

LINKING ACTIVITY 3 “DETECTING RADIATION”

The radiometer is set in motion by heat energy. It consists of a rotating shaft with 4 vanes (painted black and white on opposite sides). The shaft and the vanes are sealed in a glass container with air inside. When you expose the radiometer to a light source (lamp or sun) heat is radiated through the glass towards the shaft. The black side absorbs heat better than the white painted side and as a result, air in the vicinity of the black side increases in temperature with an associated pressure increase (remember the ideal gas law). The pressure difference causes movement of the vane from high to low pressure both directly and through airflow. A microscopic explanation is that the kinetic energy of air molecules near the black side is higher than near the white side resulting in more collisions with the vanes (pressure) on that side relative to the white resulting in net momentum transfer to the vane. Note that when air is removed from the radiometer (that is in vacuum) the shaft could rotate in the opposite direction due to a transfer momentum of photons (a quantum mechanical effect). Photons hitting the black side of the vane are absorbed while those hitting the white side bounce back with an opposite momentum, imparting a higher momentum to the white vane than the black.



This activity may take about 45 minutes.

YOU WILL NEED

1 Radiometer for each small group (E.g. Arbor Scientific)

Procedure

Working in small groups, have students observe the radiometer. Give students some time to investigate the radiometer and then have them answer the following question:

- Can you spin the vanes of the radiometer without touching it? How?

Have each group share their ideas with the class.

Next, have students put the radiometer near a light source and observe it spin. Have them move the light source closer and farther away from the radiometer and observe its motion. Then have them answer the following question:

Sense-Making

Have each student to write an explanation about how they think a radiometer works.

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