LAUSD Elementary Engineering

GOLDFISH CHALLENGE

Kindergarten – Life Science

PURPOSE

IN THE GOLDFISH CHALLENGE, STUDENTS WILL:

- Design and build a temporary shelter for a goldfish 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: How can you build a temporary home for your Goldfish?

NEXT GENERATION SCIENCE STANDARDS (NGSS)

Students who demonstrate understanding can:

K-LS1-1. **Use observations to describe patterns of what plants and animals (including humans) need to survive.** [Clarification Statement: Examples of patterns could include that animals need to take in food but plants do not; the different kinds of food needed by different types of animals; the requirement of plants to have light; and, that all living things need water.]

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

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations. • Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions. --- ***Connections to Nature of Science*** **Scientific Knowledge is Based on Empirical Evidence** • Scientists look for patterns and order when making observations about the world.	**LS1.C: Organization for Matter and Energy Flow in Organisms** • All animals need food in order to live and grow. They obtain their food from plants or from other animals. Plants need water and light to live and grow.	**Patterns** • Patterns in the natural and human designed world can be observed and used as evidence.

Connections to other DCIs in kindergarten: N/A

Articulation of DCIs across grade-levels:
1.LS1.A ; **2.LS2.A** ; **3.LS2.C** ; **3.LS4.B** ; **5.LS1.C** ; **5.LS2.A**

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-LS1-1)

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-LS1-1)*

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)

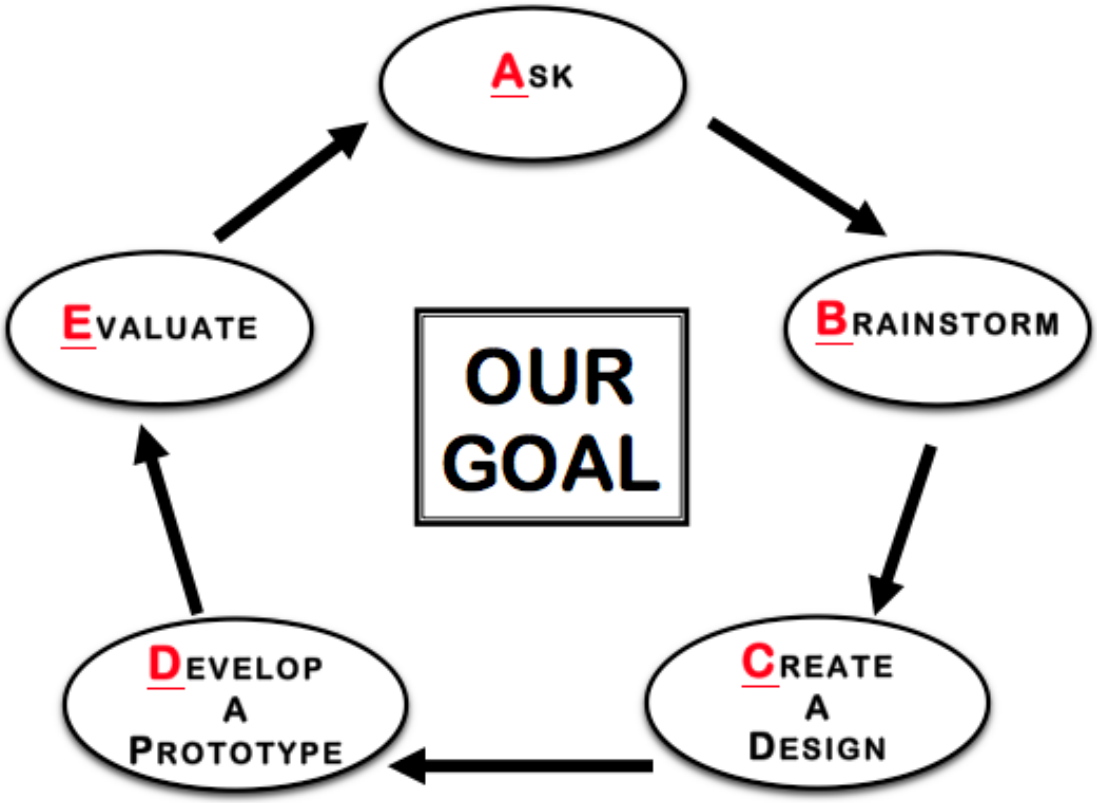
CA ENGLISH LANGUAGE DEVELOPMENT CONNECTIONS

- **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 lesson once students have completed:

FOSS CA – Wood and Paper

- **Investigation 3: Getting to Know Paper]**

FOSS CA – Animals Two by Two

- **Investigation 1: Goldfish and Guppies**

Students will have the background knowledge needed to engage in this engineering challenge. Students will know that different materials have different properties. These differences make one material more well-suited for a given task than another. Engineering teams will utilize this knowledge to construct a temporary container for a goldfish.

MATERIALS

FOR EACH TEAM (2 students)

- Tagboard Squares (from Wood & Paper)
- Chipboard Squares (from Wood & Paper)
- Corrugated Cardboard Squares (from Wood & Paper)
- Wax Paper (from Wood & Paper)
- Plastic Wrap (from Animals 2x2)
- ½" – ¾" Masking Tape (unlimited)
- 1 Vial (from Animals 2 x 2)
  - OPTION: for a challenge, you may replace the vial with one 9-oz. cup
- 1 Paper Image of a Goldfish (optional)
  - OPTION: a goldfish cracker may be used if the duration is short.

FOR THE LESSON

- Individual Student Engineering Notebook
- Pencils
- Scissors
- Water Testing Station/Area
  - Small pieces of the papers and plastic wrap
  - Eye Dropper
  - Cup of Water (half full)

GETTING READY

1. **Schedule the Engineering Challenge**
   The challenge will take about three 45-minute sessions to complete: one session for planning (Ask, Brainstorm, Create-a-design), one session to build (Develop-a-prototype) and test, and one session to improve (Evaluate).

2. **Gather / obtain materials**
   - Most of the materials are from **CA FOSS: Animals 2 x 2** and **Wood and Paper.**
   - Print and cut out paper "fish" for the test session

3. **Prepare stations**
   - Organize materials station
   - Prepare a water testing station (next to sink)

4. **Print Focus Questions**
   Have Focus Questions printed on self-stick labels OR precut labels for gluing into Engineering Notebook –
   How can you build a temporary home for your goldfish?

GUIDING THE ACTIVITY

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

- Explain that sometimes, people like to put their goldfish in a separate container while the main aquarium is being thoroughly cleaned. Unfortunately, sometimes, a good (suitable) container may not be available!

1. ASK

Present problem or need

- Inform engineers of the PROBLEM:

"Where can you put your goldfish while the main aquarium is being cleaned?"

Present Focus Question: "How can you build a temporary home for your Goldfish?" *(Printed on self-stick labels)*

- Display the Focus Question and have students stick/glue the Focus Question into their Engineering Notebooks.
  How can you build a temporary home for your Goldfish?

Present Requirements and Restrictions

- **Requirements** (Criteria) *standards that must be met; rules/directions that must be followed*:
  - Teams consist of two members
  - Design and build a temporary home for the goldfish.
  - The container must be able to hold at least 1 vial (or for the challenge, 1 cup) of water for 10 seconds.
  - Design must be approved by the teacher.
- **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

- The vial (or cup) may be kept as a reference for size (volume) of water.
- The full amount of water cannot be used until it is time to test.

2. BRAINSTORM

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

- During this stage, students may test materials at the "water station" to determine a material's water absorbency or resistance.

3. CREATE - A - DESIGN

- Each member must draw a design individually (2-3 minutes), without team member input, into his/her engineering notebook.
  - Title the page "My design"
  - Students should label parts of their design (SL.K.5) (K.MD.A.2)

- Team members share designs with one another (3-5 minutes), 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 !!! (SEP-2)

- Test design
  - Team member will each test their design to see if it can successfully hold 1 vial (or for the challenge – 1 cup) of water

- Testing should be done outdoors in case of spillage
  - Add goldfish image/cracker after water has been poured in (optional)
  - Count to ten.

5. EVALUATE

- Teacher facilitates discussion about student successes and challenges (SL.K.1). Students may observe other teams solving similar problems in a different way and consider modifying their own designs.

- 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 using both text and diagrams.
  - For scaffolding, sentence frames work well.
  - For example, "We built our goldfish home using _____ ." (W.K.2)

EXTENSIONS (Optional)

- Design an aquarium that could hold water for an extended period of time.

- Design an aquarium with a viewing window. What other / new material(s) would you need?

[paper goldfish for testing of design]