"HOW HIGH?" (construction version)

Teacher Name

Date: MM/DD

M T W R F

Summary

One important question for the single-filter purifier design is, how tall should the legs be? Too low and flow is restricted, too high and the filter is tippy. In our recommended design, we just made a guess! This activity estimates air flow for a lot of different legs heights between zero (obviously too short) and one foot (too tall).

Air flow vs. leg height can be estimated in a variety of ways; for example, by measuring the air speed at many (>10) points over the surface of the fan and calculating an average speed, or (faster) moving the anemometer around to find the maximum speed. The former method allows estimation of actual air flow in cubic feet per minute by multiplying by the fan area. The latter method will likely produce a better asymptotic relationship of max speed vs. leg height. Or do both and compare!

Recommended leg construction: four 2, 4, 6, 8, 10, and 12" long triangular prisms taped to the bottom corners of the fan for a smaller class, or make them every inch for a larger class and more data.

Connection(s)

Previous Learning:

Students are familiar with asymptotes of functions.

Future Learning:

Does an elementary function fit the flow vs. height data? If exponential, the height that gives 1/e of the maximum flow tells us about a fundamental property of the box fan filter (its resistance to air flow), but a lot of physics and modeling would be required to extract that.

Instructional Plan

(Note: WC…whole class; CL…cooperative learning structure; PR…cooperative learning pair; IND…individual work)

- Introduction to the problem: how tall should the legs be? **WC** CL PR IND
- Students guess the height above which flow doesn't increase **WC** CL PR IND
- Students constructs different height legs in pairs WC CL **PR** IND
- Speed/flow measurements of each leg height in order WC CL **PR** IND
- Graphing, analysis, discussion **WC** CL PR IND
- Reflection questions **WC** CL PR IND
- WC CL PR IND

Instructional Resource(s)

- Box fan filter
- Anemometer
- At least 8 square feet of cardboard, scissors
- Duct tape, ruler or tape measure

Reflection…

So, what is the best leg height anyway?

Can you invent a more efficient way to conduct this experiment and collect a higher density of data points?

When the fan is sitting on the ground, where does the air come from? Use the anemometer to find out!