LAUSD Elementary Engineering

GUMMY BEAR CHALLENGE

Kindergarten - Earth Science

PURPOSE

IN THE <u>GUMMY BEAR CHALLENGE</u>, STUDENTS WILL:

- Design and build a structure that reduces the effects of the sun on a Gummy Bear using the Engineering Design process (EDP)
- Exhibit understanding of relevant science content/concepts
- Construct relevant questions
- Use appropriate tools and materials to complete task
- Determine effectiveness of their design
- Answer the Focus Question: <u>How can you reduce the effects of the sun on your Gummy Bear?</u>

NEXT GENERATION SCIENCE STANDARDS (NGSS)

Students who demonstrate understanding can:

K-PS3-1. **Make observations to determine the effect of sunlight on Earth's surface.** [Clarification Statement: Examples of Earth's surface could include sand, soil, rocks, and water.] [*Assessment Boundary: Assessment of temperature is limited to relative measures such as warmer/cooler.*]

K-PS3-2. **Use tools and materials to design and build a structure that will reduce the warming effect of sunlight on an area.*** [Clarification Statement: Examples of structures could include umbrellas, canopies, and tents that minimize the warming effect of the sun.]

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

Planning and Carrying Out Investigations
Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions.

- Make observations (firsthand or from media) to collect data that can be used to make comparisons. (K-PS3-1)

Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions.

- Use tools and materials provided to design and build a device that solves a specific problem or a solution to a specific problem. (K-PS3-2)

Connections to Nature of Science

Scientific Investigations Use a Variety of Methods

- Scientists use different ways to study the world. (K-PS3-1)

Disciplinary Core Ideas

PS3.B: Conservation of Energy and Energy Transfer

- Sunlight warms Earth's surface. (K-PS3-1),(K-PS3-2)

Crosscutting Concepts

Cause and Effect

- Events have causes that generate observable patterns. (K-PS3-1),(K-PS3-2)

Connections to other DCIs in kindergarten:
K.ETS1.A (K-PS3-2); **K.ETS1.B** (K-PS3-2)

Articulation of DCIs across grade-levels:
1.PS4.B (K-PS3-1),(K-PS3-2); **2.ETS1.B** (K-PS3-2); **3.ESS2.D** (K-PS3-1); **4.ETS1.A** (K-PS3-2)

Common Core State Standards Connections:

ELA/Literacy -
W.K.7 Participate in shared research and writing projects (e.g., explore a number of books by a favorite author and express opinions about them). (K-PS3-1),(K-PS3-2)

Mathematics -
K.MD.A.2 Directly compare two objects with a measurable attribute in common, to see which object has "more of"/"less of" the attribute, and describe the difference. (K-PS3-1),(K-PS3-2)

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

- **ELD.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)

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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 – TREES

- **Investigation 1 (all parts)**
- **Investigation 2 (all parts)**
- **Investigation 3 - Part 2 (Food from Trees)**

Students will have enough content knowledge to engage in The Gummy Bear Challenge. Students enter the engineering challenge understanding that trees are made up of different parts, trees have needs, and trees provide us with food and shade.

While reading the story of "A Tree Comes to Class" (Investigation 1, Part 2), emphasize the benefits of trees. The boy's (Michael's) father mentions the "shade" trees lining their street. The family also discusses the food provided by trees. These benefits, particularly that of shade, is pertinent to the engineering challenge.

Students will be challenged to mimic a tree's shade by engineering a shelter.

MATERIALS

FOR EACH TEAM (2 students)

- 3 large index cards
- ½" – ¾" masking tape (unlimited)
- 1 Gummy Bear
  - Generic gummy bears can be purchased in bulk at Smart & Final for about $2.50/lb.
  - Different brands of gummy bears may yield different results. Gummies with greater gelatin content (firmer) may maintain its integrity longer than those with less (softer).

FOR THE LESSON

- Individual student engineering notebooks
- Scissors
- Pencils
- Paper bag
- Thermometers (outdoor/indoor – found in FOSS CA: Matter & Energy kit)
  - The thermometers may vary slightly in their readings. To reduce confusion, set out all the thermometers and find pairs with the same/similar readings.
- Spotlight / Lamp (optional – for indoor use on a cloudy day - found in FOSS CA: Matter & Energy kit)
- Camera / Smartphone / Tablet (optional – for recording change throughout the day)
- Temperature gun (optional – though recommended for teacher use)

GETTING READY

1. **Schedule the Engineering Challenge**
   The challenge will take about two to three 30-45 minute sessions to complete.

2. **Gather / obtain materials.**

3. **Prepare a materials station.**
   Tape may be pre-cut into yard long strips

4. **Observe weather forecast**
   This activity works best on a sunny, warm day.

5. **Print Focus Questions**
   Have Focus Questions printed on self-stick labels OR precut labels for gluing into Engineering Notebook –
   How can you reduce the effects of the sun on your Gummy Bear?

GUIDING THE ACTIVITY

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

- **Take engineers outside.**

    - Take engineers outside on a sunny day for a stroll. Stand in direct sunlight and then under the shade of the tree. Discuss differences. *(The temperature gun would provide instant temperature readings of different areas)*

- **Take class back to room**

    - Return to classroom and review the benefits of TREES (provide food, shelter, oxygen, and shade).

    - Capture student interest by passing around a paper bag containing hidden gummy bears. Students may use their sense of smell to determine the identity of the mystery content.

    - Ask students to guess what may happen if a gummy bear were placed outside in the sunlight. Record possible answers. *(It would melt. Get sticky, etc.)*

1. ASK

Present problem or need

- Inform engineers of the PROBLEM:

"How can you keep your Gummy Bear from becoming a Gooey Bear?"

Present Focus Question: "How **can** you reduce the effects of the sun on your Gummy Bear?" *(Printed on self-stick labels)*

- Display the Focus Question and have students stick/glue the Focus Question into their Engineering Notebooks.
  How can you reduce the effects of the sun on your Gummy Bear?

Present Requirements and Restrictions

- **Requirements** (Criteria) *standards that must be met; rules/directions that must be followed*:
  - Teams consist of two members
  - The structure must be self-standing and able to be relocated (no taped down to the table)
- **Restrictions** (Constraints) *limitations that keep something from being the best it could be; may be problems that arise or issues that come up*:
  - Use only the materials supplied by teacher
  - The team design must incorporate an aspect of each team member's design
  - Structures must be large enough to house most of the thermometer. (Structures may be smaller if using a temperature gun.)

2. BRAINSTORM

- Students may suggest placing the Gummy Bear in the shade of a tree. Ask what they might be able to do or create if no trees were available.

- Encourage students to come up with their OWN solutions, questions about criteria and constraints.

3. CREATE - A - DESIGN

- Observe materials, discuss properties of materials and imagine how they might be utilized.

- Each member must draw a design individually, without team member input, into his/her engineering notebook.
  - Title the page "My design"
  - Students should label parts of their design (i.e. gummy bear, wall, roof) (SL.K.5) (K.MD.A.2)

- 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. (SEP-1)
  - Title the next page in the engineering notebook, "Team design"
  - Team members should each draw and label parts of this collaborative design (SL.K.5) (K.MD.A.2)

4. DEVELOP - A - PROTOTYPE

- Build It! (SEP-2)

- Test design

- ***IF WEATHER CONDITIONS ARE SUNNY*** and warm outside, the gummy bear structure (including the gummy bear itself) can be placed outside where the sunlight will be unobstructed throughout the day.
  - Place thermometer inside of the structure.
  - Tape down structure to keep it from blowing away.

- Alongside the gummy bear structure, place a "control" gummy bear (a gummy bear without a structure) with a thermometer.

- Depending on your available time, you may keep gummy bears outdoors for the length of the day or simply compare temperatures of the gummy bears in the different conditions (both inside and outside of the protective structures).

- ***NOTE***: Over prolonged exposure, if the sun's rays are very strong, certain factors, such as thickness of "walls" or lack of ventilation, may result in little / no difference in temperature between the control and inside of the structure. If this occurs, assure students that the shade provided by their structures still protect the bear (and us) from the rays of the sun.

- ***IF CONDITIONS ARE POOR*** (cloudy, cold, rainy), then you may set up a "sun" station in which the gummy bear structures are placed under a spotlight / heat lamp.

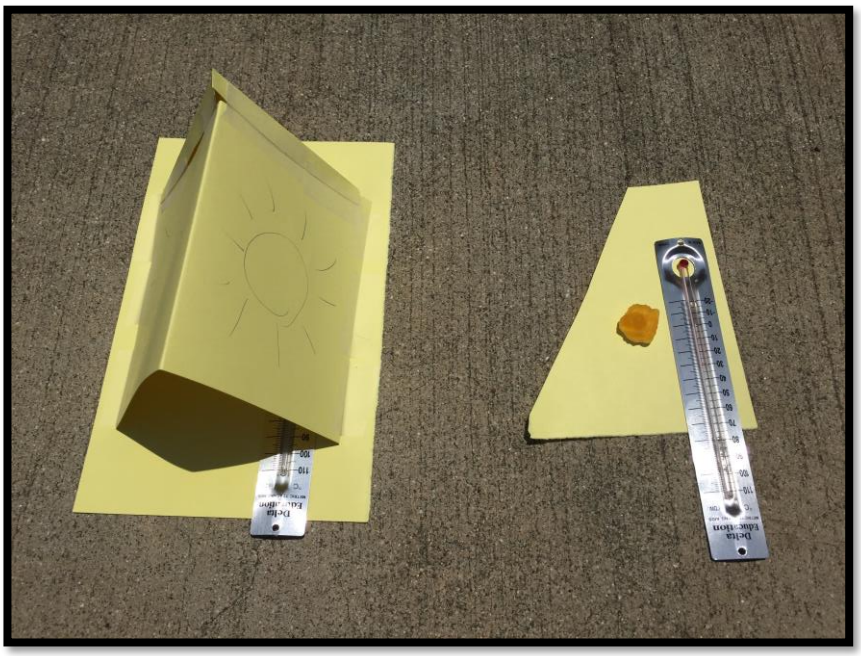
5. EVALUATE

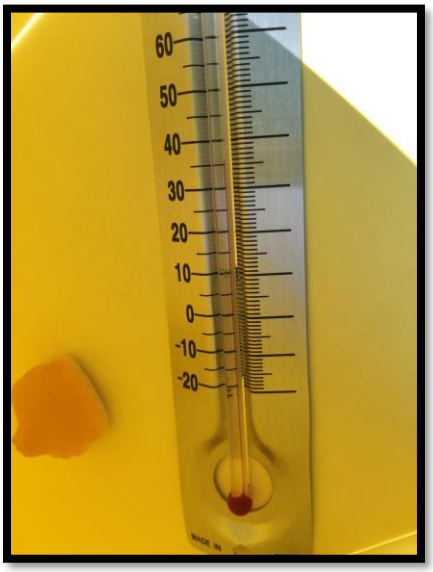
- Teacher facilitates discussion about student successes and challenges (W.K.8). Some students may have noticed that sunlight crept into their structure as the Sun changed positions in the sky. These students may decide to build additional walls.

- After observation of other designs and input from colleagues (SL.K.1), students **redesign** and **rebuild**.

- Have students answer the Focus Question in their engineering notebooks.

  - For scaffolding, sentence frames work well.
  - For example, "We protected our gummy bear from the sun by _____." (W.K.2)





96.8°F
36°C
shade

105.8°F
41°C
sun