**CO2 is a Gas**

Description:

Is CO2 dangerous? Does it explode? Can it be transported safely?

This set of experiments are used in introductory physics and chemistry to examine properties of

gases. Our motive here is to increase public understanding of the basic properties of CO2 so that

they can be informed about safe handling and so that fears derived from absence of information

will be reduced.

Materials and Supplies:

* 10-gallon aquarium or similar container
* Plastic tray to fit inside fish tank (dry ice placed directly on glass may crack it, a container will provide insulation)
* Bubble mix with bubble-blowing wand from toy store
* Candle
* Matches or lighter
* Several clear plastic cups, 12oz size
* Two hot pads (gloves are nice, for safe handling of dry ice)
* Several 1-pint water bottles filled with drinking water
* Ice pick
* Plastic bag to cover work surface
* 5-12 lb block of dry ice
* Small Styrofoam ice chest for transporting dry ice

Setup:

Freeze caution: warn participants not to touch dry ice with bare skin.

Using hot pads, place the dry ice block in a shallow plastic tub.

The plastic will provide insulation so that the cold from the dry ice does not crack the glass. Use

the ice pick to break off a number of chunks of dry ice, ice cube-size or smaller for the

experiments. Place the dry ice in the tub in the bottom of a 10-gallon fish tank.

In a turbulent or breezy setting it is helpful to cover the tank with a piece of newspaper to allow

the CO2 to build up and to break the dry ice block into more pieces to increase the rate of

sublimation. Not suitable for outside demos.

Presentation:

Dry ice is frozen CO2. Ask “Does anyone know where the CO2 goes as the dry ice sits in the room and warms up?” “Do you see any liquid CO2 drips?” (No, liquid CO2 does not exist at atmospheric pressure. Frozen CO2 “thaws” or sublimes directly to gas.) “Can anyone see the CO2 once it’s in the air?” (No, it’s colorless.) “Can anyone smell anything different?”

Even though the CO2 gas is invisible (transparent to light), we can test for it.CO2 gas is heavier

than air (air is mostly nitrogen and oxygen). So if we blow bubbles full of regular air, they will

float on CO2. Try it (figure 4). (participants should gently blow soap bubbles into the tank and

watch them “float’ on CO2.) Too vigorous swooshing of the bubble wand or blowing of bubbles

will displace the CO2 and no effect will be seen.



Figure 4. Using the property of density to test for CO2 gas that collects in the tank as the dry ice

sublimes.

Another way to see the gas is to collect it (figure5). Fill a small water bottle nearly to the top.

Drop an ice cube-size piece of dry ice (broken in several pieces) into the water. Put a balloon

over the top of the bottle and watch the CO2 gas blow up the balloon.



Figure 5. As dry ice sublimes, gas expands and fills the balloon.

Is CO2 dangerous? Is it explosive? CO2 collects in low places and displaces the lighter oxygen.

Being put in the tank full of CO2 would kill a hamster. If we light a candle and put it in the tank,

we will see that there is not enough oxygen for the candle to burn. Try putting a lighted candle

into the tank (figure 6).

CO2 is not explosive; it is used to put out fires. Moving slowly, fill a plastic cup with CO2 gas

from the bottom of the fish tank and pour it on a lighted candle (short fat candles are easier to

hit) (figure 6).



Figure 6. Testing for CO2 by extinguishing flame.

In low and moderate concentrations, CO2 is not dangerous to people. Pour a transparent cup half

full of drinking water. Add a small ice cube of frozen CO2. The water warms the frozen CO2

causing it to form gas, which fizzes (figure7). ­CO2 makes the fizz in carbonated beverages. As

some of it dissolves in the water, it forms a weak acid. If you drink the water, it tastes slightly

tangy (like lemon), this is the taste of acid. (this has proved to be very popular, and brings home

the message). Don’t let people touch the dry ice, though.



Figure 7. Making carbonated water with dry ice.