Design Challenge: Aviary Architect

Aviary Architect:
Can you design, build and test a birdhouse that will stay cool or warm in the sun?

Goal:
Working in small teams, student's design, build and test an energy efficient roof for a birdhouse.

Time:
40 minutes for activity plus 10 minutes for set up and 10 minutes for clean up.

Materials:
Craft Birdhouses (with foam plug)
Foam Core (varying thicknesses)
Poster board (different colors)
Aluminum Foil
Cardboard
Cardstock
Bubble Wrap
Insulating Foam

Tools:
Indoor/outdoor digital thermometers
Heat Lamps (250 Watt)
Stopwatch
Masking Tape
Scissors

Directions

1. **Ask**: Divide students into small design teams of two to three students. Explain the challenge to them from the student worksheet, and provide each team with one birdhouse with the roof removed.

   Ask each team to discuss what types of roofs and what color roofs they see on buildings. Have them think about the difference between the roofs on homes and the roofs on greenhouses. What were the goals of the designers of these buildings?

2. **Imagine:** Ask each team to choose a goal: will they design a birdhouse to stay cool in the summer, or a birdhouse that will stay warm in the winter? Allow teams to investigate the roof materials available, discussing how different materials may effect their design. Teams should test individual materials under the heat lamp in 3 minute trials.

3. **Plan:** Once each team has explored the available materials, ask them to design a roof layering up to three of the materials provided. Each team should sketch their design, clearly labeling the materials they have chosen, and their configuration on their roof. Upon completing their sketch, provide them with their roofing materials.

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AVIARY ARCHITECT: DIRECTIONS CONTINUED

4 **CREATE:** After receiving their materials, students should construct their roof according to their design. The thermometer should be threaded through the hole and the remainder of the hole plugged with foam. Students should tape the roofs to their birdhouse making their birdhouse as airtight as possible. If the house is not airtight, some of the heat may be lost as air escapes resulting in inconsistent data.

Once the houses are constructed, and the thermometers are placed inside the houses, students may test their design under the heat lamp. The heating works best if the birdhouse is directly underneath the bulb 7-10 inches away. Supervision will be necessary as the bulbs and lamps get very hot. Using a timer or stopwatch, students should record a temperature every 30 seconds for a three minute trial filling out the table on the student worksheet.

Upon completing the first time trial, students should use their data to calculate **ΔT,** or the change in temperature, by subtracting their start temperature from their final temperature. This value will be used to compare the success of different designs.

5 **IMPROVE:** Students should redesign and retest their roofs as needed to achieve their design goal. As students redesign their models, encourage them to make appropriate changes to the sketch of their model so that the sketch and plans reflect the new design.

Upon completing the final redesign and test, ask students to reflect on which materials and designs worked best for achieving their goals. Ask them to then consider what a next step would be in their design process. (Ex. Would they consider trying new materials?)

FACILITATION TIPS

- To save time during the imagine and create steps, have pre-cut materials available for the students to use.
- For a more thorough investigation of the available materials, assign each group a variable to examine - - one group testing roof color, one group roof thickness, and another roof material. Students can then graph their results and consult other teams graphs before creating their design.
- Emphasize the necessity of sketching a plan for a model. Drafts and drawings are essential in the engineering field, and they create an opportunity to bring math concepts of size and scale into the activity.

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