Exploding Rockets - Teacher Notes

Safety First

These rockets launch with considerable force, so once you have secured the lid, put them down quickly and stand well back. If the rocket does not launch, leave it for at least 2 minutes before approaching it – and even then make sure that you do not put your face above the rocket. (You may see a small amount of liquid leaking out of the container. Sometimes this stops the rocket from launching – but on some occasions it may still work – so again wait at least 2 minutes before approaching.)
The experiment also uses an Alka Seltzer tablet. If you think there is any danger of one of the pupils putting this in their mouth, you can instead use vinegar and bicarbonate of soda. (This will be highlighted in the text below.)

About this Activity

This experiment involves making carbon dioxide – and using the carbon dioxide under pressure to launch a small plastic rocket.

The activity introduces the children to:

- A chemical reaction which produces carbon dioxide;
- The behaviour of gases under pressure;
- Factors which influence the rate of the chemical reaction.

Before You Start

Equipment needed:

- Film canister. This is supplied in the Mission to Mars Instant Science Pack. (For more information about the use of other film canisters, see the end of these notes.)
- A couple of Alka Seltzer tablets. (Or alternatively, some vinegar and bicarbonate of soda.)
- A jug to hold a small amount of cold water.

Worksheets:
Exploding Rockets p1 examines how the rockets work.
p2 investigates what happens when we vary the amount of Alka Seltzer tablet.
P3 investigates the effect of the temperature of the water.
You can do **p1** by itself, **p1** and **p2**, or **p1**, **p2** and **p3**.

Other Information:
The experiment needs a bit of space and does make a little bit of mess – a small puddle – but you can do it in the classroom. (You can place it on a plate or chopping board if you are worried about making a mess on the floor.)
It should rise to a height of 2-3 metres, so it may hit the ceiling – but if launched from the floor it should not cause any damage to the ceiling. However, make sure that you do not place the rocket underneath a light fitting, data projector, or anything else which could be damaged.
(Note - if you decide to use vinegar and bicarb it will make a rather smelly mess – so I would definitely do the experiment outdoors!)

Launching your Rocket (Exploding Rockets p1)

- Take an Alka Seltzer tablet and break it into quarters. Place one quarter of the tablet into the film canister. (It does not matter whether it is an exact quarter.)
- Pour in a small amount of **cold** water – ordinary cold tap water is fine - to a depth of a couple of millimetres. You will notice that the tablet starts to 'fizz'.
- Place the lid on the container – making sure that it snaps securely into place – and then quickly turn the container over, placing the lid of the container on the floor. And wait.
- After about 30-40 seconds there will be a 'pop' and the canister will shoot up into the air. (If the rocket does not launch after this time, wait at least two minutes before approaching the rocket – see the Safety First notes.)

To do this experiment using vinegar and bicarb I would suggest pouring in the vinegar to a depth of about 2mm and then adding about a quarter of a level teaspoon full of bicarbonate of soda.

How does it work?

The Alka Seltzer tablet reacts with the water to produce carbon dioxide gas. (The fact that it is carbon dioxide is not important in this experiment – the rockets would work no matter what type of gas was produced.)
Once we place the lid on the film canister, the gas is trapped inside the container. As the tablet continues to react with the water, it produces more and more carbon dioxide gas – and so the pressure inside the canister increases.
When the pressure becomes too large, it pushes the lid and the canister apart. Since the lid cannot move down (because it is placed against a hard surface), the canister shoots up in the air. (If the children are not familiar with the term 'pressure' you can say that the rocket launches when there is too much gas in the canister.)

*(**Note** – some children may say that the Alka Seltzer tablet **dissolves** in the water. This may seem to be a reasonable observation, but it may be a good time to discuss the difference between **dissolving** and **reacting**. If the tablet dissolved in the water it would not produce any gas.)*

Before you launch the rocket again ...

... wipe around the edge of the film canister and rinse the lid. This will remove any small grains of tablet which might otherwise be trapped between the canister and the lid. This would reduce the pressure inside the container and may stop it launching at all. Obviously it is important to do this each time before you launch the rocket.

Varying the amount of Alka Setzer (Exploding Rockets p2)

What do you think will happen if you use more Alka Seltzer?

Ask the children to predict what will happen before you try the experiment. Common answers are:

- The rocket will go higher;
- It will make a bigger 'pop';
- It will take less time (or more time) to launch.

To test the first hypothesis we need to find some way of measuring the height of the rocket. We can do this roughly by placing the rocket close to a wall – particularly if there is some pattern or features on the wall, e.g. the courses of bricks in a brick wall. (Obviously, if your rocket hit the ceiling in the first experiment you will not be able to tell whether or not it goes higher unless you find a room with a higher ceiling – or do the experiment outside.)

To test the third hypothesis we need to measure how long it takes before the rocket blasts off. If you don't have a stopwatch you can get the children to count aloud. (To measure seconds you can count 1001, 1002, ... or 1 elephant, 2 elephants, ...)

It is obviously a difficult to test the second hypothesis quantitatively, but you can poll the children afterwards to see if they think it is any louder.

Testing these ideas

Before you repeat the experiment, make sure you have wiped around the edge of the canister and rinsed the lid – as described above.

- Do the first experiment again using a quarter of an Alka Seltzer tablet, but this time we will measure how long it takes for the rocket to launch. Start your timer (or start counting) as soon as you snap the lid into place. Also assign a couple of children to try to determine how high the rocket travels up the wall. (It is easiest do this when they are some distance away from the wall.)
- Now repeat your measurements using half a tablet, and then a full tablet.
  (If you have enough Alka Seltzer tablets you can measure the time twice for each amount of tablet and then take an average.)

What did you find out?

You should notice that increasing the amount of tablet means that:

- The rocket takes less time to launch;
- The height of the rocket does not change significantly;
- The 'pop' does not seem to be any louder.

To explain these results, they key point is that the rocket launches as soon as there is enough pressure to push the lid off. This quantity depends on the particular film canister, but does not depend on the amount of Alka Seltzer.

- So the height of the rocket and the loudness of the 'pop' should be about the same as before.
- But adding more tablet means that the reaction takes place more quickly, so the pressure reaches the critical level in less time.

Varying the Temperature of the Water (Exploding Rockets p3)

If you want to extend the experiment further you can also investigate how the performance of the rockets depends on the temperature of the water.

Using what we have found out in Worksheet **p2**, we can predict that the temperature of the water is unlikely to affect the height of the rocket (or the loudness of the 'pop'), but we might expect it to affect the time taken for the rocket to launch.

Try the experiment using ¼ of an Alka Seltzer tablet each time, but vary the temperature of the water as follows:

- Chilled water (e.g. from the fridge);
- Cold tap water;
- Luke warm water. (Do not use hot tap water or the rocket may explode before you have time to put it on the floor.)

Of course, you have already done this experiment using cold tap water in Pt 2, so you do not need to take these measurements again.

Chemical reactions usually take place more quickly at a higher temperature. So using chilled water means that the rocket takes longer to launch, whereas warm water reduces the launch time.

Additional Notes

Obtaining more Film Canisters

If you want to obtain some more film canisters, the best place is usually to ask in a local store which offers photograph printing. They often have a few empty film canisters lying around.

However, you need to make sure you get the type of canister where the lid fits **inside** the container. (These are usually made from clear/white plastic.)

In my experience, the type of container where the lid fits **outside** the container (usually black with a grey lid) are not air tight, so most of these do not work as rockets. However, if you are keen to experiment you may find one of these which does work – but you will probably notice that it does not go nearly as high as the other type. This can be used as the basis for another experiment, investigating how the pressure in the container affects the height of the rocket.

