

### Visible Elements in Photo



- Perforated metal sheets (orange/red colored, arranged in a grid pattern with small holes throughout)
- Gray support frame or backing holding the perforated sheets in place
- Dark lower section (likely a heat source or reflective chamber beneath the perforated material)
- Blue and orange light visible in the lower chamber area
- Vertical dividers creating distinct panels within the structure

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### Reasonable Inferences

1. From the perforated metal sheets: This structure is designed to allow air or heat to pass through while protecting or directing that heat—common in heating appliances like space heaters or broilers.
2. From the blue and orange light in lower chamber: A heat source (likely flame or heating element) is present below, suggesting this device generates radiant heat upward through the perforations.
3. From the repeating grid pattern: The holes are uniformly sized and distributed, which indicates the design controls heat distribution and intensity across the surface area.

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### Engineering Task

#### K-2 Challenge:

Design a heat shield that lets warm air come through but keeps things safe. You have materials like paper, cardboard, and foil. Make a pattern of holes in your shield. Test it by holding your hand near a warm (not hot!) surface with and without your shield. Does your pattern work? Can you feel the heat? Is it gentler with your shield?

#### 3-5 Challenge:

Challenge: Design a perforated heat diffuser that distributes radiant heat evenly across a surface while reducing peak temperature at any single spot.

##### Constraints:

- Use a sheet of rigid material (foam board, cardboard, or plastic) as your backing.
- Create a pattern of holes (minimum 20 holes) that allows heat transfer but blocks direct radiation.
- The diffuser must be at least 6 inches x 6 inches.
- Test with a heat source placed 4 inches below your design.

##### Success Criteria:

- Measure surface temperature at 5 different points on top of your diffuser using a non-contact thermometer.
- The temperature difference between the hottest and coolest spots should be less than 15°C.
- The diffuser must survive testing without melting, cracking, or warping.

## EDP Phase Targeted

### Ask / Define Problem

This phase fits best because students are viewing a real-world solution (a heat diffuser) and need to first understand why such a design exists—what problem does uniform heat distribution solve? Students ask: "Why are the holes there? What is this protecting? How can we design something similar?" The perforated structure itself provides visual evidence of a real engineering problem worth solving.

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## Suggested Materials

1. Foam board or rigid cardboard sheets (backing material)
2. Drill with bits or a hole punch (for creating perforations)
3. Non-contact thermometer or thermal strips (for temperature testing)
4. Heat source (safe option: heat lamp, warm water bath, or approved space heater at a distance)
5. Ruler and markers (for planning hole placement and documenting results)

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## Estimated Time

K-2: 40–50 minutes (design sketch 10 min, building 20 min, testing & discussion 15 min)

3-5: Two 45-minute sessions (Session 1: research, sketching, & prototype building; Session 2: testing, data collection, & refinement)

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## Why This Works for Teachers

This challenge directly supports NGSS ETS1.A (defining and delimiting engineering problems) by asking students to identify how a perforated structure solves a real heat-transfer problem, then apply that insight to design their own solution.