Baptist Lui Ming Choi Secondary School

Mentoring Program

2006-2007

Consultant: John Polias

Explaining scientifically

Teacher: Ngan Shiu Hei
Subject: Integrated Science
Target Students: Form 2
Topic: Explaining physical processes scientifically

Contents

Introduction

In science, students are taught a range of scientific skills such as observation, explanation, and designing experiments. Explaining scientific phenomenon is one of the most difficult skills for any student, even in their first language. So it is clear that it is a difficult task for students in EMI schools.

Since science topics are taught in primary school by generalist teachers, then students entering secondary school are very dependent on their specialist science teachers to develop their ability to explain events scientifically. This needs to start from the beginning of their secondary schooling.

Objective

Develop students' skills in explaining scientific phenomenon using English.

Procedure

Preparation

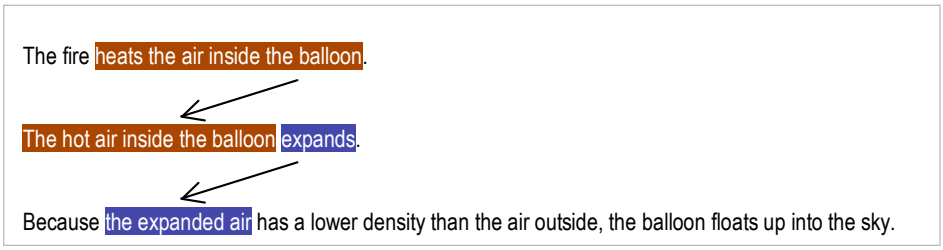
After discussing with Mr Polias at the beginning of the academic year (September 2006), we devised a method to help students to explain events scientifically.

Using visuals was seen as crucial so we decided to use a series of pictures, like a comic strip, to show the changes in a scientific event.

For example, if I want students to explain why a hot air balloon can fly in the sky (scientific event), I draw four to five pictures to show the four or five stages involved in the rise of the hot air balloon. The first picture (ie the first stage in the physical process) shows the ignition of the burner. The second shows the inflation of the balloon. The third stage shows the expansion of air in the balloon and the last stage shows the balloon rising due to the lower density of air inside the balloon compared with outside.

After showing the pictures to students, the teacher discusses the stages one by one with the students. Students are asked to describe what is happening in each of the stages and compare successive stages. This is an important learning step because by identifying the changes between two stages, students can be supported by their peers and the teacher in learning a lot of technical terms. Once they understand the scientific processes going on, they write a sentence to explain the changes from one stage to the next.

Because one stage is dependent on what has happened in the previous stage, we find that there is a pattern in the language we use to explain events. In a simple explanation such as the hot air balloon, we could say that the product of one stage is the beginning of the next stage. In terms of language, a simple explanation often has the following pattern: the end of a sentence is the beginning of the next sentence. For example:



The sentences are finally joined together to form a short passage that explains the scientific event. The ultimate goal of this activity is for students to be able to write an explanation on their own without any visual.

The advantages of this method are that:

- concepts can be represented visually
- a complicated scientific event is broken down into small stages that help students construct their knowledge
- students are required to write a sentence or two only for each stage, which makes the task of writing a whole explanation more manageable and hence more likely to be successful.

Action

To start the process of developing in students the ability to explain scientifically, a series of pictures were designed to show the changes in scientific events. For example:

1. Explain how an air cushion reduces friction between the disk and the plain surface.
   See Figure 1.
2. Using action and reaction forces, explain the propulsion of an inflated balloon when released.
   See Figure 2.
3. Using action and reaction forces, explain the work of a water rocket.
   See Appendix II.
4. Explain how fuse wire protects electrical appliances when there is excess current.
   See Appendix III.

First attempt (November 2006)

The first time I drew on the board the pictures from Figure 1 (explaining the work of an air cushion to reduce friction) and asked students to describe each picture. At the same time, I introduced the idea that the end of an event was the beginning of the next event. As it was the first time I had tried such an activity, students were not familiar with it. So I simply asked them to observe and suggest words that were related to the pictures. After discussing with the students, I wrote sentences for the pictures. The sentences from each picture were then joined together to form a short passage to. (See Appendix I)

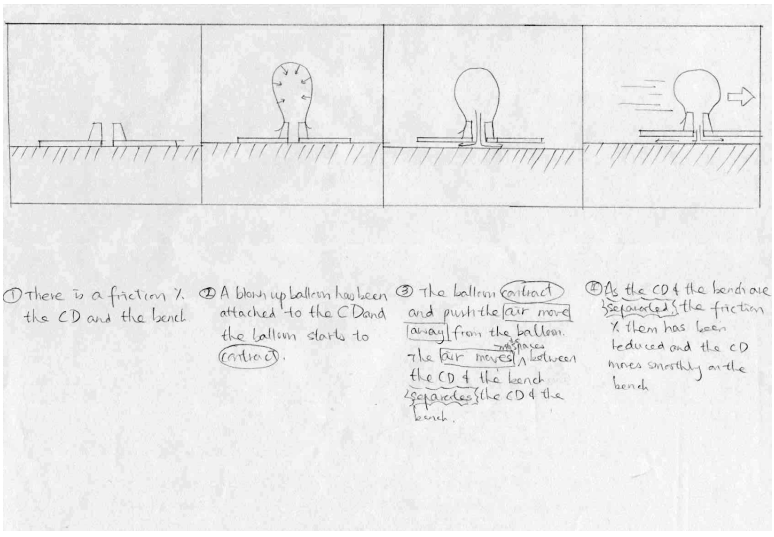


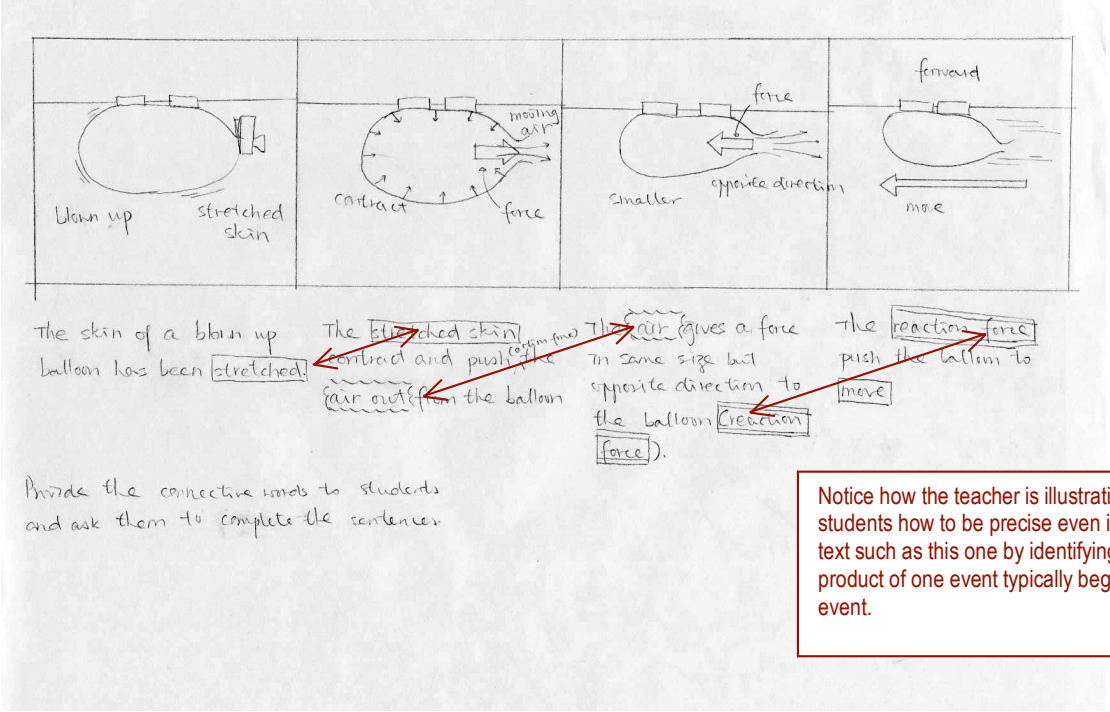
Figure 1: An explanation of the work of an air cushion to reduce friction

Whole text

There is a friction between the CD and the bench. An inflated balloon has been attached to the CD and the balloon starts to contract. The contracted balloon pushes the air away from the balloon. The air moves to the spaces between the CD and the bench and so separates the CD and the bench. As the CD and the bench are separated, the friction between them has been reduced and the CD moves smoothly on the bench.

Second attempt (November 2006)

After a few lessons, I used for this activity the task: *Using action and reaction forces, explain the propulsion of an opened balloon* (see Figure 2.) Apart from discussing with the students, I asked them to write a short explanation text. In this case, some students performed very well but some did not (Appendix I). The students' poor performance may be due to a combination of the lack of instruction given by the teacher on a comparatively difficult concept such as action and reaction forces.



Notice how the teacher is illustrating for the students how to be precise even in a simple text such as this one by identifying how the product of one event typically begins the next event.

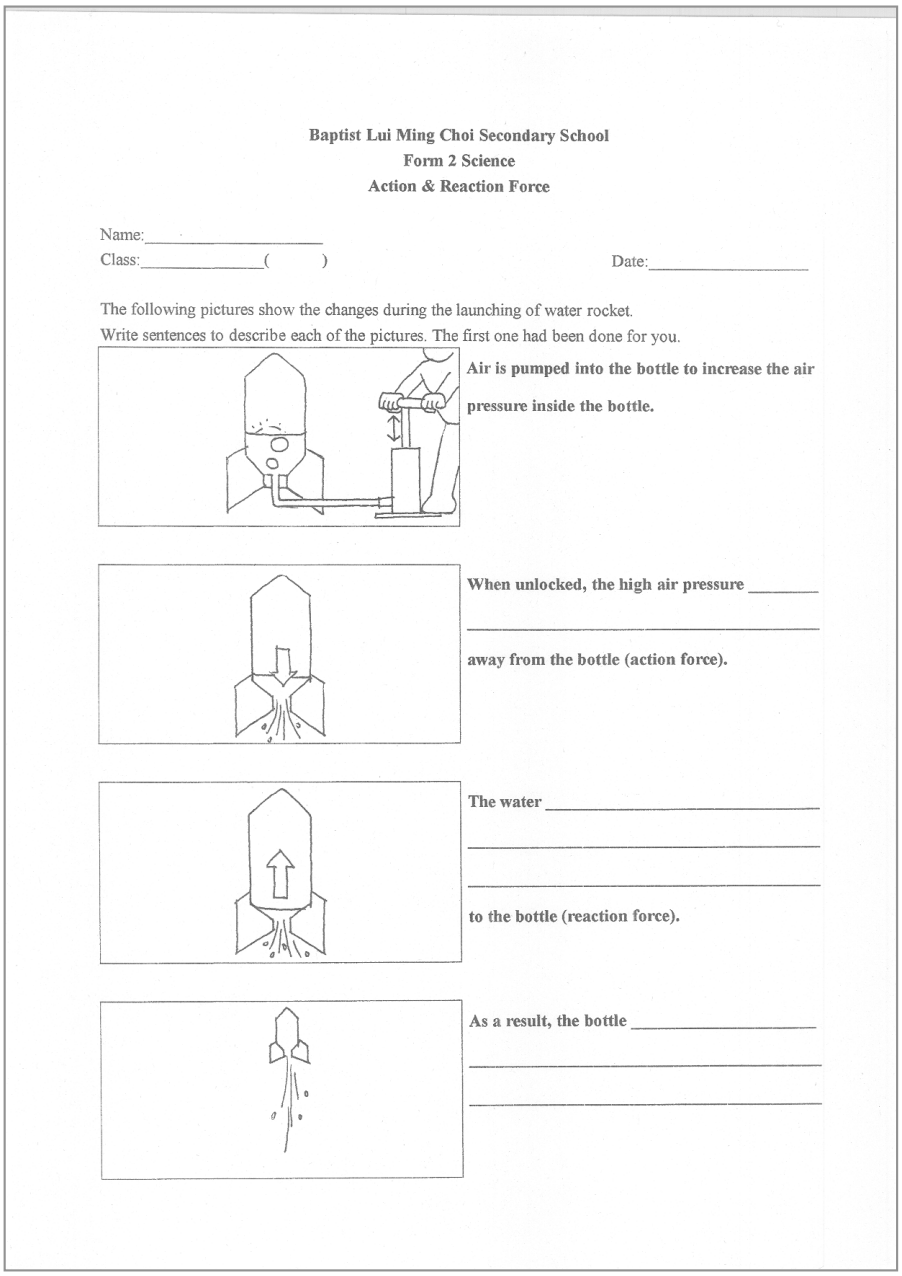
Figure 2: An explanation of the propulsion of an opened balloon

Whole text

The skin of an inflated balloon has been stretched. The stretched skin contracts and pushes (action force) the air out from the balloon. The air gives a force of the same size but opposite direction to the balloon (reaction force). The reaction force causes the balloon to move.

Third attempt (December 2006)

I thought that the students should be capable of writing their own text, so I designed a worksheet which asked the students to write an explanation on the work of the water rocket (Figure 3). On this occasion, I tried not to discuss with the students beforehand but instead provided some hints in the worksheet. Some students showed brilliant work. The general performance was satisfactory (Appendix II). I believe it was probably because more hints were given to the students.



Baptist Lui Ming Choi Secondary School
Form 2 Science
Action & Reaction Force

Name:_____
Class:_____( ) Date:_____

The following pictures show the changes during the launching of water rocket.
Write sentences to describe each of the pictures. The first one had been done for you.

Air is pumped into the bottle to increase the air pressure inside the bottle.

When unlocked, the high air pressure _____ _____ away from the bottle (action force).

The water _____ _____ _____ to the bottle (reaction force).

As a result, the bottle _____ _____ _____

Figure 3: A worksheet on explaining action and reaction force

Fourth attempt (February 2007) – with class visit

The fourth time, I designed a worksheet to explain the work of a fuse wire but providing fewer hints. I thought students should perform better than the third time but, unfortunately, the results were below my expectations (Appendix III). One of the reasons could be that the worksheet did not provide enough information to describe the pictures. Another reason might be that the activity was held long after the previous one. For details of this activity, you may refer to the class visit review (Appendix IV), the PowerPoint for this lesson (Appendix V) and the lesson plan (Appendix VI).

This activity was done again in another class with a modified worksheet. The modified worksheet provided the first statement in the beginning. This gave the students a concrete beginning that guided them to start writing. The modified worksheet and the students' texts are in Appendix III.

Evaluation

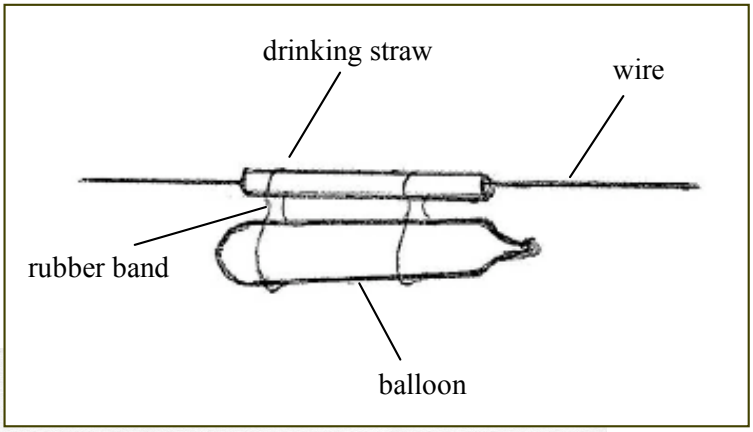
Even though the students did not perform as well as I thought, they at least have a concept about explanation. This was shown in a test about electricity. There was a question about explaining the work of a fuse. Most of the students showed the change of the current, fuse and the electrical appliance in their answer. The general performance was better than those students without such training. Although it is still far from being the success I had hoped for, this is a valuable beginning. And more activities will be provided to these students to enhance their explanation skills.

Future action

This explanation activity will be introduced in Form 1 to help students to explain the phenomenon of thermal expansion, density and pressure. The general design pattern is similar to the first round. In the first activity, the teacher will discuss with the students and also demonstrate how to write sentences one by one and how to form a passage to describe the scientific changes. In the other activities the teacher's support will be reduced bit by bit until the student is able to write the whole text independently. For details of the activity designs, please refer to Appendix VII.

Appendix I

Students' work—refer also to the adjacent visual.



Leung Chit Shing 2C

1. Stick a balloon on the ~~string~~ straw and put the string between the two stands. The balloon is stretched
2. The stretched balloon contracted, when we pull out the paper dip. The air pressure increased and made the air inside goes out
3. As the air goes out, the air moves away ~~and the air~~ and the air made a reaction force and push the balloon,
4. The pushing force made the balloon moves.

① Blow up air to the balloon so the skin of the balloon is stretched and fill with air.

② Air comes out from the balloon because skin of it is contract so the force push the air moves out.

③ Air escapes from the balloon. At the same time, there is an equal force in the opposite direction.

④ Hence, it makes the balloon moves.

To Siu Ting
2 D
16

Wu Ka Yan 2D (22)

1) Blow up the balloon and clip the balloon with a paper clip. Pass a string thoush a straw and tape the ball.. on the straw. The skin of balloon is skretched

2) The skretched skin contrack and the air in the balloon moves and goes out

3) Air moves out and forces are produce. Fone is in opposite direction

4) The fone is produce and the balloon become smaller. At last, tle balloon move.

① The balloon had ~~a~~ been stretched, it started to contract.

② When it contracted, the air pressure is larger then before and the air had pushed out.

③ It had the force ~~,~~ to push and it started to move toward.

④ Lastly, the air moves away and the balloon move more faster.

2C(24)
Sammi Yu

Appendix II

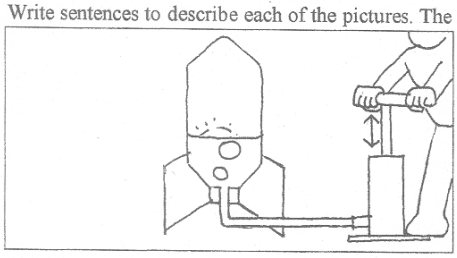
Students' work

Baptist Lui Ming Choi Secondary School
Form 2 Science
Action & Reaction Force

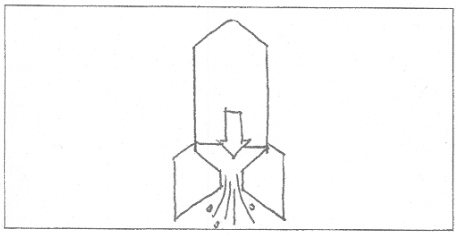
Name: Cheung Nga Wing
Class: 2D (4)

Date: 17 - 11 - 2006

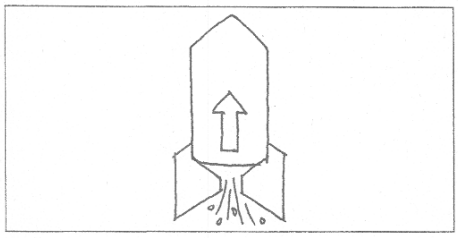
The following pictures show the changes during the launching of water rocket.
Write sentences to describe each of the pictures. The first one had been done for you.



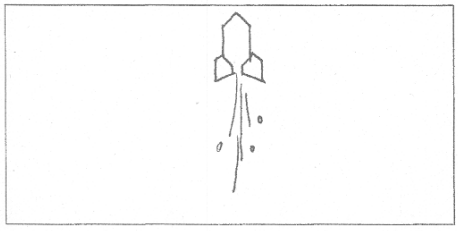
Air is pumped into the bottle to increase the air pressure inside the bottle.



When unlocked, the high air pressure pushes the water **away from the bottle (action force).**



The water pushed out, it produced an equal but opposite force **to the bottle (reaction force).**

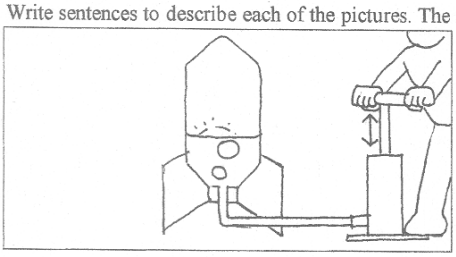


As a result, the bottle ejected the water out and the water rocket launched.

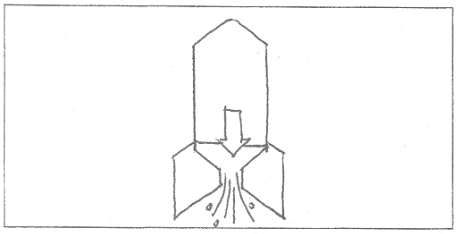
Baptist Lui Ming Choi Secondary School
Form 2 Science
Action & Reaction Force

Name: Tsang Ho Yin
Class: 2C (39) Date: 21-11-2006

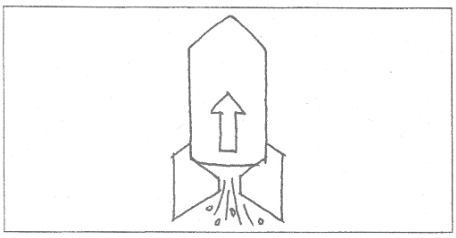
The following pictures show the changes during the launching of water rocket.
Write sentences to describe each of the pictures. The first one had been done for you.



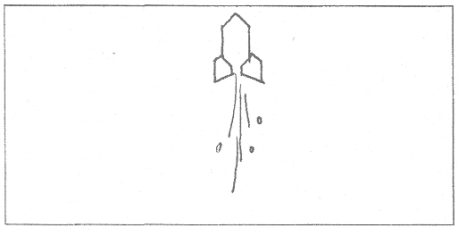
Air is pumped into the bottle to increase the air pressure inside the bottle.



When unlocked, the high air pressure pushes the water **away from the bottle (action force).**



The water is push away, it gives energy and there's an equal but opposite force is exerted. **to the bottle (reaction force).**



As a result, the bottle is pushed upwards because of the reaction force.

Baptist Lui Ming Choi Secondary School

Form 2 Science

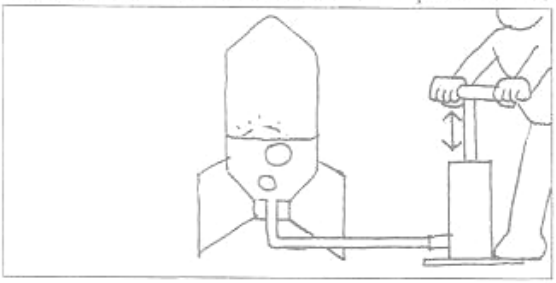
Action & Reaction Force

Name: Chung Bing Shu

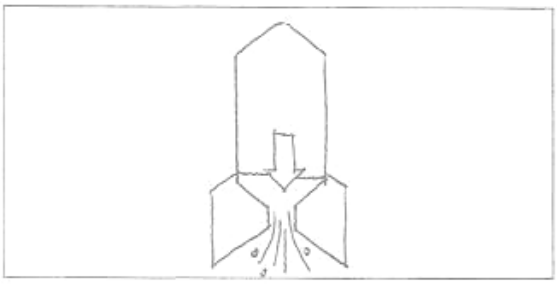
Class: 2D (29)

Date: 17-11-2006.

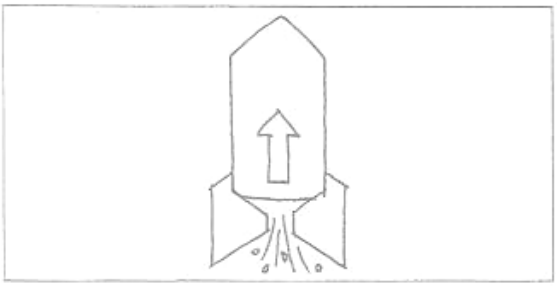
The following pictures show the changes during the launching of water rocket.
Write sentences to describe each of the pictures. The first one had been done for you.



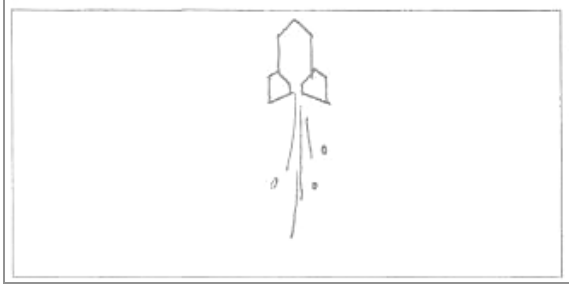
Air is pumped into the bottle to increase the air pressure inside the bottle.



When unlocked, the high air pressure will press the water **away from the bottle (action force).**



The water goes out and give the kinetic energy **to the bottle (reaction force).**



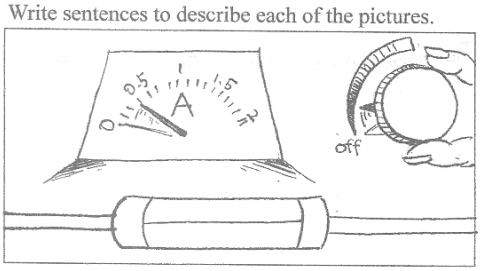
As a result, the bottle ~~was~~ to go upward

Appendix III

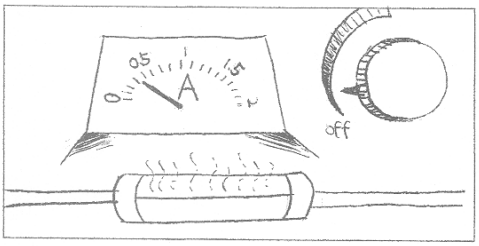
Baptist Lui Ming Choi Secondary School
Form 2 Science
Fuses

Name: Leung Chit Shing
Class: 2C (33)
Date: 2nd Feb, 2007

The following pictures show the changes of electric current and the fuse wire.
Write sentences to describe each of the pictures.

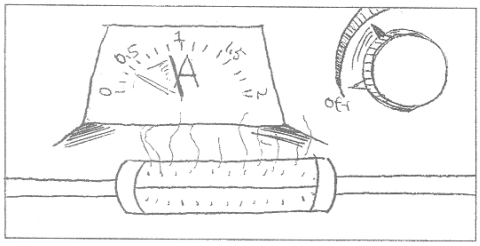


When we turn on the , there become an electricity circuit, the electricity pass through the fuses

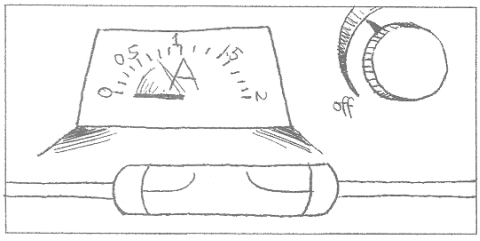


After a while, the electricity pass through the fuses change to heat energy and the fuses become hot.

If the current increase continuously,



the electricity pass through the fuse will increase and more heat will be generated and the fuse become hotter and hotter.



When the temperture is higher than the fuse can receive, the fuse will melt and break the circuit ~~cant~~ to protect the electrical appliance to beome too hot.

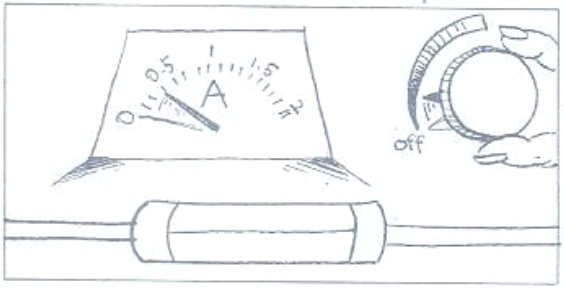
Form 2 Science

Fuses

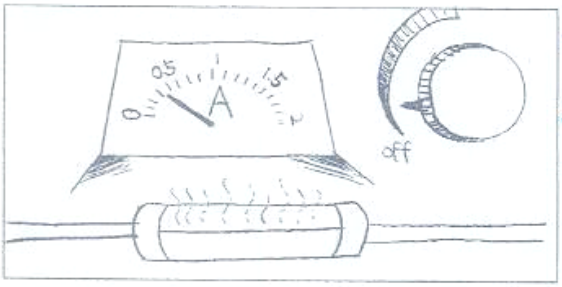
Name: Poon Wai Yan, Vivian Iris

Class: 2C (15) Date: 2nd February 07

The following pictures show the changes of electric current and the fuse wire.
Write sentences to describe each of the pictures.

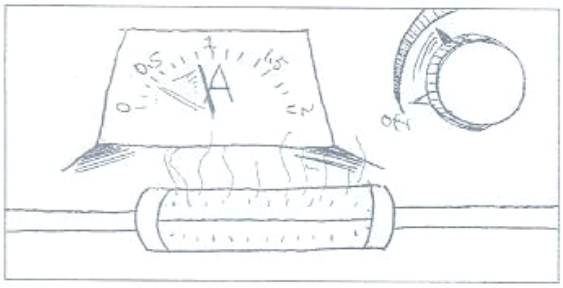


Switch on the power supply and the electric current flows in the circuit.

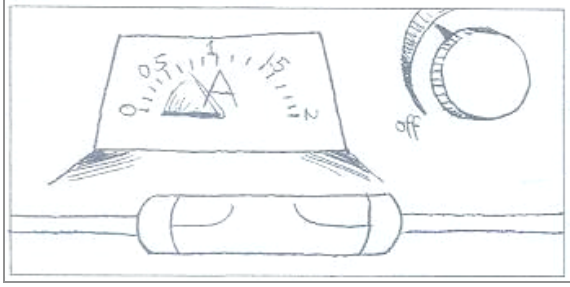


If the electric current flow through the fuse wire generate heat energy the fuse will be heated up, the current increase continuously

If the current increase continuously,



the electric current will generate more heat



If the electric current generate more heat (The heat generated) and the fuse cannot protect itself, the wire in it will break down, but it break down the circuit. The opened circuit stops the flow of current.

Baptist Lui Ming Choi Secondary School

Form 2 Science

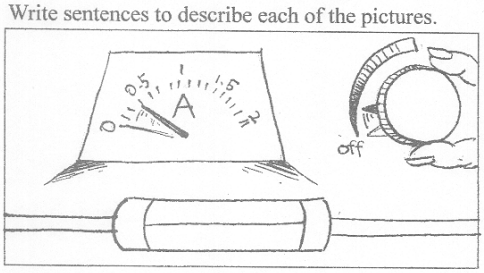
Fuses

Name: Cecilia, Yan Lok Sze

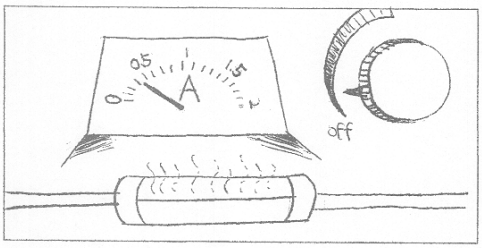
Class: 2C (22)

Date: 2nd Febuary, 2007

The following pictures show the changes of electric current and the fuse wire.
Write sentences to describe each of the pictures.



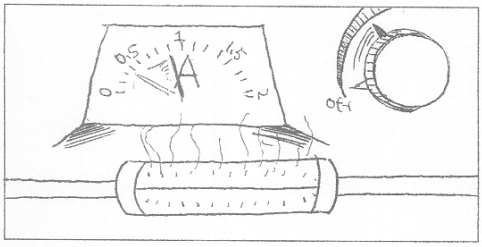
Someone closed the circuit, and the rate of the ammeter rises to about 0.3 A



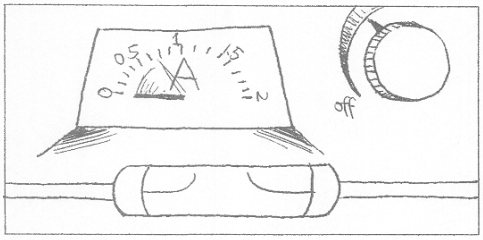
When the rate of the ammeter stays at 0.3 A, the wire in the fuse starts heating up.

When we close the circuit, the electric current flows in the circuit. The electric current flows through the fuse wire and generate heat energy

If the current increase continuously,



Someone raise the rate to about 0.9 A, the wire almost reach its melting point and produce light and heat. It is also starting to melt.



The wire burnt out.

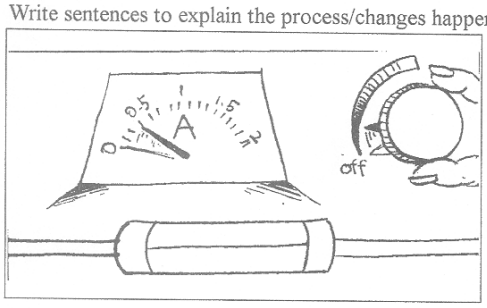
Using modified worksheet

Students' work

Baptist Lui Ming Choi Secondary School
Form 2 Science
Explanation -- Fuses

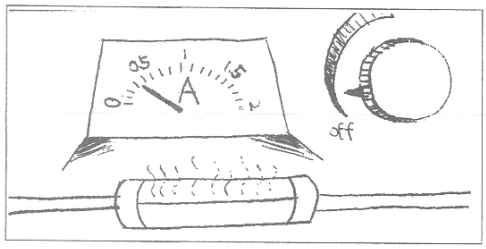
Name: Cheung Tsz Ching Cherry
Class: 2D (3)
Date: 14. 2. 2007

The following pictures show the changes of electric current and the fuse wire. Explanation
Write sentences to explain the process/changes happening in each picture.



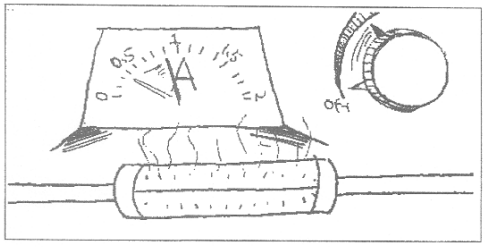
When we close the circuit/turn on the switch,

When we close the circuit, the electric current flows in the circuit.

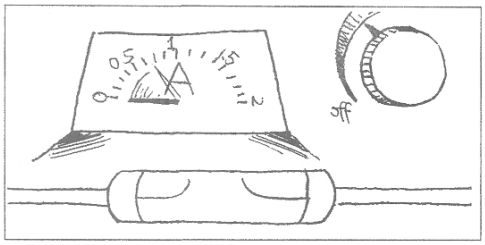


The electric current flow through the fuse wire and generate heat energy

If the current increases continuously,



more heat will be generated in the wire.



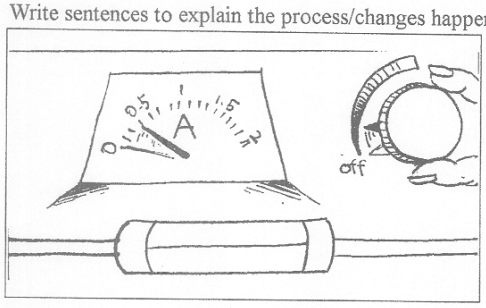
The increased heat generated will melt the wire and the melt wire will break circuit.

Baptist Lui Ming Choi Secondary School
Form 2 Science
Explanation -- Fuses

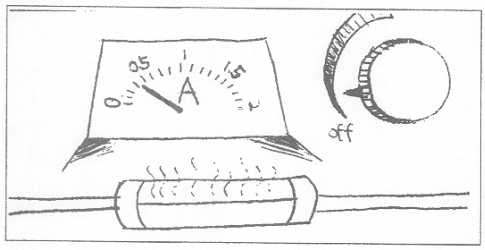
Name: Leung Hiu Pak
Class: 2D (36)

Date: 14th February, 07.

The following pictures show the changes of electric current and the fuse wire.
Write sentences to explain the process/changes happening in each picture.

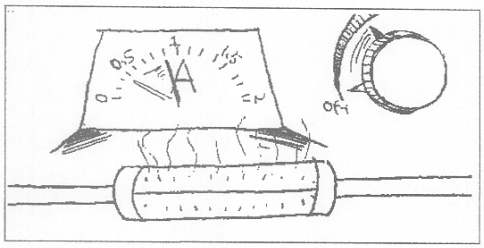


When we close the circuit/turn on the switch,
The electric current flows in the circuit.

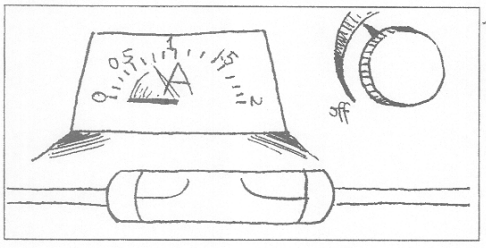


The electric current flows through the fuse wire and generate heat energy.

If the current increases continuously,



the fuse wire becomes hot and red, more heat will be generated in the wire.

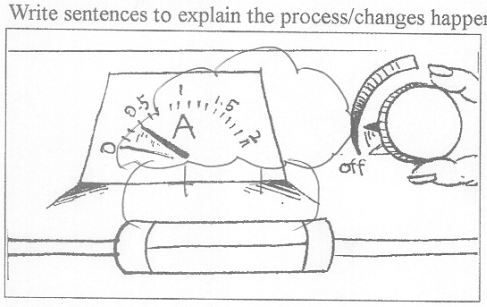


The increased heat generated will melt and break the wire. The broken wire then break the circuit

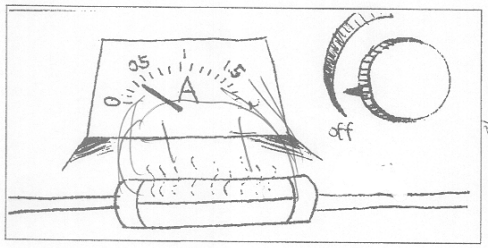
Baptist Lui Ming Choi Secondary School
Form 2 Science
Explanation -- Fuses

Name: Cheung chi Hei
Class: 2 D (26)
Date: 4/2

The following pictures show the changes of electric current and the fuse wire.
Write sentences to explain the process/changes happening in each picture.

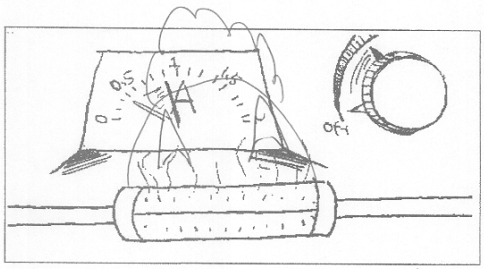


When we close the circuit/turn on the switch,
change to 0.5A
nothing happen

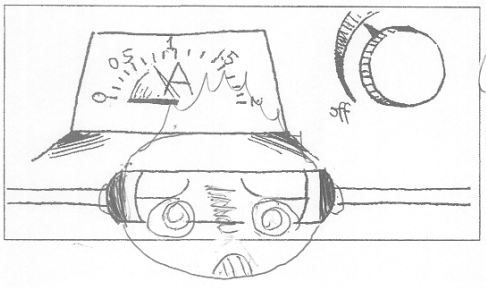


later, something change, the electric current flows in the circuit and generate heat energy

If the current increases continuously,



later change to 0.9A, the wire lighting and very hot, more heat in the circuit.



later, 0.8A, the (melt)fuse would be break the circuit.

Appendix IV

These comments are of a videoed lesson. They are the consultant's comments with the blue comments being the teacher's response to the comments.

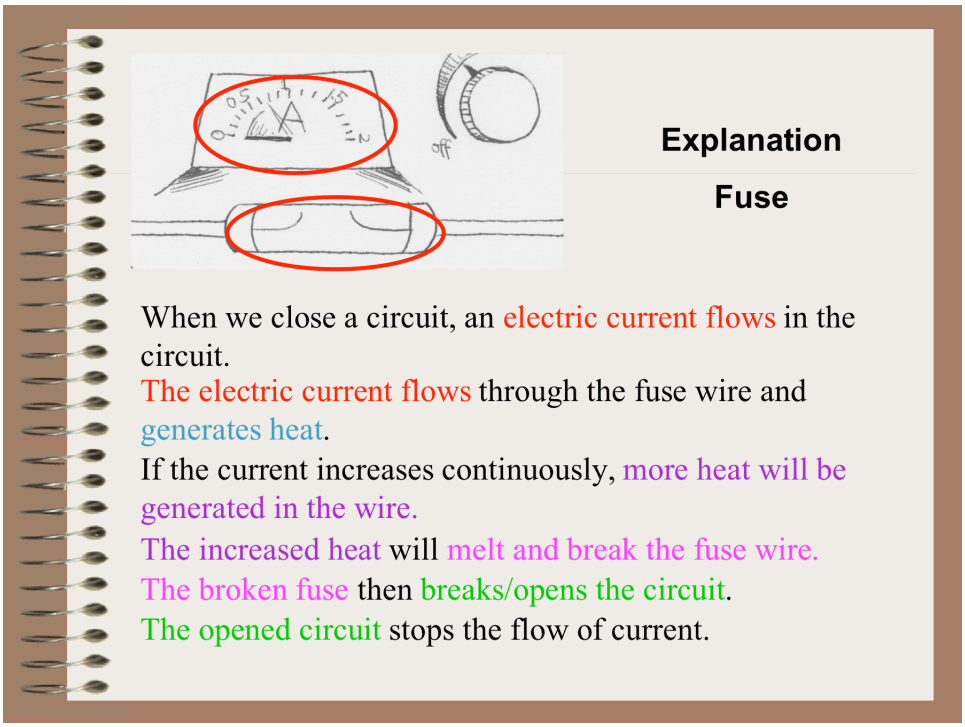
Time (mins)	Comment
00:24	"Hands up those who think it's the same; those who think it's different." The teacher has already indicated by his previous tone that the amount of heat generated would be different so why spend time on the "quiz"? Thanks for reminding me. I always make such mistakes. The purpose for doing so was to arouse students' interest and recalls their previous knowledge.
00:38	This is good because now he is asking the student to describe the difference. However, we cannot hear the student – the microphone should not be in the teacher's hand at that time but in the student's hand. Actually, it is quite difficult to pass the microphone to students. So usually I require students to speak louder instead of passing the microphone to them.
02:06	Nice use of humour. Thank you!
02:25	Nice use of action – the inner structure of the 3-pin plug plus action (using 3 fingers).
	Good use of video with native-speaker voice, well paced and clear and, importantly, with the words visible too (visual representation of the verbal), eg "Structure and use of a fuse" and "when an excessive electric current flows through the appliance"
03:00	Good use of pausing the video to reiterate the essential information that the video has presented.
03:45	Paused video again – is it possible to project for the students where the video is headed, eg instead of simply repeating almost verbatim what the narrator said, is it better to add something like "and now we will hear why more heat is generated with a thinner wire". Agree! BUT, the video does not yet go on to explain why – it simply describes the outcome, ie the fuse melts. Actually, the narration is not really good. It is ambiguous. It says: "If the current through the wire is greater than a certain value, it will melt and break the circuit." The problem is that the listener may not be sure what the 'it' refers to, is it the current or the wire? The teacher could clear this up by simply restating the narration like this: "If the current through the wire is greater than a certain value, the fuse will melt and break the circuit." Sometimes I also make such mistake like the video because when I use the words like "it, that, them", I think the students also understand the meaning. I should pay attention to this mistake.
04:15	"Do you have any questions?" The response by the teacher (humorous?) was to say the students were good students because they didn't have any questions. This is not

	really a good idea because we want students to ask questions. The teacher's statement makes them think that they will lose face if they have a question. (Good idea! I seldom think of it. You reminded me that such actions may discourage students to answer questions. Thanks a lot!) Might it be better if the teacher went through the main points of the video as a way of consolidating what has been presented to the students and hence increasing the likelihood that the students have learned what has been presented? I didn't consolidate the main points of the video because that was the previous knowledge.
04:50	Good idea to wait until the students had the worksheet in front of them before describing what the worksheet is about (verbal + visual again).
06:00	Is it "describe" the change in the fuse or is it "explain" the change in the fuse? Do you want causal meanings or not? If you do, then explain is better than describe. I agree. Thank you!
07:15	This needs to be more structured around the Teaching-Learning Cycle. Is this the modelling/deconstruction stage? Can they use their previous term's example as the model? Is it the joint construction stage?
08:00	The difference between what is to be written on the picture and what is to be written alongside is not clear. Normally, pictures have labels while the text alongside explains all the processes and the logical connections between the processes. This is not clear from the teacher's instructions. Thanks for pointing out this fault. Because the students had tried a similar activity before, I wasn't expecting them to misunderstand. That's why I just gave simple instructions to them. I will be careful in the coming activities. The trouble is evident in that the teacher is finding it hard to instruct the students in what they should do. Clearly, the students need to be shown how to do what they are supposed to do and not simply instructed to do it. This is what the video tape of the TLC should show.
08:25	Picks up on the flow of information. Gives an example about beating a student but the example should be clear from the science examples the teacher has suggested they have done in the previous term. Those examples should show not only the meaning about the result of one event being the beginning of the new event but how it is expressed through language, ie Rheme picked up in subsequent Theme. If it is not shown by the teacher how it is done through language, then the students will not necessarily be able to express the meaning. Later, the teacher has examples of the processes using fuse wires but if there was a written example (just like the fuse wire example) about something else, some other scientific process that the students already knew, that would have been better to use. The focus would then be on the language patterns and not the field (the content), which is what the teacher tried to achieve by using an everyday example but the everyday example was spontaneous and didn't really work. Actually, before the lesson, I didn't prepare any example for this activity. So I needed to design an example immediately. That's why the example used didn't fit the situation and the students couldn't understand me. That is one of the major drawbacks in the lesson. It was good that I learnt how to prepare a better lesson.
12:10	Consultant discusses with teacher the progress of the students.

13:35	Teacher interrupts and begins to model for the class the kind of language needed by showing examples of language on the PowerPoint file. He explicitly shows (by colour?) the pattern of Rheme being taken up subsequently as Theme. This is excellent. A student offers some of the content (temperature) to include in the second process.
16:30	While students are writing their Explanations, the teacher moves around the room offering individual advice.
17:00	Consultant discusses with one student her text.
23:00	Teacher talks about a model answer but considers a model answer as being a perfect answer—that is not the meaning. A model answer is simply a good example, an example which has the features the teacher wants to point out to the students.
24:15	"If the current is increased continuously, more heat will be generated in the wire" is what the teacher provides as part of the model text. He then states that the students could have simply described it as "the wire glows brightly." Is this the same? I don't think so. Saying "the wire glows brighter" is simply a statement of observation and not necessarily an understanding of why it is glowing whereas "more heat will be generated in the wire" is an understanding of the physics involved. It is true that "brighter" indicates the consequence of increasing current. Actually, I wasn't aware of that before.
26:00	The teacher discusses with the students what could be a final statement. Perhaps the teacher could give a name to this stage of the Explanation, maybe called the Deduction. The deduction provided by the teachers was "The ammeter reading is zero which indicates that no current is flowing through the circuit." It would be a good idea if the students were aware that this stage in the genre was different from the series of actions previously written about. At the outset, the students should understand clearly that the Explanation would typically have the following stages: Phenomenon Identification ^ Activity Sequence ^ Deduction (optional) I agree that is a very good idea to introduce "deduction". But I worry whether students can handle these things or not. May be I need to spend more time to train students to have such ability to deduce something from the activity. "Time" is another problem needed to be solved.

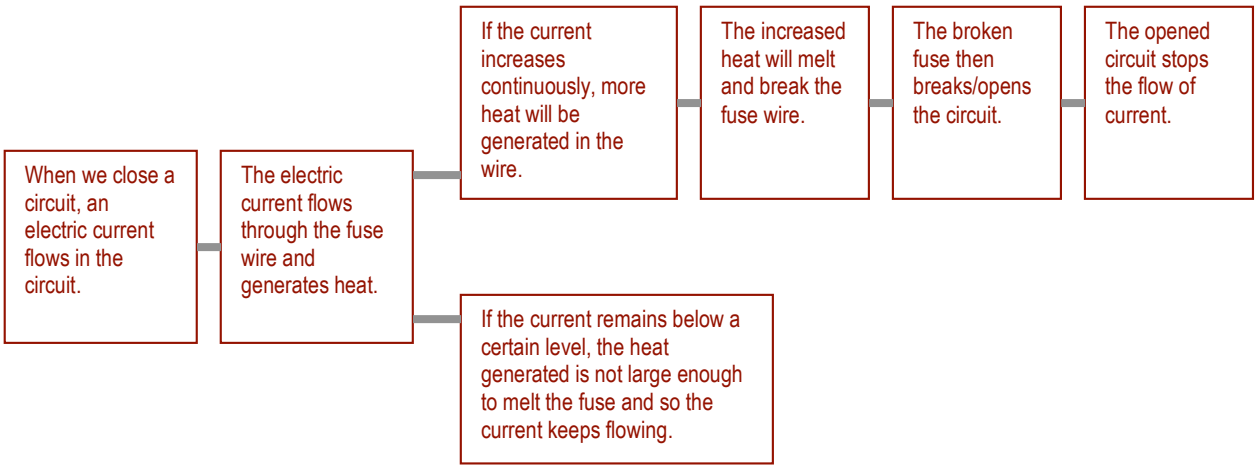
Appendix V

PowerPoint slide showing the structure of an Explanation text



In simple Explanations, we can point to the fact that the end of one stage in the process typically begins the next stage. So the first stage ends with an electric current flowing through the circuit and the second stage starts with the flowing electric current.

The difficulty comes when there are varying conditions, such as varying currents. In the third stage, for example, the condition of continuously increasing the current is introduced. So, in actual fact, the flowchart of this scientific event would have two branches, eg:



So what we see is that as the explanations become more complex, we might have to insert various "asides" in the text. Or, as the students want to develop their explanations further, each stage might be made up of multiple sentences or even paragraphs.

Appendix VI

LESSON PLAN

Class: F2 Science

Time duration: 40 minutes (one lesson)

Date: 2-2-2007

Topic: Electricity – Fuses

Previous knowledge:
1. Basic knowledge about electric circuit.
2. Heating effect of an electric current.
3. Observed the demonstration of heating effect of an electric current.

Objectives:
1. Write a short explanation on why the fuse might blow when there is a large current.
2. Choose the right fuse for different electrical appliances.
3. Understand the use of a circuit breaker.

Time (mins)	Teacher's activities	Student's activities	Teaching resources	Objective
0 - 5 (5)	Revision of fuses by asking questions. – What is the use of a fuse? – Protect the appliances in the circuit. – What are the characteristics of the fuse wire? – very thin, large resistance – What is the heating effect? p.122 – Is the heating effect stronger in a thin wire?	Recall knowledge about fuses. Answer the teacher's questions. *When an electric current flows through a wire, some of the electrical energy changes into heat energy. Larger A, more heat.*	Use animation about fuses (up to the melting and breaking of the fuse.)	
5 - 25 (20)	Distribute the worksheet about fuses. (Explain the items – ammeter, switch, fuse) Discuss the pictures on the worksheet. (What are the main points?) Point out that the end of an event (picture) will be the beginning of next event. (Recall the previous activities.) Discuss the sample passage with the students.	Discuss with teacher and classmates the pictures on the worksheet. Mark the main points on each picture and write a short explanation.	Worksheet: Fuses PowerPoint: Fuse	1
25 - 35 (10)	Introduce the concept of "working current" and "fuse ratings". Draw an electrical appliance on the board. Indicate the working current of the appliance and show different fuses on the board. Teach students to choose a fuse with a suitable fuse rating for different electrical appliances. Draw another appliances on the board and do Activity 8D on p.125	Answer the question and choose the suitable fuse. Finish Activity 8D on p.125.	Activity 8D on p.125	2
35 – 40 (5)	Point out the disadvantages of fuses. Introduce circuit breaker and point out the difference between fuses and circuit breaker.			3
40 (0)	Give homework.		Workbook 8.4-6	

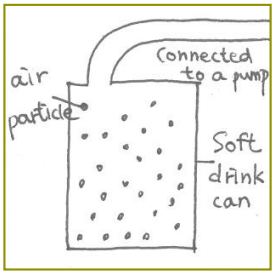
Appendix VII

Form 1 Explanation activity 1 – The power of air pressure

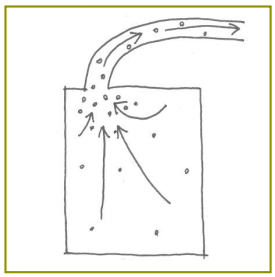
Teacher discusses with students and then writes the text on the blackboard.

This session has the teacher in full control, explicit and directing the activities. Students suggest words to describe each of the pictures and begin explaining the differences between two successive pictures.

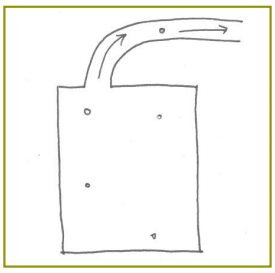
The teacher also needs to introduce to students the pattern of language for simple explanations: "The end of a sentence becomes the beginning of the next sentence."



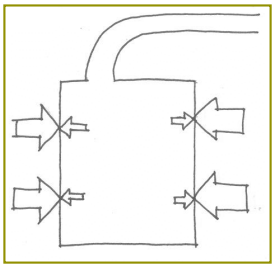
Initially, the air pressure inside and outside the can are equal.



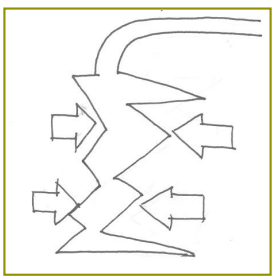
When the vacuum pump is turned on, it **draws air away from the can**.



As the air is pumped away from the can, **the number of air particles in the can decreases**.



As the number of air particles in the can decreases, **the air pressure outside is greater than the air pressure inside**.

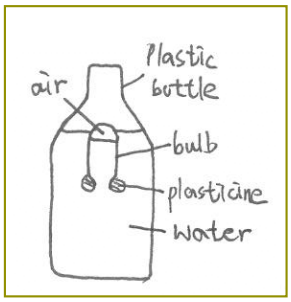


The greater air pressure outside compresses the can and the can crumples.

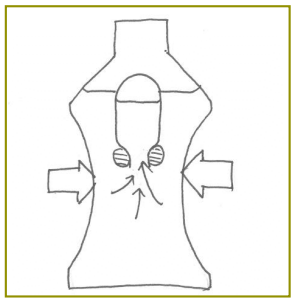
Form 1 Explanation activity 2 – The effect of density change

Teacher discusses with the students, who are then asked to finish the worksheet.

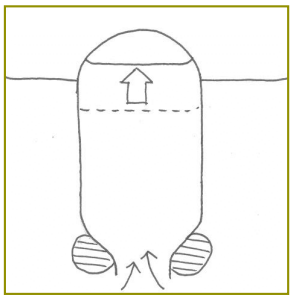
Students need to complete the sentences by filling in the blanks. The words in grey indicate the blank spaces.



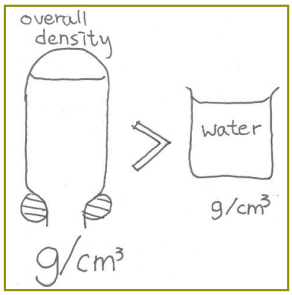
A bulb filled with water floats on the water surface.



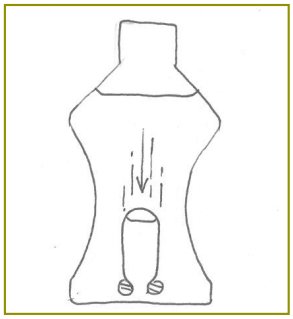
When the bottle is squeezed, water rushes into the bulb.



As water rushes into the bulb, the air is compressed and the amount of water inside the bulb increases.



Because the amount of water inside the bulb increases, the overall density of the bulb is higher than the density of water alone.

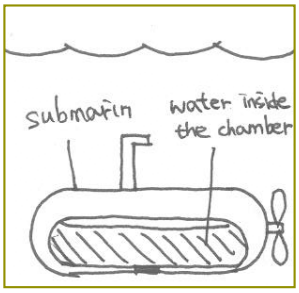


The higher density of the bulb makes it move downward.

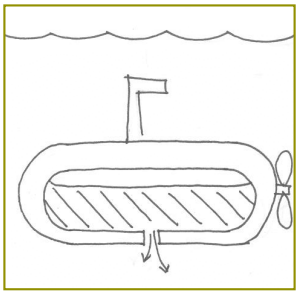
Form 1 Explanation activity 3 – The effect of density change

Teacher discusses with the students, who are then asked to finish the worksheet.

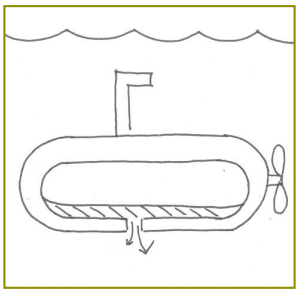
Students need to complete the text by filling in the blanks—indicated in grey.



A submarine with the same density as sea water is moving in the sea.

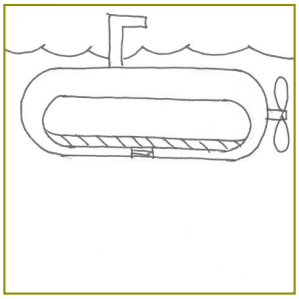


When the pump is turned on, it draws water away from the submarine.



As the water is pumped away from the submarine, the amount of water inside the submarine decreases.

As the amount of water inside the submarine decreases, the density of the submarine decreases so that it is lower than the sea water outside.

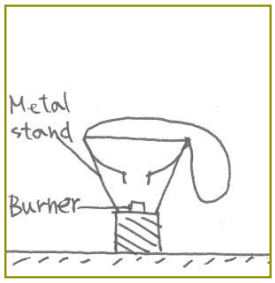


Since the submarine has lower density than the sea water, it floats to the top of the sea.

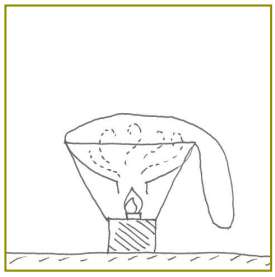
Form 1 Explanation activity 4 – The effect of thermal expansion on density

Teacher discusses with the students, who are then asked to finish the worksheet.

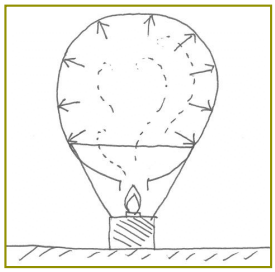
Students need to complete the text by filling in the blanks—indicated in grey.



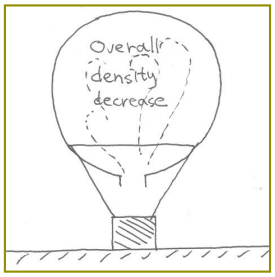
A deflated hot-air balloon is placed on a metal stand which has a burner in it.



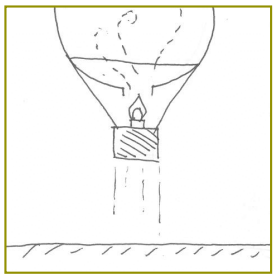
When the burner is ignited, the burner heats the air inside, which becomes hotter.



As the air inside the balloon becomes hotter, it expands.



Because the air inside the balloon expands, the density of the air inside the balloon is lower than the density of the air outside.



The lower density of the air balloon causes it to float.