LAUSD Elementary Engineering

ISOPOD DREAM HOME CHALLENGE

Fourth Grade – Life Science

PURPOSE

IN THE <u>ISOPOD DREAM HOME CHALLENGE</u>, *STUDENTS* WILL:

- Design and build an ideal habitat for isopods using the Engineering Design Process (EDP)
- Exhibit understanding of relevant science content/concepts
- Use appropriate tools and materials to complete task
- Determine effectiveness of their design
- Answer the Focus Question: <u>How can you engineer an ideal habitat for your isopods?</u>

NEXT GENERATION SCIENCE STANDARDS (NGSS)

Students who demonstrate understanding can:

4-LS1-1. **Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.** [Clarification Statement: Examples of structures could include thorns, stems, roots, colored petals, heart, stomach, lung, brain, and skin.] [*Assessment Boundary: Assessment is limited to macroscopic structures within plant and animal systems.*]

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
Engaging in Argument from Evidence Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). • Construct an argument with evidence, data, and/or a model.	**LS1.A: Structure and Function** • Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction.	**Systems and System Models** • A system can be described in terms of its components and their interactions.

Connections to other DCIs in fourth grade: N/A

Articulation of DCIs across grade-levels:
1.LS1.A ; **1.LS1.D** ; **3.LS3.B** ; **MS.LS1.A**

Common Core State Standards Connections:
ELA/Literacy -
W.4.1 Write opinion pieces on topics or texts, supporting a point of view with reasons and information. (4-LS1-1)
Mathematics -
4.G.A.3 Recognize a line of symmetry for a two-dimensional figure as a line across the figure such that the figure can be folded across the line into matching parts. Identify line-symmetric figures and draw lines of symmetry. *(4-LS1-1)*

Students who demonstrate understanding can:

4-LS1-2. **Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.** [Clarification Statement: Emphasis is on systems of information transfer.] [*Assessment Boundary: Assessment does not include the mechanisms by which the brain stores and recalls information or the mechanisms of how sensory receptors function.*]

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
Developing and Using Models Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. • Use a model to test interactions concerning the functioning of a natural system.	**LS1.D: Information Processing** • Different sense receptors are specialized for particular kinds of information, which may be then processed by the animal's brain. Animals are able to use their perceptions and memories to guide their actions.	**Systems and System Models** • A system can be described in terms of its components and their interactions.

Connections to other DCIs in fourth grade: N/A

Articulation of DCIs across grade-levels:
MS.LS1.A ; **MS.LS1.D**

Common Core State Standards Connections:
ELA/Literacy -
SL.4.5 Add audio recordings and visual displays to presentations when appropriate to enhance the development of main ideas or themes. *(4-LS1-2)*

3-5-ETS1 Engineering Design

3-5-ETS1 Engineering Design

Students who demonstrate understanding can:

3-5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

3-5-ETS1-3. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

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 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships.

- Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost. (3-5-ETS1-1)

Planning and Carrying Out Investigations
Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.

- Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. (3-5-ETS1-3)

Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.

- Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem. (3-5-ETS1-2)

Disciplinary Core Ideas

ETS1.A: Defining and Delimiting Engineering Problems

- Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. (3-5-ETS1-1)

ETS1.B: Developing Possible Solutions

- Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. (3-5-ETS1-2)
- At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. (3-5-ETS1-2)
- Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. (3-5-ETS1-3)

ETS1.C: Optimizing the Design Solution

- Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. (3-5-ETS1-3)

Crosscutting Concepts

Influence of Engineering, Technology, and Science on Society and the Natural World

- People's needs and wants change over time, as do their demands for new and improved technologies. (3-5-ETS1-1)
- Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands. (3-5-ETS1-2)

Connections to 3-5-ETS1.A: Defining and Delimiting Engineering Problems include:
Fourth Grade: 4-PS3-4

Connections to 3-5-ETS1.B: Designing Solutions to Engineering Problems include:
Fourth Grade: 4-ESS3-2

Connections to 3-5-ETS1.C: Optimizing the Design Solution include:
Fourth Grade: 4-PS4-3

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

Common Core State Standards Connections:

ELA/Literacy –

RI.5.1	Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. *(3-5-ETS1-2)*
RI.5.7	Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. *(3-5-ETS1-2)*
RI.5.9	Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (3-5-ETS1-2)
W.5.7	Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. (3-5-ETS1-1),(3-5-ETS1-3)
W.5.8	Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. *(3-5-ETS1-1),(3-5-ETS1-3)*
W.5.9	Draw evidence from literary or informational texts to support analysis, reflection, and research. *(3-5-ETS1-1),(3-5-ETS1-3)*

Mathematics –

MP.2	Reason abstractly and quantitatively. *(3-5-ETS1-1),(3-5-ETS1-2),(3-5-ETS1-3)*
MP.4	Model with mathematics. *(3-5-ETS1-1),(3-5-ETS1-2),(3-5-ETS1-3)*
MP.5	Use appropriate tools strategically. *(3-5-ETS1-1),(3-5-ETS1-2),(3-5-ETS1-3)*
3-5.OA	Operations and Algebraic Thinking *(3-5-ETS1-1),(3-5-ETS1-2)*

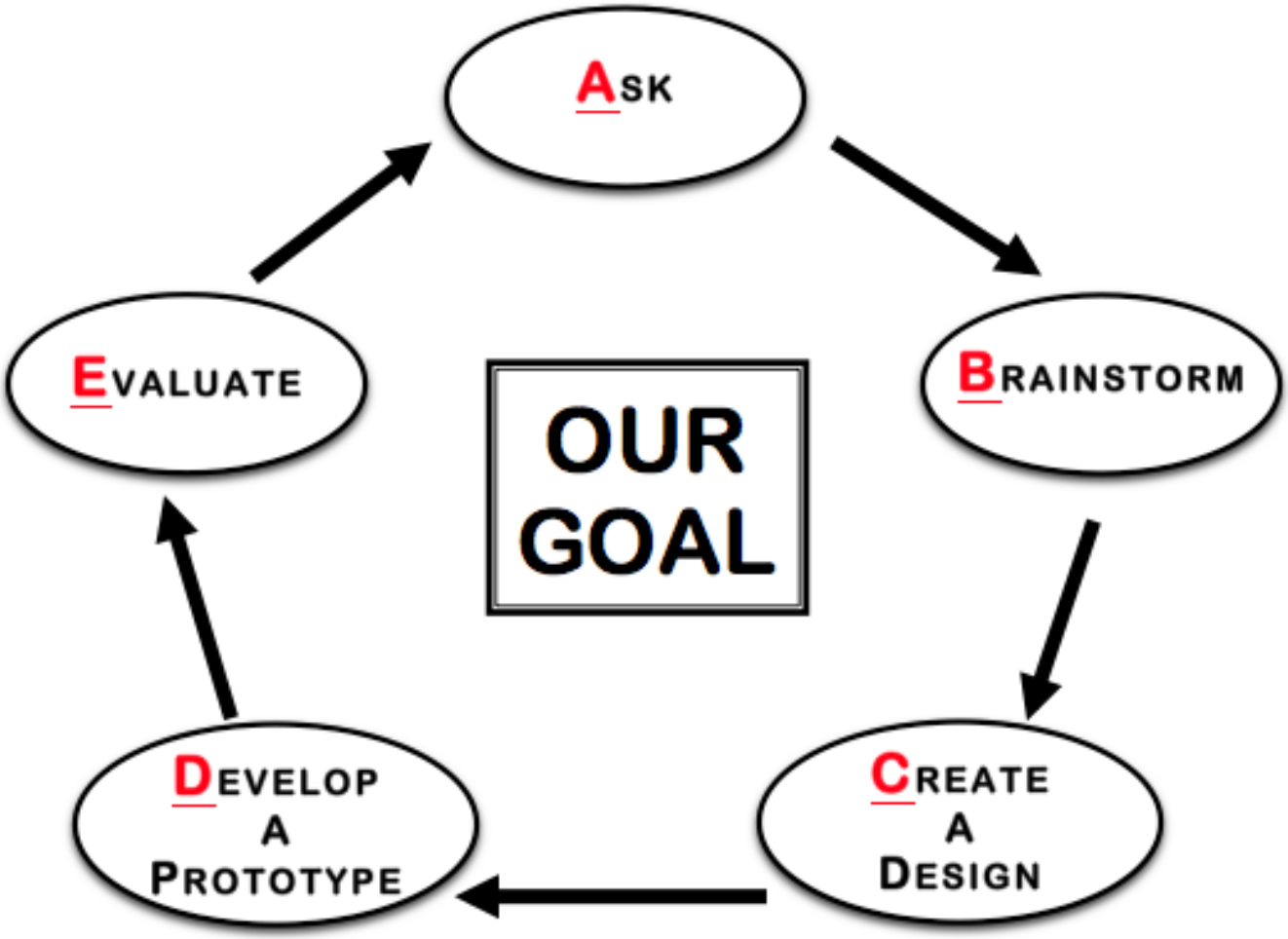
CA ENGLISH LANGUAGE DEVELOPMENT CONNECTIONS

- **P1.4.A.1** Exchanging information and ideas with others through oral collaborative discussions on a range of social and academic topics
- **P1.4.A.2** Interacting with others in written English in various communicative forms (print, communicative, technology, and multimedia)
- **P1.4.A.3** Offering and supporting opinions and negotiating with others in communicative exchanges
- **P1.4.A.4** Adapting language choices to various contexts (based on task, purpose, audience, and text type)
- **P1.4.C.9** Expressing information and ideas in formal oral presentations on academic topics
- **P2.4.B.3** Using verbs and verb phrases
- **P2.4.B.4** Using nouns and noun phrases
- **P2.4.B.5** Modifying to add details

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 – Environments

- **Investigation 2, Parts 1 - 2**

During Investigation 2, Parts 1 - 2, students discover through active investigation, observations, and text, that isopods are organisms with specialized structures and behaviors that aid in their survival. Students learn that isopods, like Darkling Beetles, use their senses to locate their preferred environment. Isopods prefer to exist in environments void of light. Students also learn that isopods are crustaceans. Similar to their aquatic relatives, these isopods have gill-like structures to breathe, and therefore, need to live in a moist environment.

MATERIALS

FOR EACH GROUP

- 2 or 3 Isopods (Pillbugs or sowbugs) in a 9oz plastic cup with moist paper towel
- 1- 100ml beaker (for water)
- 1- spoon (for carefully extracting isopods)
- plastic gloves * (for students with sensitivities/allergies)

FOR THE LESSON

- Individual student engineering notebooks
- Aluminum foil sheets (36cm x 46 cm)
- Black construction paper
- Craft sticks
- Gravel and pebbles (from 2nd grade CA FOSS-Pebbles, Sand, and Silt)
- Plastic wrap
- Soil
- Scotch tape
- 1 Stopwatch, Smartphone or Tablet to monitor time (teacher use)

GETTING READY

1. **Schedule the Engineering Challenge**
   The challenge will take about 45 - 60 minutes

2. **Gather/Obtain Materials**
   Pebbles and gravel can be obtained from FOSS CA [2nd grade] Pebbles, Sand, Silt

3. **Prepare Materials**
   Set up a materials station. Prepare 1 cup of isopods for each team.

4. **Plan Teams**
   Predetermine collaborative teams of 3 - 4 students

GUIDING THE ACTIVITY

Students will engage in the Engineering Design Process (EDP)

1. ASK

Setting the Context

- Start with a short story. Isopods are cute little creatures that either roll up into a ball or run away when threatened. We would like to have some isopods as pets in the classroom.

Present Problem or Need

- The challenge is to design a proper environment for the isopods to survive and thrive in our classroom using the knowledge you have gained through your investigations with isopods environmental preferences.

- Have students record the Focus Question in their engineering notebooks - How can you engineer an ideal habitat for your isopods?

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

Present Requirements and Restrictions

- **Requirements** (Criteria) *standards that must be met; rules/directions that must be followed*:
  - Build an environment within an aluminum container that fulfills all the environmental needs of the organisms.

- **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 the teacher.
  - The isopods should not be able to climb out of the container.

2. BRAINSTORM

- Give students 5 minutes to discuss, think, and choose two of their best ideas/solutions.

3. CREATE - A - DESIGN

- Give students 5 minutes to draw a diagram with labels into their engineering notebooks. Give students 5 minutes to do a Critical Design Review (Share their diagrams with the class and receive input on their design). Not all teams have to share.

4. DEVELOP - A - PROTOTYPE

- Give students 30-40 minutes to build their environmental prototype.
- Test it for stability and leakage. Place the isopods in the environment and observe the isopods.

5. EVALUATE

- If the prototype needs improvements after placing in the isopods, remove isopods carefully and make adjustments and improvements.

- Have students answer the Focus Question in their notebooks.
  - For scaffolding, sentence frames work well. For example, "We engineered an ideal habitat for our isopods by _____ ."
  - Encourage students to include information about both their successes and failures.