

“SAVING TIME WITH SYMMETRY”

Teacher Name _____

Date: _____ MM/DD
M T W R F

Summary

Symmetry is not just a property of shapes, it can also be used to speed up experiments and calculations by eliminating unnecessary measurements that will not provide new information!

First, estimate the total flow out of your box fan filter by sampling the air speed at regularly spaced points over the fan's output side. Calculate the average speed, then multiply by the area of the opening inside the shroud to get the flow rate (in cubic feet per minute).

Next, point out that by symmetry, you could divide the fan into quadrants, and since each quadrant should be the same, you can just measure one quadrant to get the average speed, then use the total area to get the flow rate. Do that and compare.

Finally, measure a different quadrant and compare the result with the first one.

Connection(s)

Previous Learning:

Exposure to the concept of symmetry, lines of symmetry, and averages.

Future Learning:

[High school] Expressing locations on the fan in polar coordinates, the flow rate is a function of r , but not θ . Measure air speed as a function of r and try to write a general equation for box fan filter flow in polar coordinates.

Instructional Plan

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

- Review symmetry and lines of symmetry WC CL PR IND
- Estimate flow rate for the whole fan WC CL PR IND
- Estimate flow rate by measuring one quarter of the fan WC CL PR IND
- Discuss (dis)agreement between the two methods WC CL PR IND
- Estimate flow for a different quadrant and discuss WC CL PR IND
- Reflection question WC CL PR IND
- WC CL PR IND

Reflection...

Instructional Resource(s)

-  Box fan filter _____
-  Anemometer _____
-  Duct tape _____
-  Ruler or tape measure _____

Assuming you have an approximately circular fan shroud: wait, a circle has infinitely many lines of symmetry! What is the most efficient way you could apply symmetry to get an accurate measurement?