



CRS

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SCATTERING SEEDS: SEED DISPERSAL & ENGINEERING CHALLENGE

Grades 3-6

Overview: By observing seed characteristics and designing a seed for a specific dispersal mode, students discover that seeds are dispersed in a variety of methods, that the features of the seeds are related to how they are dispersed, and that the surrounding environment can influence how seeds are dispersed.

Quick summary:

- 1) Students think about and discuss why seeds disperse
- 2) Students observe a variety of seeds to explore structures associated with different dispersal modes
- 3) Using their observations of seeds, students build and test seed models for dispersal by animals
- 4) Students have the opportunity to improve their design

Grade Span: 3-6 grade (adaptable for younger grades)

Time: Approx. 90-120 mins* (35-45 mins for observation/discussion of seeds, 50-70 mins for engineering design/build/test model) *can be split into 2-3 days

Learning Goals:

Students understand that

- different seeds disperse in different ways: water, wind, animals (on fur, in gut, carried), mechanical/explosive
- unique characteristics of a seed help make dispersal successful
- the surrounding environment affects how seeds are dispersed
- it is advantageous for a seed to disperse away from its parent

Students use engineering principals to solve problems and to understand the relationship between structure and function.

Materials:

For seed introduction: (5 types for each of the dispersal methods)

- Water: coconut (seeds that float or that commonly grow in or on the edge of water - others include lotus, water lily, mangrove, cat tail)
 - Wind: maple, ash, dandelion, milkweed, grasses (seeds with wings/helicopters)
 - Animal - Burr: burdock, foxtail (seeds w/ hooks, or rough/sticky surface)
 - Animals - eaten: cedar, watermelon, pumpkin, berries, tomatoes (fleshy fruit that is eaten, seeds that are buried by animals)
 - Mechanical/explosive: poppy, jewelweed, wisteria (fling mechanism, pods that explode – may need images or video for this)
- (note – you can use colored images for the stations if necessary)

For model building

- Dried beans as base for model (kidney beans work well, or if you want something larger for little hands you can use dried lima beans)
- Tape – masking and scotch
- Toothpicks
- Paperclips
- Paper (different types)
- Cotton balls
- Rubber bands
- Popsicle sticks
- Scissors

- Packing peanuts (they are good for sticking things into)

For model testing

- Create a small furry animal by wrapping fuzzy fabric around a coffee can (a Swiffer dusting mop sheet works really well)
- Tub of water
- Fan or hairdryer and/or high place to drop seeds from (stairwell, ladder, play structure)

Groupings: Whole group for introduction, small groups for observation of seed types, individual or pairs for making seed models.

Vocabulary:

fruit	dispersal mode	burr
seed	float	mechanical/explosive
germination	wind	model
dispersal	hitch-hiker	adaptation

Introduction (5-10 mins)

Hook/engage: Show the class/pass around a variety of fruits that have been cut in half (to expose the seeds). Real fruit is best, but pictures could be used here. Ask students what all of them have in common (seeds).

Activate Prior Knowledge:

Group discussion:

- Why are seeds important? What is their purpose?
- What happens when you plant a seeds?
- Where have you seen seeds before (park, backyard, other fruits/veggies, flowers, etc.)
- How do seeds get to those places?

Introduce the idea that humans plant seeds to grow plants, but nature and plants also have ways of spreading seeds around to grow more plants.

Introduce the word dispersal – write on vocab wall

Think-Pair-Share: Why is it valuable to a plant to move its seeds? Why might it not be a great idea to plant a bunch of seeds in the same place?

Today we are going to learn how seeds get dispersed or spread around an area. Generate a class list of the ways that seeds might get dispersed.

Activity:

1. Observation of seeds (30-35 mins)

Guiding question: what features of these seeds/fruits might help them disperse?

- Set up 5 centers, each focused on a different seed dispersal mode (water, wind, animal burrs, eaten by animals, mechanical. Divide class into 5 groups. Students rotate between the 5 centers and observe the seeds. You can let them observe with a magnifying glass, and/or test to see how the seeds float in water or air, or if they stick to things. While at each station, students should sketch a seed in their notebook and note interesting/unique characteristics (shape, size, texture, etc.) that they think might help with dispersal. Students can write free observations or complete the sentence frame “I think this seed is dispersed by _____ because _____”.
- Rotate students every 3-5 minutes. Guide student observations by asking questions to help students extend their thinking, help them notice and describe the features of the seeds, and to work out their thinking about dispersal modes.
- Wrap up for part 1
 - What did you observe about the seeds? Any interesting characteristics?
 - Go through the collection of seeds from the observation activity and ask, how students think each of these types of seeds are dispersed and why (or you can have each table

- present one dispersal mode). Ask what features of the seed help it to disperse that way (structure and function).
- iii. Note vocabulary for dispersal modes on vocab wall (burr, hitch-hiker, mechanical/explosive)
2. Engineering challenge: (30-60 mins)
- a. The challenge: based on what you learned from observing seeds, you will now design a seed to be dispersed by water, wind, or hitch-hiking.
 - b. Instructions:
 - i. work in pairs (or individually – teacher’s choice)
 - ii. take a bean/seed and use the variety of materials provided to make a seed that can be dispersed by either wind, water, or by hitch-hiking (you can let them choose what dispersal mode they build, or have them draw a card that will tell them what to build - see OBIS seed dispersal cards)
 - iii. use what was learned from observing seeds to create the designs
 - iv. once designs are completed, we will test how well they work
 - v. this is a good time to talk about engineering (challenge, criteria, constraints/materials, and testing and redesigning).
 - c. Show students the materials and give them time to think of a design for their seeds. Have students complete a diagram of their design idea in their notebook -- they should connect the structures in their design with intended function and think about how they will know if their design is successful.
 - d. Pass out materials and start building!
3. Test designs
- a. Once designs are completed students must test them. Provide materials to test seed designs. A tub of water, a fur/fabric covered can (see materials), a high place to drop seeds from or a fan or hairdryer to provide wind. Students must quantify test results so that any redesign can be compared to the original. Record results in notebook.

Notebook entry:

My design _____ (worked/didn’t work)

My evidence that it worked/didn’t work is _____

The design worked/didn’t work because _____

I could improve my design by _____
4. Redesign/design adjustment
- a. Have students adjust and retest their designs, recording data in their notebook
 - b. Notebook entry: summarize the outcome with the prompts:

My re-design _____ (worked/didn’t work)

My evidence that my changes worked/didn’t work is _____

I think the re-design worked/didn’t work because _____

I could further improve my design by _____

Debrief:

- Have students present their designs to the class, specifically calling out the design features they used and how effective the design was. Did your design meet the challenge? What successes and failures did you experience?
- Discussion ideas:
 - For each dispersal mode - what design was the most successful? what specific features were most effective?
 - How is failure important in engineering?

Extensions:

1. Take the class outside to find seeds around the school (or have students bring seeds in from home as homework). Students can bring them inside and use the same observation methods as before to try and determine how it is dispersed. (This activity can be used as an assessment to determine the extent of students' understanding of types of seed dispersal.)
2. Explore how humans influence seed dispersal -- see accompanying reading. →DCI ESS3.C: *Human Impacts on Earth Systems: Things that people do to live comfortably can affect the world around them. But they can make choices that reduce their impacts on the land, water, air, and other living things.*)
3. Seed dispersal is just one part of the life cycle of a plant – expand on this activity to explore other parts of the life cycles of plants. →DCI 3-LS1-1. *Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction & death.*
4. Explore adaptation -- groups of students could each be given a different ecosystem (desert, forest, grassland, etc.) and construct an argument that certain plants may thrive or not survive in that system because of their seed dispersal methods. How might environmental changes (flooding, drought, global warming etc.) affect particular seed dispersal plants. →PE 3-LS4-3. *Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.*
5. After exploring structure and function for seed dispersal, examine other plant features and their function. →PE 4-LS1-1. *Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.*
6. Build off of this seed dispersal lesson to explore an entire ecosystem. Plants make seeds ---> animals eat the seeds --->animals are consumed by other animals... Students in small groups could then research and construct a model or visual representation of different ecosystems' flow of energy and give presentations to the class. →PE 5-PS3-1. *Use models to describe that energy in animals' food (used for body repair, growth, and motion and to maintain body warmth) was once energy from the sun. Clarification Statement: Examples of models could include diagrams, and flow charts.)*

NGSS Standards for this activity:

Performance Expectation and associated Disciplinary Core Ideas

GRADE 3 – each PE followed by relevant DCI

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.]

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.

3-LS4-2. Use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing. [Clarification Statement: Examples of cause and effect relationships could be plants that have larger thorns than other plants may be less likely to be eaten by predators; and, animals that have better camouflage coloration than other animals may be more likely to survive and therefore more likely to leave offspring.]

LS4.B: Natural Selection - Sometimes the differences in characteristics between individuals of the same species provide advantages in surviving, finding mates, and reproducing.

3-LS4-3. Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all. [Clarification Statement:

Examples of evidence could include needs and characteristics of the organisms and habitats involved. The organisms and their habitat make up a system in which the parts depend on each other.]

LS4.C: Adaptation - For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all.

GRADE 4

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.]

LS1.A: Structure and Function - Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction.

GRADES 3-5 Engineering, each PE followed by relevant DCI

3-5-ETS1-1. Define a simple design problem - Asking Questions and Defining Problems
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. (Asking questions and defining problems in 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships.)

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-ETS1-2. 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.

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. 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-ETS1-3. 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.

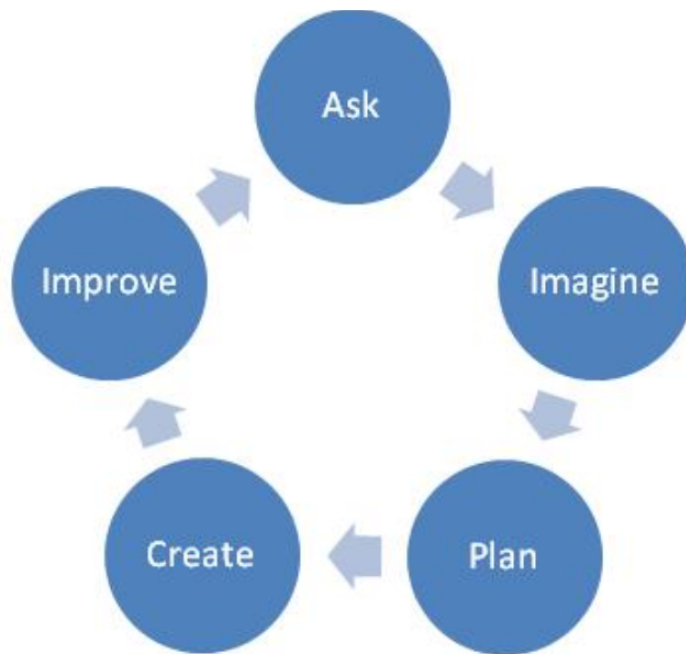
ETS1.B: Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved.

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.

Cross-Cutting Concepts (CCC): Patterns, Cause and effect, **Structure and function**

Practices of Science and Engineering: Develop and use models, Plan and carry out an investigation, Analyze and interpret data, Design solutions

Engineering Design Process Template



Adapted from: teachengineering.org

ASK:

Define the problem
Do background research
Specify requirements

IMAGINE

Brainstorm solutions

PLAN

Choose a solution
Develop/draw the solution

CREATE

Build a prototype
Test the prototype

IMPROVE

Communicate, share ideas
Evaluate results

Then: redesign

***Cycle can start at any
point!***