In this Engineering Challenge, students will refine their skills.

(This Engineering Challenge is a modification of Inv.1, Part 5)

MATERIALS

FOR EACH TEAM (2 students)

- 2 Particleboard samples
- 2 Redwood samples
- 1 Clear basin
- 1 Plastic cup
- 40 Paper clips, jumbo

FOR THE LESSON

- Individual student engineering notebooks
- Pine sample
- 50 Rubber bands, #8
- 1 Plastic cup
- Sponges
- Water *
- Paper towels*
- Newspaper*
- Teacher sheet no. 5, *Center Instruction Card – Sinking Investigation*

* Supplied by the teacher

GETTING READY

1. **Schedule the Engineering Challenge**
   The challenge requires 20 - 30 minutes at the center for three to five teams (pairs) of students. Plan 10 minutes to introduce and 5-10 minutes to wrap up.

2. **Gather/Obtain Materials**

3. **Prepare Materials**
   Half fill the clear basins with water. The water should stay clean enough to be used with several groups. Put about 40 paper clips into a plastic cup for each pair of students. Put about 50 rubber bands in one cup for all the students at the center to share.

4. **Plan Partners/Teams**

5. **Print Focus Questions**
   Have Focus Questions printed on self-stick labels OR precut labels for gluing into Engineering Notebook - How can you find out **exactly** how many paper clips it takes to sink particleboard and redwood?

GUIDING THE ACTIVITY

Students will engage in the Engineering Design Process (EDP).

1. ASK

Setting the Context

- Call students to the rug and ask them if they were able to sink the wood samples last time they worked with these materials. How did they do it? [Attached paper clips with rubber bands to the pieces of wood.]

Present Problem or Need

- Tell students that today they are going to work with two pieces of wood and that this time they are going to find out exactly how many paper clips it takes to sink each one.

- Display the Focus Question and have students stick/glue the Focus Question into their Science Notebooks.
  How can you figure out exactly how many paper clips it takes to sink particleboard and redwood?

Present Requirements and Restrictions

- **Requirements** (Criteria) *standards that must be met; rules/directions that must be followed:*
  - Teams consist of two members.
  - The wood pieces must lie completely flat on the bottom of the basin.

- **Restrictions** (Constraints) *limitations that keep something from being the best it could be; may be problems that arise or issues that come up*:
  - Teams must figure out what is the LEAST number of paperclips required to "sink" each wood piece.

2. BRAINSTORM

- Teams gather materials (without the water basin) to assist in visualization and planning.

3. CREATE - A - DESIGN

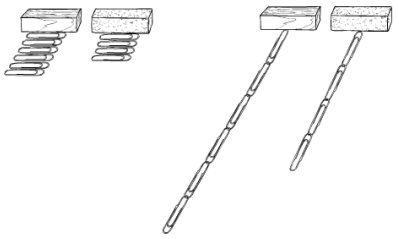
- Each member must draw a design individually, without team member input, into his/her science notebook.
  - Title the page "My design"
  - Students should label parts of their design (i.e. wood, rubber bands, paperclips) and show steps.
- Team members share designs with one another, compromise, and collaborate in order to create into a "team design" incorporating an aspect of each member's own design.
  - Title the next page in the science notebook, "Team design"
  - Team members should each draw and label parts of this collaborative design.

4. DEVELOP - A - PROTOTYPE

- Teams test their design / process.
  - Ask teams to leave the paper clips and rubber bands on the wood pieces once they have sunk them.

5. EVALUATE

- Move the water basins to another location where they will be out of the way, but easily retrieved for use with the next group.



- Tell team they will make a graph to compare the number of paper clips needs to sink the redwood and particleboard.
- Teacher facilitates discussion about student successes and challenges.
    - Draw students' attention to teams that used a fewer number of paper clips to sink their wood.
    - After observation of other designs and input from colleagues, students redesign and retest.
    - Have students answer the Focus Question in their science notebooks.
        - For scaffolding, sentence frames work well. For example, "We found out exactly how many paperclips are needed to sink our wood by _____ ."
        - If students are not yet able to write out the complete answer, students may be given a printed sentence frame to complete.
        - *Possible answer: We found out exactly how many paperclips are needed to sink our wood by adding paperclips one at a time."*