Monarch Caterpillar

Life Science | Engineering Design Process

Engineering Challenge

Visible Elements in Photo

- A monarch butterfly caterpillar (Danaus plexippus larva) with distinctive black, white, and yellow bands
- The caterpillar is positioned on a light-colored rock or stone surface
- Green plant foliage visible in the blurred background
- Two black antenna-like tentacles (filaments) protruding from the caterpillar's head and rear end
- Textured, granular surface of the rock providing a natural substrate
- …

Reasonable Inferences

1. From the rock surface + exposed caterpillar position !' The caterpillar is vulnerable to weather, predators, and falling objects while crawling in open spaces; it needs protective shelter that allows movement and feeding access to plants.

2. From the bright coloring (aposematism) !' The caterpillar's bold stripes warn predators it may be toxic; any shelter design must not obscure these warning colors or trap the caterpillar inside.

3. From the antenna-like structures !' The caterpillar uses sensory organs to navigate and locate food; a shelter must allow the creature to sense its environment and move freely toward milkweed plants.

Engineering Task

K-2 Challenge:

Design a Safe Resting Spot for a Hungry Caterpillar

Make a cozy hiding place for a caterpillar using paper, leaves, and tape. Your shelter must:
- Be big enough for a caterpillar toy to fit inside
- Have an opening so the caterpillar can crawl in and out
- Keep the caterpillar safe from pretend rain (you'll test it with a spray bottle)

Draw or build your design. Does your caterpillar stay dry? Can it move freely?

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3-5 Challenge:

Design a Protective Shelter for a Monarch Caterpillar

A monarch caterpillar needs a shelter that protects it from wind, rain, and predators—but it must also reach milkweed plants to eat and grow. Using natural and recycled materials, design and build a shelter that meets these criteria:

Constraints:
- Maximum dimensions: 15 cm wide × 10 cm tall
- Must be built from at least 3 of these materials: leaves, twigs, paper, bark, or cardboard
- Must have at least one opening for the caterpillar to enter/exit
- The caterpillar's bright warning stripes must remain visible from at least one side

Success Criteria (measurable):
- Shelter withstands a 10-second "wind test" (gentle fan at low speed without collapsing)
- Shelter keeps a wet sponge (representing the caterpillar) dry during a 20-second water spray
- A toy caterpillar can move from outside the shelter to inside and back out in under 5 seconds

Document your design with a labeled sketch before building.

EDP Phase Targeted

Ask / Define Problem

This photo shows a real creature in a real environment without an active human intervention or prototype visible. Students need to identify and define the caterpillar's actual needs (protection + food access + sensory freedom) before designing. The visible vulnerability of the caterpillar on an exposed rock makes the problem authentic and obvious—perfect for the Ask phase, where students ask "What problem does this creature face?" and "How can we help?"

Suggested Materials

1. Fresh or dried leaves, twigs, and bark (collected outdoors or kept in a learning collection)
2. Cardboard tubes, paper scraps, and newspaper for structural support
3. Paper tape or low-adhesive painter's tape (doesn't harm materials or create litter)
4. Small spray bottle (for water testing)
5. Toy caterpillar or sponge piece (for testing movement and water resistance)

Estimated Time

- K-2: 45–60 minutes (design discussion + building + simple water test)
- 3-5: Two 45-minute sessions (first: sketching and material selection; second: building, testing, and reflection)

Why This Works for Teachers

This task directly addresses NGSS ETS1.B: Developing Possible Solutions, as students must identify trade-offs between protection and access, then test their designs against measurable criteria—grounding abstract engineering thinking in a real organism's survival needs.

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