



# Centripetal Force

## Topic

Geosynchronous orbital



## Time

1 hour



## Safety

Please click on the safety icon to view safety precautions. Be careful when using a drill.

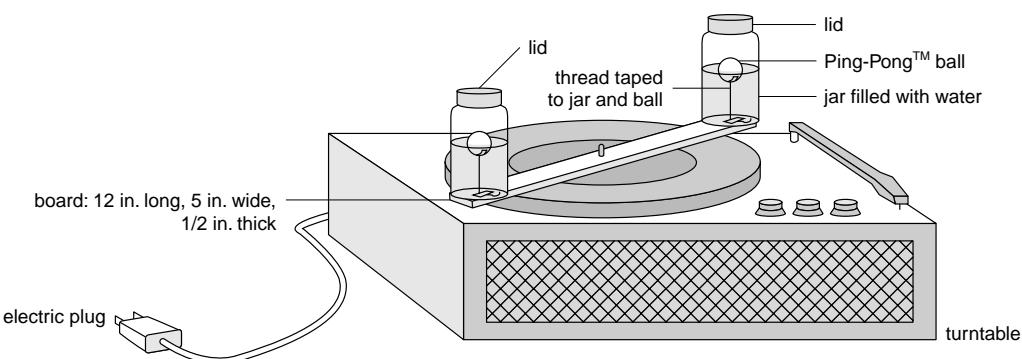
## Materials

two empty small jars with screw lids  
(must be the same brand and size)  
two Ping-Pong™ balls  
one old record player turntable  
wooden board 5 in. 2 12 in. 2 1/2 in.

drill  
thread  
tape  
water  
glue

## Procedure

1. Drill a hole in the middle of the board so that it will fit tightly over the center prong on the turntable.
2. Glue the bottom of each jar to the opposite ends of the board (see figure).
3. Cut a piece of thread the length of the height of the jars.
4. Tape one end of the thread to each Ping-Pong™ ball.
5. Tape the other end of the thread to the inside of the jar. The ball extended on its thread should reach only three-quarters of the height of the jar.



6. Fill each jar to the rim with water. Screw on the lids tightly.
7. Predict the movement of the Ping-Pong™ balls before you turn on the turntable. Turn on the turntable. Record your observations on the data table.
8. What happened to the balls? What happened to the balls when you added water? Record your observations.
9. Pour the water out of the jars, and dry them completely. Screw on the lids. Predict what will happen when you turn on the turntable. Record your predictions on the data table.
10. What happened to the Ping-Pong™ balls? Where were the balls before you turned on the turntable? Record your observations.

DATA TABLE			
Setup	Prediction	Actual, turntable off	Actual, turntable on
Ping-Pong™ balls in water			
Ping-Pong™ balls without water			

#### What's Going On

The Ping-Pong™ balls are lighter than water; therefore they will float and remain up when you add water to cover them. The balls will tend to go to the center of the rotating turntable when the turntable is turned on because the water molecules, which are heavier, are forced toward the outside of the turntable, making the outside dense and the inside less dense. The balls go towards the less-dense area. The opposite will occur with air in the jars because the balls are heavier than air. Therefore, they will go towards the outside of the turntable.

#### Connections

A geosynchronous orbital allows a satellite 1 day to complete an entire orbit. The rate of motion of the satellite seems to be stationary because the motion rates of the satellite and the earth are similar. Satellites in a geosynchronous orbital exhibit centripetal force, which keeps them within the orbital.

#### Troubleshooting

It is easier to do the experiment first without water and then to add water and do it again, rather than do it with water first and then wait for the jars to dry out.

#### Additional Activities

Take a bucket with a handle, and attach a strong string to the center of the handle. Fill the bucket to the halfway mark with water. Swing the bucket in a circle so that the water is upside down. Centripetal force will keep the water in the bucket.

# Safety Precautions

READ AND COPY BEFORE STARTING ANY EXPERIMENT

Experimental science can be dangerous. Events can happen very quickly while you are performing an experiment. Things can spill, break, even catch fire. Basic safety procedures help prevent serious accidents. Be sure to follow additional safety precautions and adult supervision requirements for each experiment. If you are working in a lab or in the field, do not work alone.

This book assumes that you will read the safety precautions that follow, as well as those at the start of each experiment you perform, and that you will *remember* them. These precautions will not always be repeated in the instructions for the procedures. It is up to you to use good judgment and pay attention when performing potentially dangerous procedures. Just because the book does not always say “be careful with hot liquids” or “don’t cut yourself with the knife” does not mean that you should be careless when simmering water or stripping an electrical wire. It *does* mean that when you see a special note to be careful, it is extremely important that you pay attention to it. If you ever have a question about whether a procedure or material is dangerous, stop to find out for sure that it is safe before continuing the experiment. To avoid accidents, always pay close attention to your work, take your time, and practice the general safety procedures listed below.

## PREPARE

- Clear all surfaces before beginning work.
- Read through the whole experiment before you start.
- Identify hazardous procedures and anticipate dangers.

## PROTECT YOURSELF

- Follow all directions step by step; do only one procedure at a time.
- Locate exits, fire blanket and extinguisher, master gas and electricity shut-offs, eyewash, and first-aid kit.
- Make sure that there is adequate ventilation.
- Do not horseplay.
- Wear an apron and goggles.
- Do not wear contact lenses, open shoes, and loose clothing; do not wear your hair loose.
- Keep floor and work space neat, clean, and dry.
- Clean up spills immediately.
- Never eat, drink, or smoke in the laboratory or near the work space.
- Do not taste any substances tested unless expressly permitted to do so by a science teacher in charge.

## USE EQUIPMENT WITH CARE

- Set up apparatus far from the edge of the desk.
- Use knives and other sharp or pointed instruments with caution; always cut away from yourself and others.
- Pull plugs, not cords, when inserting and removing electrical plugs.
- Don’t use your mouth to pipette; use a suction bulb.
- Clean glassware before and after use.
- Check glassware for scratches, cracks, and sharp edges.
- Clean up broken glassware immediately.

- Do not use reflected sunlight to illuminate your microscope.
- Do not touch metal conductors.
- Use only low-voltage and low-current materials.
- Be careful when using stepladders, chairs, and ladders.

#### USING CHEMICALS

- Never taste or inhale chemicals.
- Label all bottles and apparatus containing chemicals.
- Read all labels carefully.
- Avoid chemical contact with skin and eyes (wear goggles, apron, and gloves).
- Do not touch chemical solutions.
- Wash hands before and after using solutions.
- Wipe up spills thoroughly.

#### HEATING INSTRUCTIONS

- Use goggles, apron, and gloves when boiling liquids.
- Keep your face away from test tubes and beakers.
- Never leave heating apparatus unattended.
- Use safety tongs and heat-resistant mittens.
- Turn off hot plates, bunsen burners, and gas when you are done.
- Keep flammable substances away from heat.
- Have a fire extinguisher on hand.

#### WORKING WITH MICROORGANISMS

- Assume that all microorganisms are infectious; handle them with care.
- Sterilize all equipment being used to handle microorganisms.

#### GOING ON FIELD TRIPS

- Do not go on a field trip by yourself.
- Tell a responsible adult where you are going, and maintain that route.
- Know the area and its potential hazards, such as poisonous plants, deep water, and rapids.
- Dress for terrain and weather conditions (prepare for exposure to sun as well as to cold).
- Bring along a first-aid kit.
- Do not drink water or eat plants found in the wild.
- Use the buddy system; do not experiment outdoors alone.

#### FINISHING UP

- Thoroughly clean your work area and glassware.
- Be careful not to return chemicals or contaminated reagents to the wrong containers.
- Don't dispose of materials in the sink unless instructed to do so.
- Wash your hands thoroughly.
- Clean up all residue, and containerize it for proper disposal.
- Dispose of all chemicals according to local, state, and federal laws.

BE SAFETY-CONSCIOUS AT ALL TIMES