Liquid and Acceleration Teacher's Notes

Main Topic	Motion
Subtopic	Acceleration
Learning Level	High
Technology Level	Low
Activity Type	Student

Description: Use a liquid accelerometer to observe different types of motion

Required Equipment	Liquid Accelerometer, Constant Velocity Car, Dynamics Cart, Spring Scale, rubber band, string
Optional Equipment	Rotating Platform or Rotating Stool, Food coloring

Educational Objectives

- Observe the behavior of liquid in an accelerometer in conditions where the acceleration is understood.
- Classify acceleration in new situations by observing the accelerometer.

Key Question

- How does a liquid accelerometer show the direction of acceleration?

Concept Overview

Accelerometers work by using inertia. The water in an accelerometer resists motion, and moves away from the direction of acceleration. An accelerating accelerometer looks like this:

Students will observe straight-line motion (constant velocity and constant acceleration), and then take their knowledge of the water's behavior to more complex circular and pendulum motion. They will discover the centripetal (toward the center) acceleration of circular motion, and the acceleration toward equilibrium of a pendulum system.

Lab Tips

1. Fill accelerometers half-full with tinted water.
2. Accelerometers may be attached to cars and carts with lumps of clay.
3. If time is an issue, the teacher may perform the experiments for circular and pendulum motion, with students observing and recording their observations.
4. Extend the lab by placing the accelerometer at the center of a rotating platform and demonstrating how the liquid moves to both ends at once.
5. Arbor Scientific's Rotational Stool has an available accessory that quantitatively demonstrates centripetal acceleration at different points on the rotational radius.

Liquid and Acceleration

Name: _____

Class: _____

Pre-Lab Questions:

1. Describe, using a few words, the acceleration of the Constant Velocity Car.

2. Describe, using a few words, the acceleration of a low-friction cart pulled forward by a constant force.

Goal:

Observe the behavior of liquid in an accelerometer in conditions where the acceleration is understood, and classify acceleration in new situations by observing the accelerometer.

Materials:

Liquid Accelerometer, Constant Velocity Car, Dynamics Cart, Spring Scale, rubber band.

Procedure:

1. Wrap the rubber band around the accelerometer so that it marks the level point of the water.
2. Attach the accelerometer to the Constant Velocity Car, so that it is level. Start the car and observe the water in the accelerometer.
3. Write a sentence describing the acceleration of the car and the behavior of the water in the accelerometer.

4. Remove the accelerometer from the CV Car and attach it to the Dynamics Cart.
5. Hook a spring scale to the cart and pull it with a constant force. (Practice if necessary.) When you can pull smoothly, write a sentence describing the cart's acceleration and the behavior of the water in the accelerometer.

6. Draw a diagram of the water in the accelerometer with arrows showing the direction of acceleration and the direction of the net force on the accelerometer.

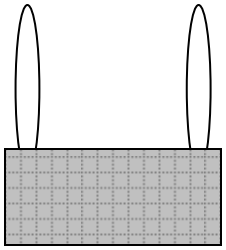
7. Pull the cart in the opposite direction and check your description and diagram above. Change them if necessary.

8. Remove the accelerometer from the cart.
9. Choose one member of your group to model rotational motion. This person should hold the accelerometer at arm's length in front of them, between two hands, so that the person holding the accelerometer can easily observe its face and the shape of the water within.
10. That group member should turn in a slow circle, at as constant of a speed as possible. Describe the behavior of the water as he/she turns.

11. Now turn the accelerometer so that it points out parallel to the person's arms. The rotating person will now not be able to observe the water.
12. Repeat the rotational motion, as before, at as constant of a speed as possible. Describe the behavior of the water.

13. Write a sentence describing the direction of acceleration of an object moving in a circle. Draw a diagram of the accelerometer showing acceleration.

14. Hang the accelerometer from two strings, as shown. The strings should be long enough to let the accelerometer freely swing from side to side like a pendulum.



15. Let the accelerometer swing back and forth. Observe the water at each end of the swing, and in the middle. Draw the water level in each of the diagrams below, and draw arrows showing the directions of acceleration and net force in each position.