Germination

Life Science | Engineering Design Process

Engineering Challenge

Visible Elements in Photo

- A green plant stem with a seedling emerging from soil
- A seed coat (brown, textured shell) attached to the top of the stem
- A second seed coat visible lower on the stem or nearby on the ground
- Moist dark soil surrounding the base
- The seed coat appears to be splitting or separating as the plant grows upward

Reasonable Inferences

- From seed coat structure: The hard, protective shell must break apart or separate to allow the delicate seedling to emerge, suggesting a need for a removable or flexible protective barrier.
- From soil and moisture: Seeds require specific environmental conditions (moisture, support) to sprout successfully, implying students need to understand how growing structures interact with their surroundings.
- From the seed coat still attached: Young seedlings are fragile and may need temporary protection during the critical sprouting phase before they develop their own toughness.

Engineering Task

K-2 Challenge:

Design a protective shell for a sprouting seed using play dough, papier-mâché, or paper. Your shell must:
- Fit snugly around a bean or pea seed
- Break apart or open easily when the seed pushes it (you can test by gently squeezing)
- Be made from only natural or recyclable materials

What makes it work? Your seed coat should protect the seed but not stop it from growing!

3-5 Challenge:

Design a biodegradable protective casing for a sprouting seed that will:
- Remain intact for at least 48 hours in moist conditions
- Separate or dissolve within 5–7 days when the seedling reaches 2 cm in height
- Be constructed from at least two different natural materials (examples: paper, gelatin, plant fibers, cardboard, cornstarch)
- Allow water to pass through so the seed can absorb moisture

Success criteria: Test your design with a real seed in moist soil. Does your seed sprout? Does your casing release as the seedling grows?

EDP Phase Targeted

Ask / Define Problem

This photo shows a real biological challenge—how does nature protect vulnerable sprouting seeds while still allowing them to grow? Students must first understand what the seed coat does (protection, but not forever) before jumping to solutions. This natural observation naturally leads to the question "What does a seed need?" which frames the whole engineering problem.

Suggested Materials

- Paper towels or coffee filters
- Unflavored gelatin or agar powder
- Play dough or air-dry clay
- Cornstarch or biodegradable packing peanuts
- Bean or pea seeds
- Moist potting soil
- Clear plastic cups or containers for testing

Estimated Time

3–4 weeks (if testing with real seeds) or 2–3 class periods (if testing with dummy seeds and water only)
- Session 1: Observe, discuss the problem, design (30–40 min)
- Session 2: Build prototypes (40–50 min)
- Sessions 3+: Test, observe over days, refine (5–10 min check-ins daily)

Why This Works for Teachers

This task directly addresses NGSS 3-5-ETS1-1 (Define a problem that can be solved by designing an object, tool, or system) by grounding the challenge in observable natural phenomena, then asking students to solve a real biological constraint with engineered materials.