60–90 minutes | Grades 3–5, 6–8

Aviary Architect

Build a roof for a birdhouse that will stay cool in the summer.

DISCOVER ENGINEERS WEEK
FEBRUARY 18–24, 2018

Instructions

Students design, build, and test an energy-efficient roof for a birdhouse to keep the birdhouse from heating up too much under the hot summer sun.

PREPARATION:

- Remove the roof from each birdhouse.
- Pre-cut available roofing materials to the approximate size needed.

ACTIVITY:

1. Organize students into teams and introduce the challenge.
2. Engineers work to keep buildings energy efficient, cool in the summer and warm in the winter. Roofs can account for a lot of lost energy. Have teams discuss the types and colors of roofs they see:
   - What qualities do you notice among the roofs of different buildings (such as homes, greenhouses, offices, sports stadiums, and so on)?
   - What are some benefits and drawbacks of different roof designs?
3. Encourage teams to investigate the roofing materials available, discussing how different materials may affect their design. Teams can test individual materials with the heat lamp in 3-minute trials by holding their thermometer probe right under each material to see how the temperature is affected.
4. Direct each team to design a roof of the materials provided. They may combine up to three layers (an engineering "constraint"). Have them begin with a sketch of their design, clearly labeling the materials they have chosen and the configuration of their roof.

Materials

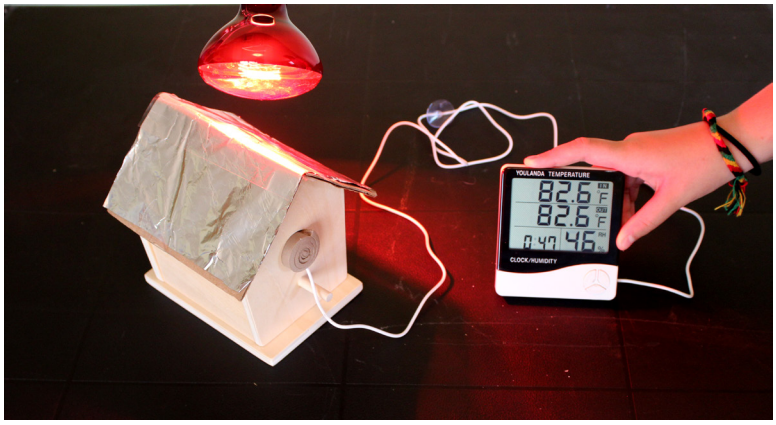
FOR EACH TEAM OF 2–4 STUDENTS:

- ☐ Simple wood birdhouse (with single entry hole)
- ☐ Foam plug for birdhouse hole
- ☐ Sheets of foam core (varying thicknesses)
- ☐ Poster board (different colors)
- ☐ Range of other building materials (aluminum foil, cardboard, cardstock, bubble wrap, insulating foam)
- ☐ Indoor/outdoor digital thermometer
- ☐ Heat lamp (150–250 watts)
- ☐ Stopwatch
- ☐ Masking tape
- ☐ Scissors

5 Distribute roofing materials and instruct students to construct their roof. The thermometer probe should be threaded through the hole and taped to the underside of the roof. Plug the remainder of the hole with foam. Students should tape the roofs to their birdhouse, making their birdhouse as airtight as possible.

6 Test each design under the heat lamp. Place the birdhouse directly underneath the bulb 1–6 inches away (you will need to determine the best distance depending upon your heat lamp setup). Have students use a stopwatch and record the temperature every 30 seconds for a 3-minute trial. *Supervision will be necessary, as the bulbs and lamps get very hot*. Have students record their data using a table like the one below. Then have them calculate ΔT, or the change in temperature, by subtracting their start temperature from their final temperature.

7 As time allows, have students redesign and retest their models, using what they learned from the first design to improve the roof. Discuss results together and why ΔT is a good measure for comparing roof designs.



Guiding Questions

Why is it important to sketch your design before building the roof and before making changes?

How can you best set up the birdhouses to get consistent data when you test them?

What properties make some building materials better insulators?

What other materials could you use to improve your design?

	Temperature (F˚)							
	0 sec (Start)	30 sec	60 sec	90 sec	120 sec	150 sec	180 sec (finish)	ΔT
Design 1								
Design 2								

This activity was provided by the Boston Museum of Science, funded through the Institute of Museum Library Services by an act of Congress, in accordance with the FY2004 Consolidated Appropriations bill.

Museum of Science.