LAUSD Elementary Engineering

SEED DISPERSAL CHALLENGE

Third Grade – Life Science

PURPOSE

IN SEED *DISPERSAL TOOL CHALLENGE*, STUDENTS WILL:

- Design and build a seed dispersal tool that will move their seed away from the parent plant by wind, water, or animals using the Engineering Design Process
- Exhibit understanding of relevant science content/concepts
- Construct relevant questions
- Use appropriate tools and materials to complete the task
- Determine effectiveness of their design
- Answer the Focus Question:
    - How can I design and build a seed that can move by wind, water, or animal?

NEXT GENERATION SCIENCE STANDARDS (NGSS)

Students who demonstrate understanding can:

3-LS1-1. **Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death.** [Clarification Statement: Changes organisms go through during their life form a pattern.] [*Assessment Boundary: Assessment of plant life cycles is limited to those of flowering plants. Assessment does not include details of human reproduction.*]

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. • Develop models to describe phenomena. ***Connections to Nature of Science*** **Scientific Knowledge is Based on Empirical Evidence** • Science findings are based on recognizing patterns.	**LS1.B: Growth and Development of Organisms** • Reproduction is essential to the continued existence of every kind of organism. Plants and animals have unique and diverse life cycles.	**Patterns** • Patterns of change can be used to make predictions.

Connections to other DCIs in third grade: N/A

Articulation of DCIs across grade-levels:
MS.LS1.B

Common Core State Standards Connections:

ELA/Literacy —

RI.3.7 Use information gained from illustrations (e.g., maps, photographs) and the words in a text to demonstrate understanding of the text (e.g., where, when, why, and how key events occur). *(3-LS1-1)*

SL.3.5 Create engaging audio recordings of stories or poems that demonstrate fluid reading at an understandable pace; add visual displays when appropriate to emphasize or enhance certain facts or details. *(3-LS1-1)*

Mathematics —

MP.4 Model with mathematics. *(3-LS1-1)*

3.NBT Number and Operations in Base Ten *(3-LS1-1)*

3.NF Number and Operations—Fractions *(3-LS1-1)*

3-5-ETS1 Engineering Design

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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)*

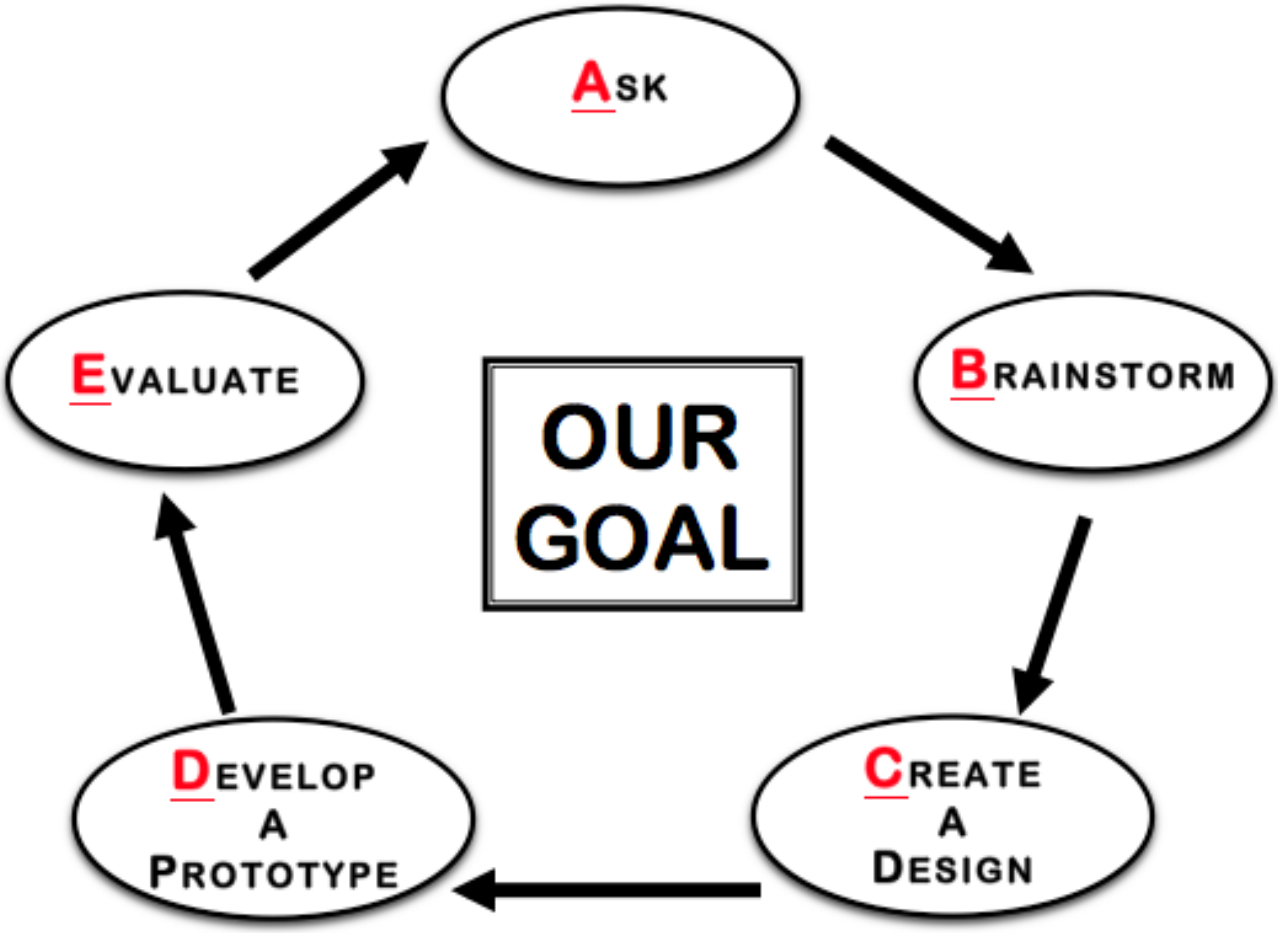
CA ENGLISH LANGUAGE DEVELOPMENT CONNECTIONS

- **P1.3.A.1** Exchanging information and ideas with others through oral collaborative discussions on a range of social and academic topics
- **P1.3.A.3** Offering and supporting opinions and negotiating with others in communicative exchanges.
- **P1.3.B.5** Listening actively to spoken English in a range of social and academic contexts
- **P1.3.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 – STRUCTURES OF LIFE

- **Investigation # 1 (Parts 1-3)**

Students will gain the additional content knowledge needed to engage in The Seed Dispersal Challenge by watching the videos listed in the "Getting Ready" section of the lesson. Students enter the engineering challenge understanding that seeds must travel away from the parent plant in order to obtain enough sunlight, water, and nutrients needed to grow and thrive.

While watching the videos, emphasize the different ways seeds disperse—wind, water, and transportation by animals. In their engineering notebooks, have students note each seed's structure, draw a labeled diagram, and record the function of those structures in the seed's dispersal.

Student teams will be challenged to mimic the way a seed disperses in nature by engineering and testing their seed's design. There are five challenge cards. Depending on the size of the class, teams can either be made larger (5 teams of 5 members + 1 team of 4 members) to give each team separate challenges, or smaller teams in order to duplicate the challenges (3 members per team, only using 4 of the challenges). By giving two separate teams an identical challenge, students are able to see different solutions to the same engineering challenge.

MATERIALS

FOR EACH TEAM (3 - 6 students)

- Small Pom-Pom or a seed (black-eyed pea or other small light seed)
- 1 challenge card (depending on the class size, more than one team may have the same challenge)

FOR THE LESSON (materials for 24 students)

- Individual student engineering notebooks
- Scissors
- Masking tape or transparent tape - cut into 1-foot strips
- Found items from school cafeteria area or at home (sporks)
- Cotton balls
- Colored construction paper
- Toothpicks
- Popsicle sticks
- Twister ties
- Colored play dough
- Rubber bands
- Glue or glue sticks
- Electric fan (to test wind dispersal)
- Dandelion round seed head (optional) and Bur (optional) or Google Search an image

Seed Dispersal Challenge 1

Design a seed that will float on water for 3 minutes. It may not touch the sides or bottom of the water container.

Seed Dispersal Challenge 2

Design a seed that will float in the air for a distance of 1 meter.


Seed Dispersal Challenge 3

Design a seed that can stick to an animal and be transported for at least 3 meters.


Seed Dispersal Challenge 4

Design a seed that will project itself at least 2 meters. Remember seeds do not have hands or feet.

Seed Dispersal Challenge 5

Design a seed that will attract birds or animals to eat it. Place it outside and leave it for 10 minutes. Watch for birds or animals.


GETTING READY

1. **Schedule the Engineering Challenge**
   The challenge will take about two to three 30-45-minute sessions to complete.
   - Based on teacher time constraints, determine the amount of time students will be afforded to Develop-A-Prototype.

2. **Gather/Obtain Materials**
   - Download the videos:
     https://www.youtube.com/watch?v=xY4JFOSuqvY (Seed Dispersal—The Great Escape) 12.51 minutes;
     https://www.youtube.com/watch?v=OB0P3mx_IxY (Seed Dispersal by Explosion) 1.53 minutes;
     https://www.youtube.com/watch?v=xKBkhPJ9SVQ (The Sneaky Reason Why Plants Bear Fleshy Fruit) 2.53 minutes
   - Copy the Challenge Cards (Decide if you want one per group or one per person of each group—same challenge card for all group members)
     Note: You will need to make an additional copy of one of the challenges if you want 4 students per group and have 24 students. If you choose to have 5 students per group, then the 5 challenge cards will be enough—one group will only have 4 students.

3. **Prepare a Materials Station**

4. **Plan Teams**

GUIDING THE ACTIVITY

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

1. ASK

Setting the Context

- Elicit discussion about what students know about plant structures, and review what plants need to grow and survive.

- Ask students if they have ever picked a dandelion and blown the seeds to watch them float away.
  Or if they ever got a bur stuck in their clothing when walking in a field.
  Show the seeds you brought in with your document camera. Ask students what they noticed about the structures of each seed.

- State that seeds often have a special structure to help them move away from their parent plant so they do not need to compete with their parent plant for sunlight, water, or nutrients. That increases their chances of survival.

Present Problem or Need

- Inform engineers of the PROBLEM:

  "How can you design a seed that will disperse away from its parent plant?"

- Have students record the Focus Question in their engineering notebooks - How do seeds disperse away from the parent plant?

- Encourage students to come up with their OWN questions about materials, criteria, and constraints.
  - Students ask clarifying questions and record answers in their engineering notebook.

(Possible sample questions asked: What materials can we use? How long do we have to work? Will we be working alone or in groups? How do seeds disperse away from their parent plants?* What do different seeds look like?*)

* Inform the class that there are a few videos that will help answer these questions.

Present Requirements and Restrictions

- **Requirements** (Criteria) *standards that must be met; rules/directions that must be followed)*:
  - Students must work in collaborative teams of 3 to 5 members.
  - The dispersal design/tool must meet the challenge given.
- **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 materials provided by the teacher
  - Only one light bulb and one battery
  - Structure must be built within the time constraint.
  - The team design must incorporate an aspect of each team member's design.

2. BRAINSTORM

- Teams evaluate the available materials and determine their usefulness based on the materials' properties.

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 the parts of their design and list the materials utilized

- Team members share designs with one another, compromise, and collaborate in order to create into a "team design."
  - Title the page "Team design"
  - Team members should label the parts of their team design and list the materials utilized

4. DEVELOP - A - PROTOTYPE

- The "Getters" go to the material station with their list of materials and gather materials for their team.
  - If teacher stops the lesson here, group material lists can be collected and filled by the teacher. Then, when the lesson continues, Getters can collect the prepackaged materials for the group.)

- Build it!
  - Inform the teams of how much time is allotted for building, and give a time reminder at 7 minutes before the deadline to allow for clean up.

- Test designs

- Teams should record the results in their notebooks

5. EVALUATE

- Teacher facilitates discussion about team successes and challenges.

- Teams meet to discuss their design and input from classmates.

- Teams redesign according to discussion and recommendations, adding the new design and materials needed in their notebooks.

- Build the new design and test it.

- Record the results in notebooks. Compare the original design to the redesigned model.

- Have students answer the Focus Question in their notebooks.
  - For scaffolding, sentence frames work well. For example, "We helped our seed disperse away from the parent plant by engineering _____ ."
  - Encourage students to include information about both their successes and failures.

EXTENSIONS

- Which fabric is best for collecting "hooked seeds"? Devise a test.

- Create a seed dispersal challenge and a seed dispersal tool to meet the challenge.

- Do all fruits contain the same number of seeds? Encourage a range of fruits to find out the answer. You may wish to encourage the children to use biological reference books.