Ghana Summer School

I. Flipping Water

Supply List:
- Cup
- Screen
- Plastic Card
- Wall Tack Putty

Fill your cup partially with water and top it with the plastic card. While holding the card against the cup, flip the cup upside down. Carefully remove your hand from the plastic card.

What has happened? What is the pressure distribution inside the cup when inverted? How does the pressure at the bottom of the cup compare with a typical atmospheric pressure of 1 bar?

Repeat the experiment with the piece of mesh between the cup and the plastic card. You will need to secure the mesh to the cup using the wall tack putty. Completely line the rim of the cup. Once the cup is upside down, carefully remove the plastic card. *Describe what has happened and why? Why is the mesh important? Try to get the water out of the cup without removing the mesh.* [Hint: When considering the importance of the mesh, it may help to think about stability of a system. For example, a ball balanced on the top of a very steep hill will roll further away from its position if slightly disturbed: a unstable situation. In contrast, a ball at the base of a very steep valley will roll back to its position if disturbed: a stable situation.]

Challenge question- What is the tallest cup of water that you could flip?

II. Melting Ice

Supply List:
- Two Large Containers
- Fresh water
- Salt
- ice cubes
- Food coloring

Two containers hold equal amounts of water and ice; however, one container is filled with fresh water and one is filled with salty water. In which container will the ice melt the fastest? Why?

Now let’s test your theory. Fill both containers equally with about 1600 ml of fresh water. Mix 35 ml of salt into container #2 (make sure all the salt is dissolved). Place a few ice cubes in each container. Observe what happens.

Now drop a (very) little food coloring on to the ice in the containers. What does this reveal? Once the ice has completely melted in one of the containers, discuss how you might induce the ice to melt faster in the other container. Draw temperature, salinity, and density profiles in each cup at the beginning, in the middle, and at the end of the experiment.

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III. Coriolis Machine

Supply List:
Plastic Sheet
Paper with Reference Frame
Thumbtack
Dry Erase Marker

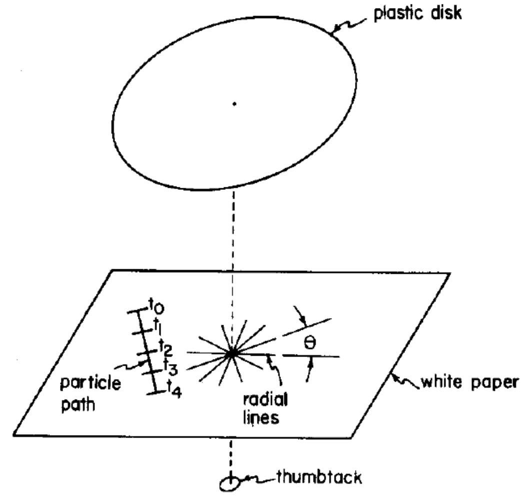

Fig. 1. Exploded view of Coriolis machine.

The Coriolis Machine is composed of a plastic sheet placed over a white piece of paper secured together in the center with the thumbtack. The plastic sheet is your rotating reference (non-inertial) frame, as it can be easily rotated over the white paper (which represents the non-rotating or inertial reference frame). To measure a rotation rate, radial lines of equal spacing are drawn through the center of the paper. The distance between radial lines marks the rotation angle over one time step Δt. Paths of particles moving in straight lines are also marked on the inertial reference frame. Ticks on the paths mark the distance the particle traveled in one time step. *Considering the spacing of the particles, can you identify which line represents an accelerating particle?*

Now you are ready to run the machine. Start by marking the initial position of the particles with a small x. Also mark one of the radial lines as a reference for turning. Now rotate the non-inertial reference frame counter-clockwise one time step, i.e., move your reference radial line over one position to the right. Now mark the new location of the particle by placing another mark at the second tick on the particle path. Continue to rotate and mark the particle positions until you understand the path of the particles on the non-inertial (plastic) reference frame.

Which direction are the particles deflecting? Does one particle deflect more than the other particle? What happens if you try the machine again, rotating clockwise? Try it!