

## Generations Symposium

### Is the Beaker Full?

Andy Cherkas

Stouffville DSS [Retired]

[cherkas@sympatico.ca](mailto:cherkas@sympatico.ca)

Cathy Cherkas

**Purpose:** to illustrate the points of the particle theory of matter that there are spaces between particles, and that the particles attract one another.

To illustrate that particles are in constant motion, and that there are spaces between the particles, the particles are very small [microscopic].

**Materials:** Styrofoam spheres, sand, 1 liter beaker, 3 100 mL graduated cylinders, food colouring, water, ethanol, thermometer, 250 mL beaker, vanilla extract [or other material with a pleasant odour], balloon, Petrie dish.

**Safety:** check to see if anyone has a latex allergy to see if you can use the balloon. Use goggles with a balloon. If the balloon breaks, latex can stick in the eye and must be removed by a medical doctor. Ethanol is flammable and is in the vanilla extract as well as in the ethanol. Keep ignition sources away.

**Procedure: 1.** Place a Petrie dish with 10 mL of vanilla extract in a spot at the back of the classroom. Note who smells the odour first second etc. and the time it takes for the odour to permeate the room.

*What causes the smell? Why can't you see the material causing the smell? How does the smell get from one part of the room to the next? Why is the room not instantly filled with the odour?*

The questions can be answered by having microscopic particles of vanilla that are constantly moving in all directions [that is some particles move in one direction others in a different direction]. There must be room for the particles to move between the other air particles in the room. The particles have a certain average speed so take a longer time to travel a larger distance. Hence the room is not completely filled with the odour instantaneously.

2. Place some vanilla extract into a balloon. Blow up the balloon and tie it off. Pass the balloon around and note the odour.

*How is the odour getting out of the balloon?*

There are microscopic holes in the balloon allowing the microscopic vanilla particles to escape.

3. Fill a 1 liter beaker with styrofoam spheres. *Is the beaker full?* No there are spaces between the spheres which can be filled with sand.

Fill a 250 mL beaker with sand. *Is the beaker full?* No. There are spaces between the sand that can be filled with water.

Place 50 mL of water in a 100 mL graduated cylinder. Dye the water blue. Place 50 mL of pure ethanol into a second 100 mL graduated cylinder. Dye the ethanol red.

*What volume do the two liquids make together?* 100 mL

Take the temperature of the two liquids.

Now pour the two liquids into a third 100 mL graduated cylinder. *What is the final volume?* 96 mL. *Why?* There are microscopic spaces between the water and ethanol particles. On mixing some of that space got filled.

*What is the final temperature?* One to two degrees warmer. *Why?* The molecules attract each other, [hydrogen bonds form between the water and ethanol molecules] As attractions increase [bond forming] energy is released.

Use to introduce and illustrate the particle theory of matter,

To illustrate diffusion

To illustrate an exothermic bond forming reaction,

To illustrate formation of hydrogen bonds.