# Training Intervention Portfolio

A research tool for promoting

Dialogic talk in teaching science

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## Introduction

This Portfolio contains all the materials that have been developed for the research technique of ‘Training Intervention’. It is divided into three parts;

* Pre-Workshop tasks: Students’ prior knowledge
* Workshop 1: Addressing students’ prior knowledge in teaching
* Workshop 2: Planning teaching toward more dialogic talk

Each part has its specific aims, though each one incorporates the others towards the main aim of the intervention to promote more Dialogic talk in Omani science classes. The content of these workshops moves from addressing the theme of pupils’ prior knowledge to characterizing the different types of classroom talk according to the communicative approach (Mortimer & Scott, 2003). Within each part, there are different materials and tasks that have been developed for the aims of this intervention and supported by some contributions from the ‘CLIS training course’ for promoting interactive teaching in science (Johnston, 1990).

Each Workshop consists of:

* a statement of aims
* list of contents
* an overview of the included activities with suggested timing
* copies of some of the workshop materials

## Pre-Workshop tasks: Pupils’ prior knowledge

Aims:

This pre-workshop activity contains two tasks. In the first task, teachers will be given a questionnaire that is designed to find out what pupils think in several areas of science (Johnston, 1990). Data collected and analysed by the researcher and teachers are to be reviewed and discussed in the first workshop. The main aim of this task is to introduce some everyday ideas held by pupils that might contradict what we consider, usually, as simple facts in science.

The second task is planned also to support the aim of introducing the issue of everyday and scientific knowledge to highlight the significance of students’ prior ideas. In this task, teachers will be given a short handout to be read and reflected on. Teachers’ reflection on the issues presented in the handout will be discussed through the first workshop.

Content:

First task: a questionnaire, to investigate pupils’ ideas. The questionnaire covers five areas of science:

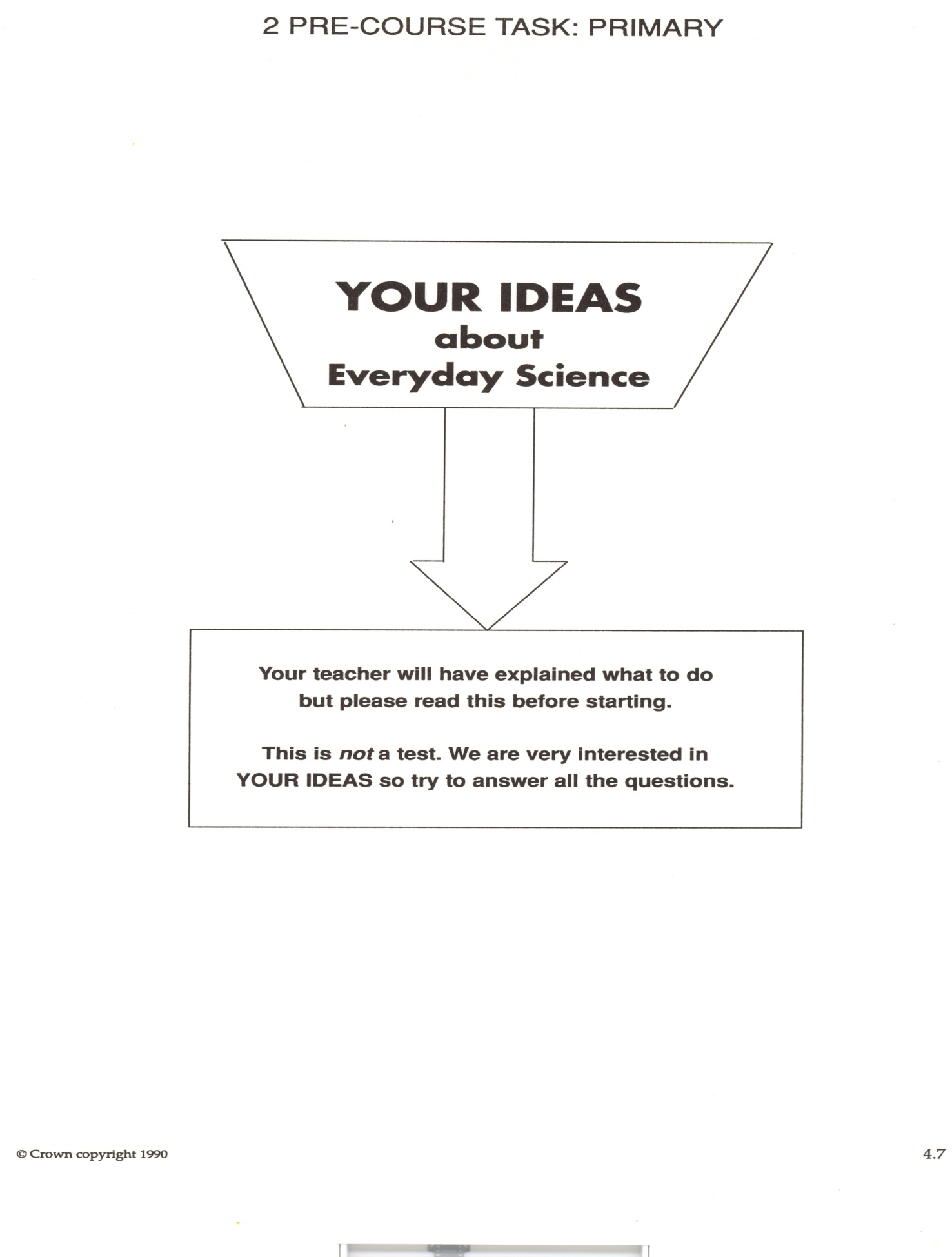
* classification of animals. Plants, living things
* air
* change of state/condensation
* conservation of mass
* the nature of matter

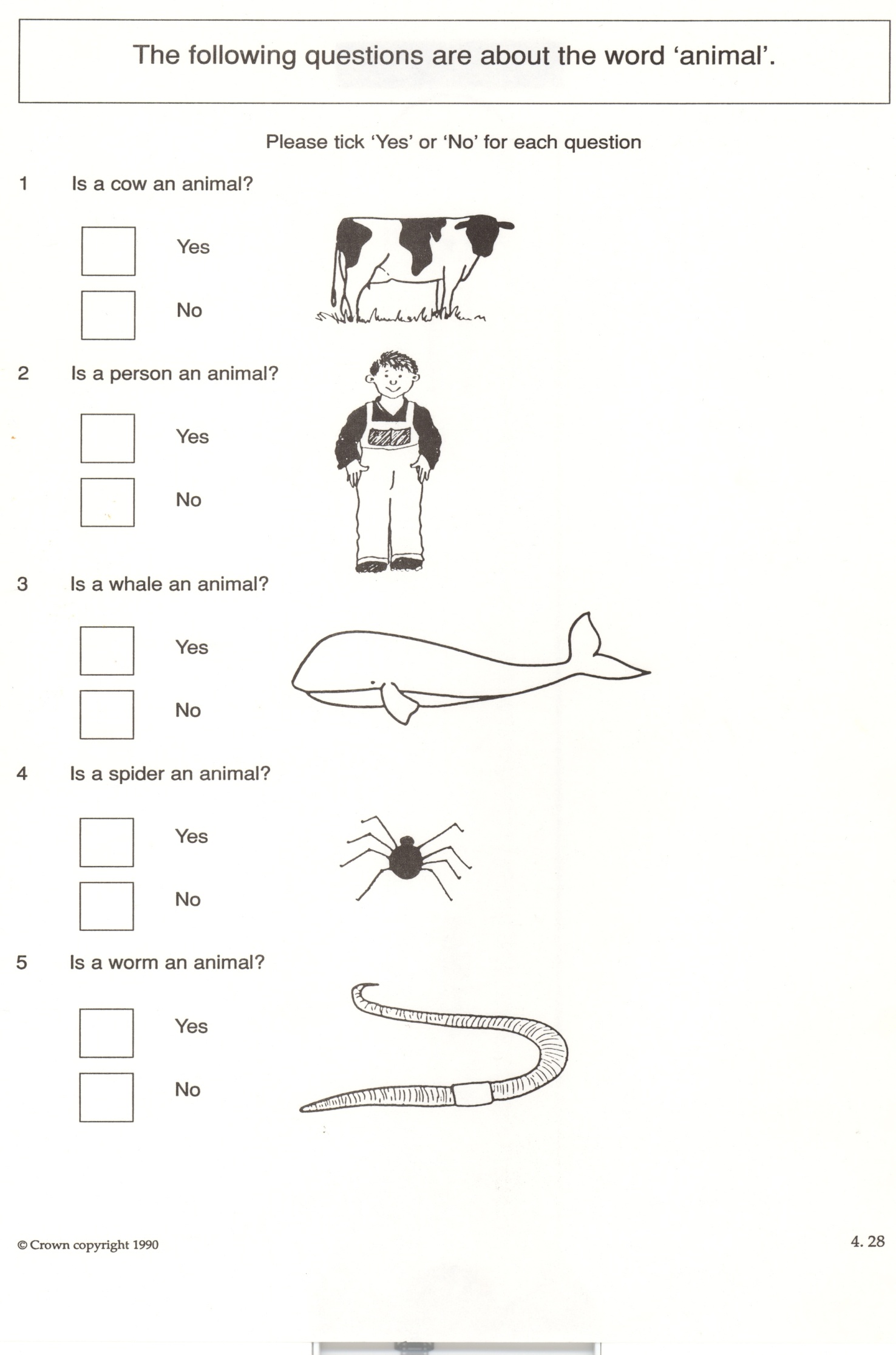
Second task: a handout: part 1. It has been prepared by the researcher in a non-academic language. It presents the ideas of everyday/scientific knowledge and everyday/scientific social languages. The Arabic version has been refined and formatted differently from the English version included in this portfolio. In fact, the English version is provided just to give the reader an idea of the content of both parts of the handout given to the participated teachers.

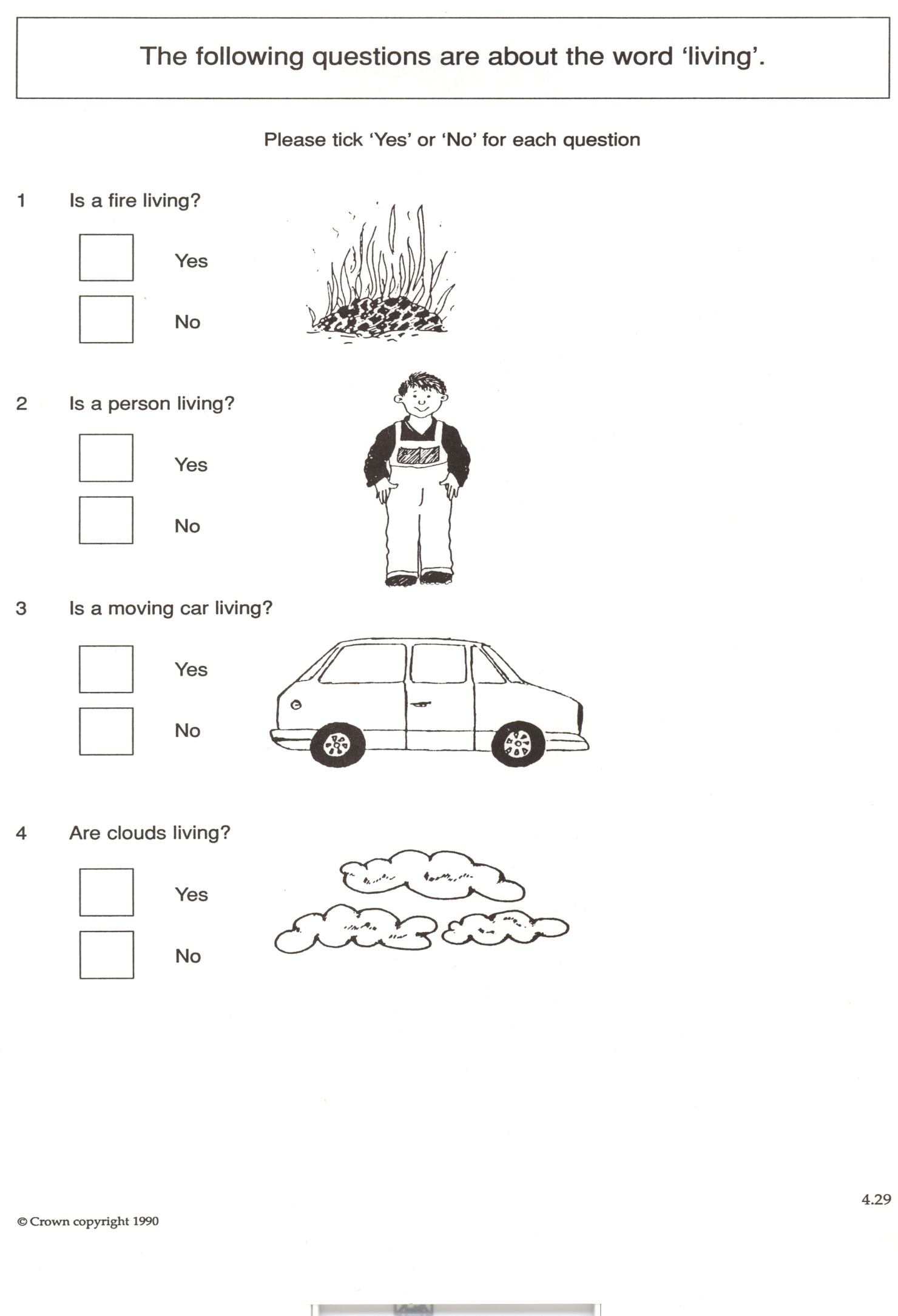
Included activities and materials:

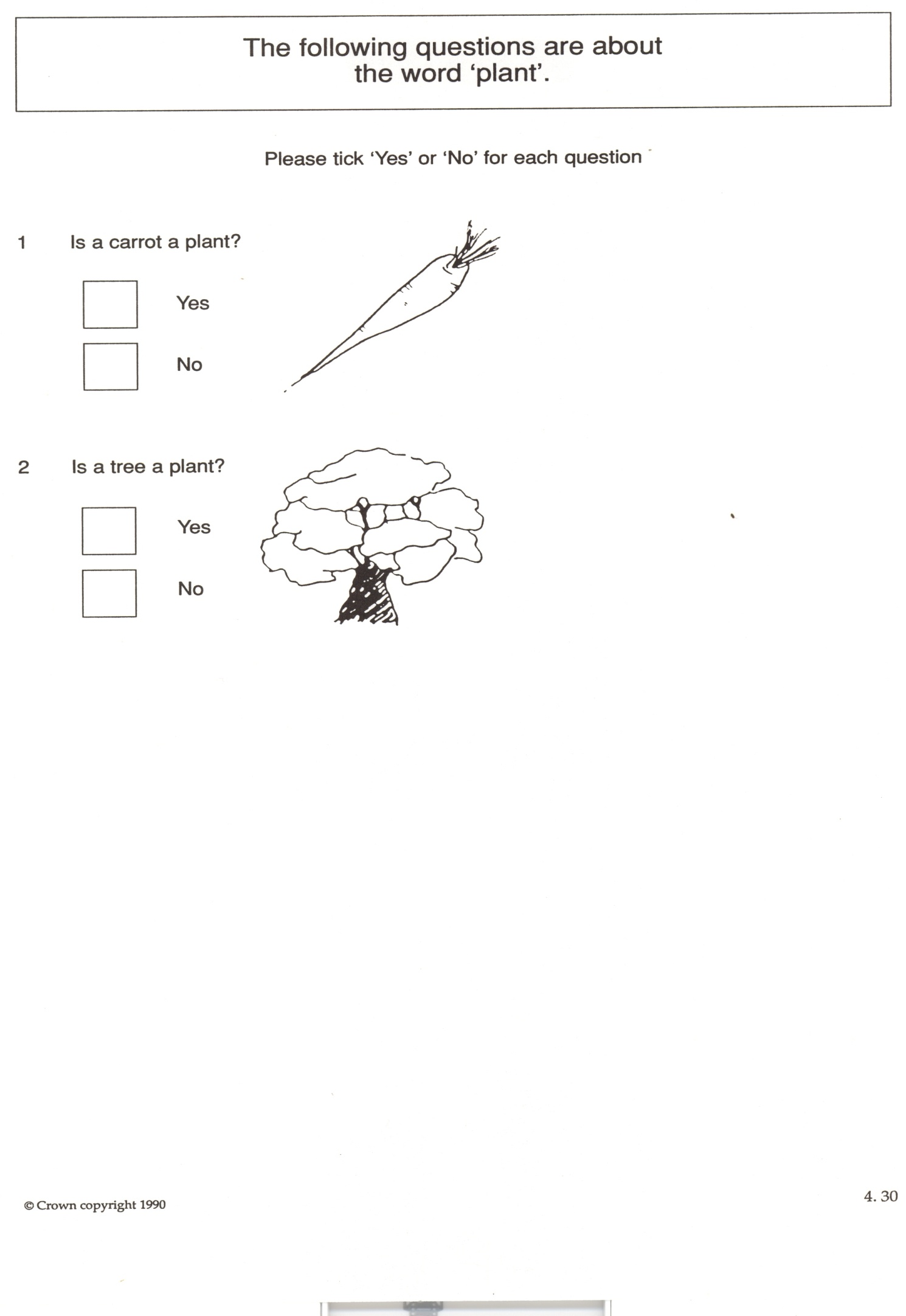
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| Activity | Materials | Suggested Use |
| First task: filling the questionnaire.  Time for collecting and analyzing data is to be managed by the teachers | Questionnaire for use with students in grade nine.  Instructions for teachers.  Coding sheets | Materials are to be given to teachers.  Teachers collect and analyze data results are to be discussed in the first workshop. |
| Second task: handout, part 1  Time for reading and reflecting on the presented issues is to be managed by the teachers | Written account for teachers  Reflection sheet | The handout with the reflection sheet, are to be given to teachers.  Teachers’ reflections is to be discussed in the first workshop |

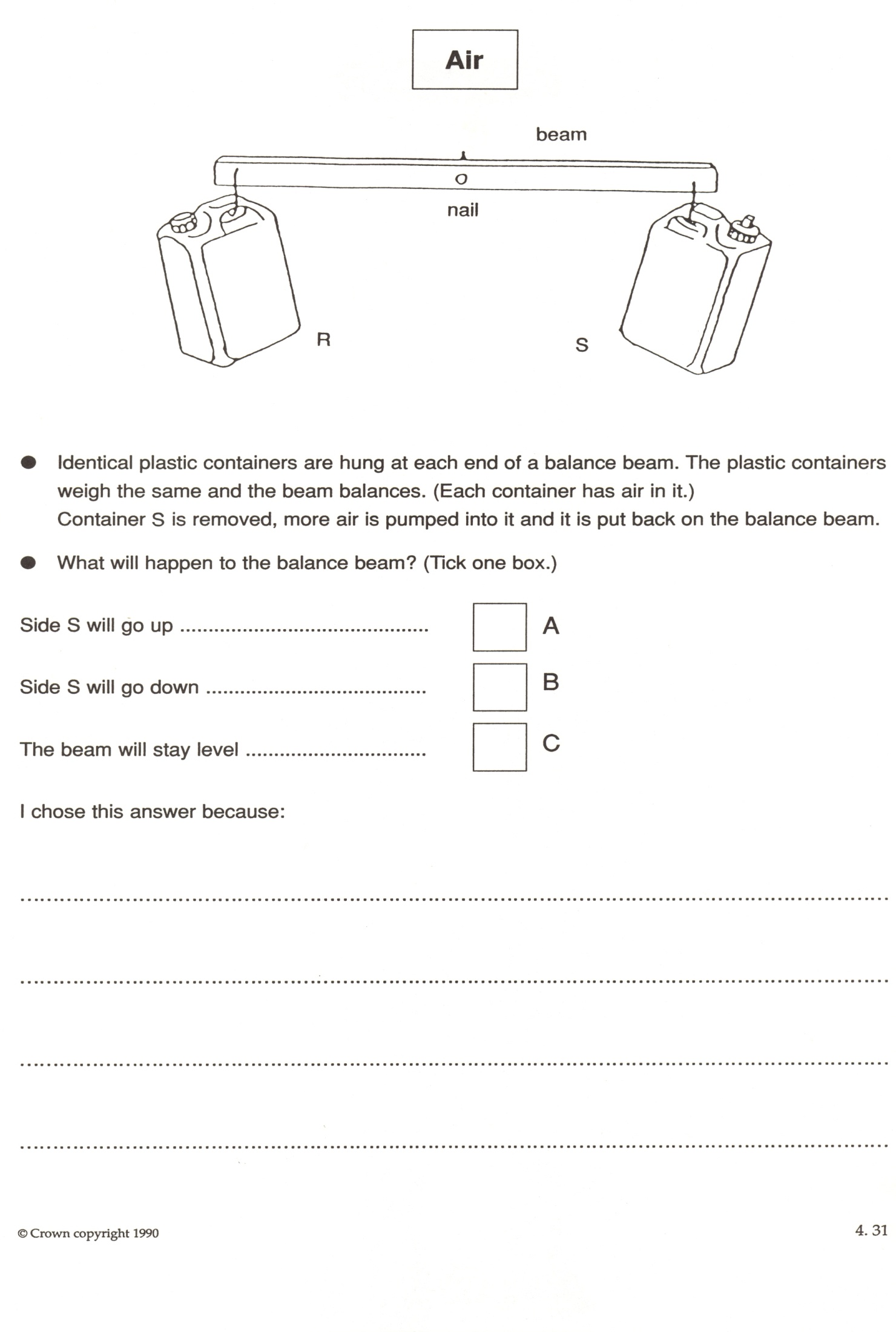
The Questionnaire

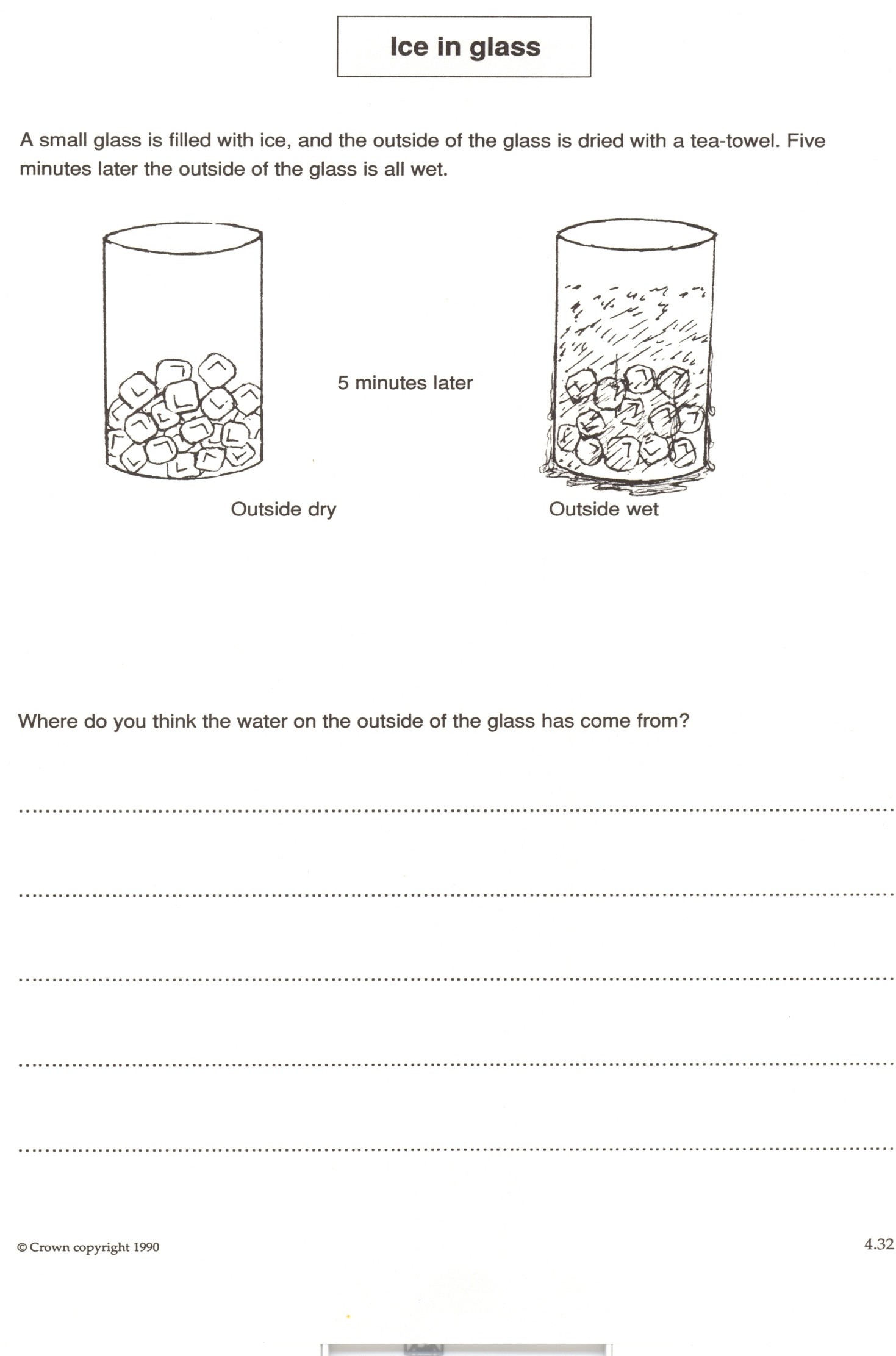


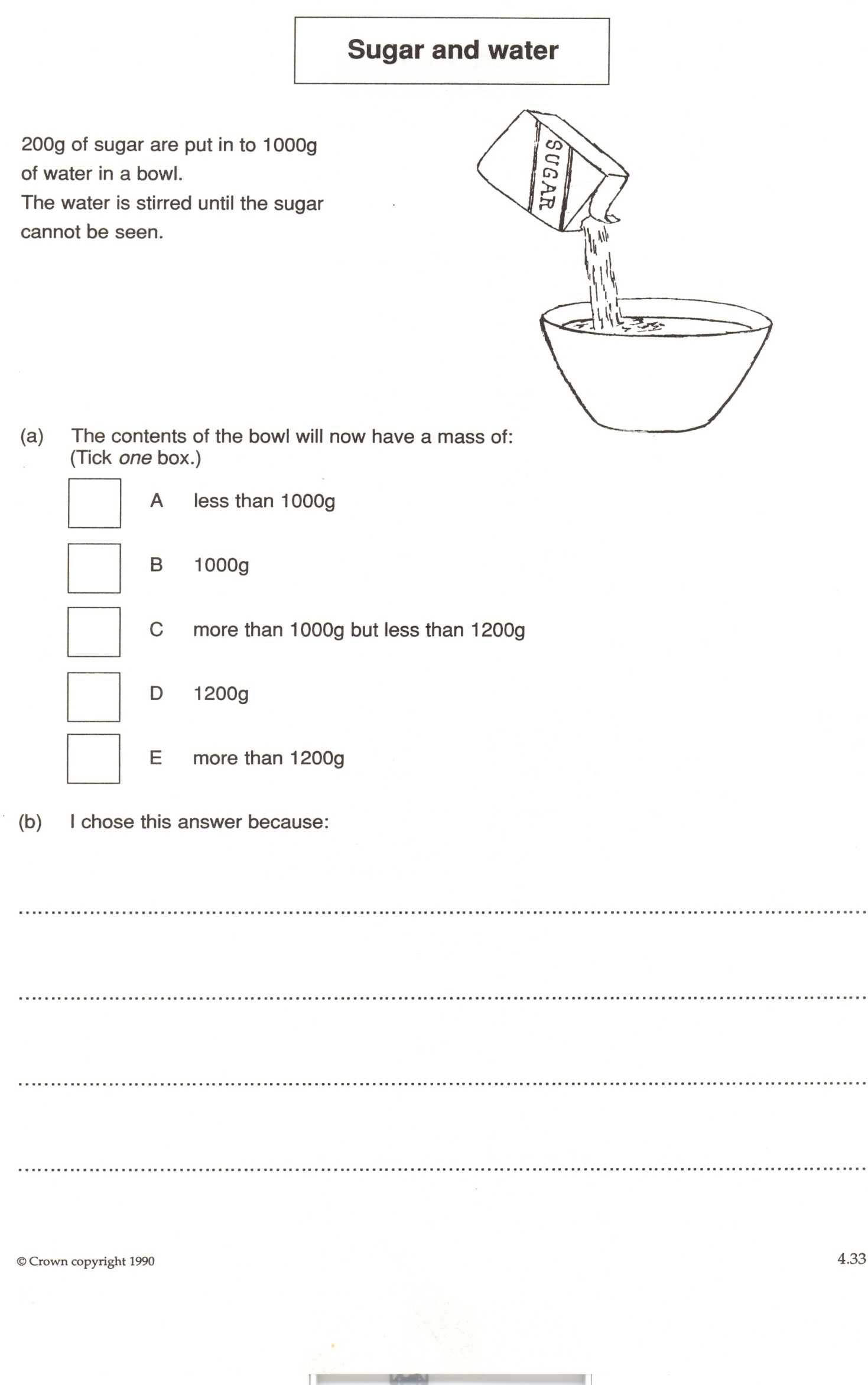












## First Workshop: Addressing students’ prior knowledge in teaching

Aims:

This workshop is designed to pursue the discussion on the pupils’ prior knowledge introduced by the pre-workshop tasks and develop it towards addressing the need of teaching science to incorporate this kind of knowledge. Through the activities of this workshop, the researcher aims to elaborate:

* the differences between everyday and scientific knowledge in terms of phenomenon and language.
* How students’ prior knowledge might affect the pupils’ learning
* How can teaching science be thinking of in terms of pupils’ prior knowledge

Content:

1. The materials of the pre-workshop tasks to be reflected on

2. A presentation that goes through the following issues:

* Why teaching/learning science is difficult?
* Prior ideas interact with teaching
* What’s involved in thinking through some teaching?
* Teaching interaction
* How to orchestrate the classroom talk?

3. Some written questions about chemical/physical change and electricity.

4. The handout, part 2 is to be given in this workshop and reflected upon in the second workshop.

Included activities and materials:

|  |  |  |
| --- | --- | --- |
| Activity | Materials | Suggested Use |
| Group discussion of the teachers’ reflections (40-50 minutes). | Materials of the pre-workshop tasks | Discussing the teachers’ reflections on the handout 1 and their pupils’ answers to the questionnaire |
| Doing the presentation (20 minutes).  Group discussion after the presentation (30-40 minutes). | Power-point presentation | Displaying the presentation and open the discussion about its different concerns. |
| Task: how do you might deal with the misconceptions of the two questions in the questionnaire of ‘Air and Ice in glass’ (20-30 minutes) | The questionnaire | Teachers to be given the time to plan instructional activities |
| Presenting episodes of Omani pupils’ talk | Power-point | Displaying examples of pupil-pupil talk from Omani science classes and discussing their details |

Teacher Intervention: Handout “Part I”

In one of the jokes, a child was asking his mother:

Mom, why do teachers ask us questions when they know the answers?!

What a remarkable question?! And how striking for us, the teachers, to ask ourselves why we do so. Yes, we tend to ask lots of questions that we already know their answers. We do it naturally, and naturally so, students would accept it because, simply this is school. This is what teaching and learning is about.

But, is this really, what teaching and learning is about?

We might all agree that questions in teaching are like the vehicles that carry some kind of knowledge we have to our students. Though, these vehicles can also convey what students know to us. Here, whether students will ask us questions that they know their answers, which can be hardly thinking of, or we can ask them questions that we do not know their answers. Probably, we would do this to know what they are thinking of. But then; do we need to know what students have in their minds? And why do we?

When constructivism theory of learning emerged, it directed the attention toward learners; their active role in the process of teaching and learning. Constructivism says that each one of us has his/her own storage of knowledge that he/she has constructed through daily life experience. We all grow up and live within larger-scale social organizations, or institutions: family, school, community centre, city, state, Internet…etc. Our lives within these social and cultural organizations give us the knowledge directly or indirectly as much as it gives us the tools to build up this knowledge. Each one is unique with his/her personal traits, thoughts, feelings, skills, experience…etc. And so, everyone is unique with the knowledge he/she has constructed.

Students come to school carrying their own views to the things that we aim to teach them about. When we try to present the knowledge we have about something, students will, unsurprisingly, link it with their everyday life. They would look in their past experiences of what is there to be related to that thing. If we ask them, for example, how do we see a tree? Predominantly in their minds, they would picture the light travelling from their eyes and reflecting off the tree. Their experience with seeing says that they see things with their eyes. Unconsciously, they will think of the light coming from the eyes, but hardly thinking of the light from the sun being reflected off the things and entering their eyes.

We can then expect that part of the difficulty that students find with science comes, actually, from the pre-ideas that they bring to their classes prior to formal instruction- ideas that are largely based on everyday experiences and observations but which may be fundamentally incorrect or inconsistent with the current scientific understanding, though, strongly held.

This means that there is an everyday thinking besides or opposite to the scientific one about how the world works. This results in what is called today as spontaneous and scientific concepts. We might think of the spontaneous concepts as to arise from the simple situations of daily life and which are learned through the daily interactions without conscious attention, whilst scientific concepts can be learned through instructions in particular disciplines like science, for example.

It is a spontaneous concept of force to think about as a property of an object- to think that an object has force and when it runs out of force it stops moving. This comes from the everyday idea that sustaining motion requires a continued force. The simple scientific concept, however, views the force as an action on an object that causes it to accelerate in its direction (Newton’s second law). Unless there is another force(s) to oppose its motion, then the object will move forever although the force that caused its motion at the beginning is not ‘stick’ to it anymore. More precisely, force is more than just an action; it is an interaction between two objects which makes both of them move in an opposite direction to each other (Newton’s third law).

If we think more about spontaneous and scientific concepts, then we will see that spontaneous concepts come from speaking the everyday social language, while scientific concepts reflect a scientific social language. Any meaning in any utterance is governed by its context; who is talking, to whom, when, where, how…etc. In a particular situation, certain words might carry a particular meaning. Under other conditions in this situation, the same words would have a different meaning, and this is where the different social languages come from. There is a story of a married man who gets up early to cut the grass on the lawn of his house. The telephone rings and his wife answers. The caller is one of her husband’s friends, who asks, ‘Is your lazy husband still in bed?’ The wife replies, ‘No, he’s outside cutting the grass.’ A little later, another friend calls and asks, ‘Is Fred working?’ The wife, knowing the friend’s intention of going fishing with her husband replies; ‘No, he’s outside cutting the grass.’ The wife did actually use the same words, but the two different contexts have given these same words different meanings.

Similarly, when we, the teachers, present the words of force, energy, gas, heat, matter, for example, using the scientific social language, we have to realize that students might think of them using their everyday social language. So, learning about these concepts will, invisibly, involves the interface between these two social languages. If there is a ‘big’ overlap between the two languages, then the scientific account might be difficult to be understood. If, however, there is no overlap or the overlap is just small, then the scientific understanding is easier to be attained.

The overlap between the two social languages creates a misconception or different alternative conceptions regarding a certain scientific term. But although an alternate concept may not be in agreement with the contemporary scientific view, it might have varying degrees of logic and truth to it, and for the student, that concept may be quite real and part of his/her private knowledge. This in turn would make it more difficult to give up the held misconception to adopt the scientific one or to develop the held alternative one towards the scientific meaning.

There are lots of different misconceptions in different areas of science. Here are some examples from the areas of atmosphere, colour and vision, and energy;

Misconception in Biology:

* Students believe plants get food from soil.
* Students believe tree growth material (mass) comes from soil
* Students believe sunlight, carbon dioxide, water, and minerals (fertilizers) are food.
* Students believe plants breath in carbon dioxide and drink water
* Students believe food is anything that goes into the organism including minerals, water, carbon dioxide, and sun (for plants).

Misconception in Chemistry:

* Students may not understand the difference between atoms and molecules because they are not differentiated in sketches.
* They believe that atoms can be seen with a microscope.
* Students believe the space between molecules contains air.
* Students believe atoms have electrons circling them like planets around a star.
* Students believe atoms are like cells with a membrane and nucleus.
* Students believe the size of an atom depends on the number of protons it has.
* Students believe the electron cloud is like a rain cloud, with electrons suspended in it like droplets of water.

Misconception in Physics:

* Students believe that gravity "holds" things
* Students believe objects are pushed down rather than being pulled down by gravity.
* Students believe big means the same thing as heavy, massive means the same thing as big, and weight means the same thing as mass.
* Students believe air and gas are weightless and have no mass.
* Students believe the higher the altitude, the stronger the gravity until outside the atmosphere.

Reflection Sheet:

What are your general comments on the presented issues?

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How do you perceive the students’ prior knowledge?

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Do you think your students have misconceptions in science like the mentioned ones?

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Do you think that you, usually, pay attention to your students’ pre-conceptions in your teaching?

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Task

Choose two from the four questions of air, ice in glass, sugar and water or syringe in the questionnaire. Using your students’ answers and your knowledge about the topic, try to figure out the everyday view compared to the scientific one concerning the chosen topic:

Question topic: ………………………

|  |  |
| --- | --- |
| Everyday view | Scientific view |
|  |  |

## Second Workshop: Planning teaching toward more dialogic talk

Aims:

This workshop is designed to introduce dialogic teaching by moving from planning teaching according to ‘Learning demand’ (Leach and Scott, 2002), to characterizing the classroom talk according to the ‘Communicative approach’ (Mortimer and Scott, 2003). Through a discussion of the examples presented in the handout, the researcher aims to:

* Exemplify how planning teaching can move between pupils’ starting point and the scientific knowledge for a certain scientific topic
* Display the kinds of talk that might be exchanged between teacher and pupils.
* Encourage the teachers to practice more Dialogic talk in their teaching.

Content:

1. The handout, part 2 which contains:

* Teaching design of ‘Electric circuit’ (Leach and Scott, 2002)
* Teaching episodes that show the different classes of communicative approach
* Some questions on electric circuit

2. Presentation that explains the activities in the teaching sequence of ‘Electric Circuits’ and display examples of the different kinds of communicative approach, some of which are from Omani science lessons.

Included activities and materials:

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| Activity | Materials | Suggested Use |
| Practical demonstration of the activities of ‘Big Circuit’ & ‘Rope Loop’ and discuss their details (20-30 minutes) | Battery – long electric wires – Bulb - Rope | Reviewing theoretically and practically the details of the two activities |
| Presenting the ‘Supermarket’ analogy (10-15 minutes) | Power point | Discussing the details of the analogy |
| Presentation about the Communicative approach + examples from Omani science classes (20-30 minutes) | Power-point presentation | Reviewing the details of the communicative approach and going through the teaching episodes |
| Task: Classifying episodes of talk | Written episodes | Classifying the given episodes according to the communicative approach |
| Displaying some questions on electric circuit | Written questions | Discussing the kinds of questions most likely to promote Dialogic talk |

Teacher Intervention: Handout “Part 2”

In teaching science, the teacher might plan his/her teaching to work over the difference between the school science and everyday social languages. For a given topic; if the differences between everyday and school science reasoning are great, then this topic appears difficult to be learned and taught. Conversely, if the difference is small because there is little contradiction between the two views, then students may think that the school science account is ‘easy’ or ‘obvious’.

For students to give up a misconception, we might imagine the following scenario; becoming aware of the misconceptions, considering alternative conceptions or explanations, making a personal evaluation of the two competing ideas and adopting a new conception as more reasonable than the previously held-misconception.

So, for us the teachers to play over the difference between the two social languages, we can plan our teaching following these steps:

1. Identify the school science knowledge to be taught;
2. Consider how this area of science is conceptualized in the everyday reasoning of students;
3. Identify learning demands from the differences between 1 and 2;
4. Develop a teaching sequence to move between these differences by identifying the teaching goals and the activities to be implemented.

To illustrate how to follow these steps in planning the teaching of certain scientific topics, we can look at this example:

Example: Electric circuit

Step 1: School science knowledge to be learned

Let us suppose that we are interested in introducing the basic elements of a simple conceptual model for an electric circuit, and that this model is based on the idea of energy transfer via an electric current where:

* the electric current consists of a flow of charge;
* the charges are set in motion by the battery;
* energy is transferred to the surroundings when charges pass through any resistance in the circuit.

Step 2: Students. Everyday reasoning about electrical circuits

The literature on teaching and learning about simple electric circuits points to the following characteristic patterns in students reasoning:

• The electric circuit is not viewed as a whole system, with changes occurring virtually simultaneously in all parts (for example, when a switch is closed charges are set into motion in all parts of the circuit together). Instead, students often explain effects in terms of sequential models, where any disturbance travels in one direction and affects circuit components in succession. This is a form of linear causal reasoning such that when an extra resistive component (perhaps a bulb) is added in series to a circuit, students often predict that the first component after the battery gets most, or all, of the energy.

• Students often think about electric circuits in terms of a source (the battery) and a consumer (for example, a bulb). This can lead to problems in that:

* the charge which constitutes an electric current is considered to originate in the battery (the source).
* the battery is considered to provide a fixed electric current.
* when an extra battery is added to a circuit the extra current is thought to come from the additional battery (the source).
* electric current and energy are not differentiated, with students suggesting that the current is used up in a bulb (the consumer). It is likely that the students will have little (or no) knowledge of what we mean by a scientific model of an electric circuit and little (or no) experience of moving between the .theoretical world. of the model (based on the abstract concepts of charge, current and energy) and the .real world of observations and measurements. In addition, students are likely to have a limited appreciation of the fact that scientific models can be applied generally to a wide range of contexts

Step 3: Identification of learning demands

By comparing the school science and everyday accounts of the electric circuit, the key learning shift for the student involves moving:

From a battery-as-source perspective:

* the circuit is initially empty and fills with a .substance-like material. That eventually reaches the bulb and causes it to light.
* students use a .linear causal. pattern of reasoning
* To an all-at-once perspective:
* when the circuit is completed the charges present are set in motion in all parts simultaneously
* students need to use .cyclic causal. reasoning in which causes and effects co-occur.
* Furthermore, in developing this understanding of the scientific model, the students must come to:
* develop abstract scientific concepts of charge, current, resistance and energy in the context of explaining the behaviour of simple electric circuits.
* understand that the battery is the source of energy for the circuit.
* understand that energy is transferred in the circuit whilst the current is conserved.
* understand that the charges originate in the circuit and not in the battery

4- Step 4: Design teaching interventions

Teaching intervention 1: The BIG circuit!

**Specific learning goals:**

The learning demand analysis points to the prominence of the ‘battery-as-source’ model in students’ everyday thinking. Specific learning goals for this intervention are therefore for students to:

1. recognize the nature of the battery-as-source model and its shortcomings in accounting for the behaviour of simple circuits.

2. become motivated to think about an alternative way of accounting for the behaviour of simple circuits.

**Instructional activity:**

This is a teacher-led demonstration which focuses on the BIG circuit. The BIG circuit is a simple electrical circuit consisting of a supply and a single bulb. The defining feature of the BIG circuit is its size; it is set up to pass right around the perimeter of the classroom. The instructional activity involves the students in making predictions about what will happen when the circuit is completed. Will the bulb light immediately? Will there be a slight delay? Working from their existing ideas (of battery-as-source), students typically predict a short, but observable, delay. When the BIG circuit is completed, the bulb is seen to light immediately, prompting dialogue about what is happening in the circuit and challenging the battery-as-source model.

Teaching Intervention 2: The Rope Loop

The BIG circuit teaching intervention challenges the battery-as-source model of electric circuits, but does not offer an alternative way of accounting for the observation of the bulb lighting immediately. This second intervention involves the introduction of the school science view.

**Specific learning goals:**

As outlined earlier, the learning demand analysis points to the specific learning goals for this intervention. These are for students to:

1. Develop an understanding of a simple model of an electric circuit model.

2. Come to recognise and understand the following specific features of the model:

- When the circuit is completed the charges present are set in motion in all parts simultaneously

* that the battery is the source of energy for the circuit.
* that energy is transferred in the circuit whilst the current is conserved.
* that the charges originate in the circuit and not in the battery.

It is important to recognise that these learning goals do not simply list the canonical school science knowledge to be taught. Having been derived via a learning demand analysis, they also reflect the key differences between school science and everyday views.

**Instructional activity:**

The Rope Loop intervention is a teacher-led demonstration which involves using a loop of rope as an analogy for an electric circuit. The students stand in a large circle in the classroom and hold out their hands to allow the rope to pass lightly over their fingers. The teacher sets the rope loop in motion (by pulling it around) and invites one of the students to grip the rope a little more tightly. This produces a heating effect on the student’s fingers. The teacher systematically develops the various links between the analogy and a simple electric circuit model (teacher/battery as source of energy; moving rope as moving charge; energy transferred in fingers/bulb).

These, then, are the first two teaching interventions of a full instructional sequence. The intention here has been to illustrate the steps involved in planning instruction starting with an analysis of the intended learning outcomes.

Ok.. we do have now a general plan for what we are going to do in the classroom to help students get what we consider the ‘right scientific view’. We set the learning goals and specified the activities for achieving these goals. Is it enough? In other words, does this picture of planning need to be supported by other details?

The point here is that we did this planning for ourselves. We are drawing the lines of our instructional plan. But we need to know how we are going to do it in the classroom;

In terms of the content, we can think of three forms:

* Misconception or alternative conceptions (everyday views)
* Scientific information (scientific views)
* Between everyday-scientific views

In terms of the purposes, we can imagine several ones moving between; exploring students’ ideas and supporting the students’ understanding of the scientific views.

In terms of the instructional activities, we have discussed two examples of such activities and might think of others.

But the question here is; how are we going to ‘communicate’ our purposes, content and activities to the students in our classes? How are we going to talk to them in order to know their everyday views? How are we going to present them, firmly, the scientific point of view? And how can we talk to them about their difficulties in understanding the scientific account?

These inquiries just progress the discussion to a very sensitive and vital part of our teaching, that is; the classroom talk. Talking about classroom talk, in turn, bring us back to the purpose of questions that we continuously direct them to our students through the course of teaching.

Through the period of the lesson, we might picture the teacher talk and students listen, teacher and students are exchanging the talk but still the teacher dominates, teacher and students are fairly exchanging the turns of talk without any dominance from the teacher, or students are just talking to each other without the teacher.

So, if I’m planning, as a teacher, to explore the students’ ideas about the electric circuit, then I have to give them the chance to talk as I have also to listen to what they are talking about. I do not need to dominate the conversation as I do not also need, in this stage, to tell them about the scientific view.

In opposite, if I want to tell them what exactly the school science says about this issue, then I might need to dominate the talk and to be quite firm in presenting the scientific account without giving a space for their points of views.

However, if I’m looking to working on their ideas to develop them towards the scientific point of view, then I might exchange or dominate the talk about their ideas or the scientific ones.

So, if we think deeply about the kind of talk happening between us and students, then we could put it into two categories. The talk might be:

1) Verbally interactive or non-interactive (we might just say interactive and non-interactive);

* the teacher only talk : verbally non-interactive
* the teacher and students are exchanging talk: verbally interactive

2) Intellectually interactive or non-interactive (we will call them authoritative and dialogic);

* teacher alone or teachers & students together talking only about the scientific view : intellectually non-interactive (authoritative)
* teacher alone or teachers & students together talking about different points of views : intellectually interactive (dialogic)

If we then combine the two categories together, then we are going to have four kinds of talk; interactive-dialogic, interactive-authoritative, non-interactive-dialogic and non-interactive-authoritative. (see the table below)

|  |  |
| --- | --- |
| Interactive | Non-interactive |
| Authoritative | interactive-authoritative | non-interactive-authoritative |
| Dialogic | interactive-dialogic | non-interactive-dialogic |

* Interactive-dialogic: teacher and students are exchanging the talk about different points of views;
* Interactive-authoritative: teacher and students are exchanging the talk, but only about the scientific view;
* Non-interactive-dialogic: teacher talks only about the different scientific and everyday views;
* Non-interactive-authoritative: teacher talks only, and only about the scientific view.

To illustrate the four kinds of talk, I will present an example of a teaching sequence practiced by a science teacher in UK ( Lynn). This sequence took place in grade 9 class over three lessons about the scientific topic of rust.

The overall teaching approach

In the UK, the topic of ‘rusting’ is often taught in lower high school and a common teaching approach involves asserting that iron, water and oxygen are essential for rusting, then carrying out experimental tests to confirm this point. Typically the tests would involve placing iron pins in test tubes, each of which presents a different set of conditions (iron pin with water without oxygen; iron pin without water with oxygen; iron pin with water with oxygen).

Lynne took a rather different approach. Three weeks prior to the first lesson, at the end of a science class, each student was given an iron nail and a small square of abrasive cloth and instructed to polish up the nail such that ‘it shines like new’. Lynne then explained to the students: ‘I want each one of you to take your nail home and to put it in a place where you think it will go very rusty, as rusty as possible over the next three weeks’. In the lesson prior to the three rusting lessons, the students brought their nails back to school (all of them remembered to bring them in) and each mounted their nail on a sheet of card with information about where the nail had been placed, and why they had placed it there. Lynne and some of the students then made a display on the science classroom wall with the nails placed in sequence, from least to most rusty.

At the start of the first of the three lessons, Lynne reviewed with the students all of the different places where they had placed their nails. She then compiled a list of students’ ideas about what had caused the rusting to occur in each of those places. Teacher and students worked on this list to identify any factors which were present in all of the cases of rusting, this with a view to isolating the conditions essential for rusting to occur. Finally, the students designed and carried out test-tube experiments (using the approach outlined above) to confirm these as the essential conditions.

The teaching and learning episodes

We now turn to examining, in some detail, some of the episodes of the lessons as the teaching and learning performance unfolds.

Episode 1: What was it about those places that made the nails go rusty?

At the start of the first lesson, the students were gathered around Lynne’s table at the front of the room. Lynne begins by reviewing where various students had left their nails:

1. Teacher: You put them in some really interesting places. The sort of places you put them - Dawn put hers on a slope outside in the garden, and Matthew, Andrew and Louise also put theirs outside in the garden...Now - er - Barry put his in a cement hole outside in a wall. Clare put hers near the garage. Jill put hers in a cellar. Now all of those went rusty.

Lynne then collects ideas from the students on what it was about the places selected, that made their nails go rusty:

2. Teacher: So - what I want to do - put on the board, is perhaps put down your ideas of what it was about the places that made your nail go rusty. What do you think it was - thinking about the places - that made your nail go rusty?

3. Haley: Damp

4. Teacher: Damp. Now - we'll put things up first of all, then we'll have a think about them in a minute. Right - so, damp [Lynne writes it on the board]. Yes - Cheryl?

5. Cheryl: Moisture

6. Teacher: Moisture [writes it on board]. Damp, moisture. Anything else? Gavin?

7. Gavin: I put mine in some mud in the garden.

8. Teacher: What was it about that mud that you think made yours go rusty?

9. Gavin: 'Cos it were all wet and all boggy.

10. Teacher: Wet - so it was wet again. Wet [writes it on board]. Right - wet. Any other ideas, Matthew?

11. Matthew: Air

12. Teacher: Air - right you think air could actually - right [writes it on board]. Air could make it go rusty. Fiona?

13. Fiona: Condensation might.

14. Teacher: Condensation - right [writes it on board]. Dawn?

15. Dawn: Could it be like - climate like - if it's hot or cold?

16. Teacher: Hot or cold. Do some other people think that hot or cold might be something significant, in making something go rusty? Hot or cold - is that an idea - yeah? Hot. Which? Both of them, or just one?

17. Dawn: Both

18. Teacher: Haley's saying perhaps cold. Cold? [students mutter] Well, is there anybody who put their's in a hot place and it went rusty? [mutters] Don't forget you're thinking about where you put your nail - what it was - what things in that place - were making it go rusty. Yes?

19. Student: Cold.

20. Teacher: Right [adds ‘cold’ to list on board], have we got anything else it could have been? Anyone that hasn't given me an answer yet? No? Andrew then.

21. Andrew: On me bike - if I scrape me bike and leave it out in the rain, it goes rusty.

22. Teacher: So - what are you saying is making it go rusty then? Which of these things, which is causing it to go...

23. Andrew: Rain

Lynne started by inviting the class to offer their ideas on what ‘made your nail go rusty’. She simply accepts the suggestion made by the student and writes it on the chalkboard. Eventually, over half of the students offer ideas. It is noticeable that many of them present their ideas as possibilities rather than as necessarily correct answers. It is clear that the talk here is interactive in nature and is located towards the dialogic end of the dialogic- authoritative dimension and this, of course, is consistent with the teaching purpose of exploring the students’ views.

(Interactive/dialogic communicative approach)

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Episode 2: Have we actually repeated ourselves?

The students are still seated around the teacher’s table, and on the board the list of suggested things needed for rusting reads:

Rain, Damp, Moisture, Wet, Salt, Vinegar,

Air, Condensation, Cold, Dark.

Lynne invites the students to look more closely at these suggestions:

1. Teacher: Now - what I'd like you to do first of all is to look at these suggestions - because - is there anything that some of them actually have in common - have we actually repeated ourselves with any of the things that we've got on the board at the moment? Kevin, first of all then - what d'you think we've repeated ourselves with?

2. Kevin: Erm - rain, damp...then cold.

3. Teacher: Rain, damp.

When Kevin suggests 'rain, damp...then cold', Lynne ignores 'cold' and selects 'rain, damp’. A number of students call out 'and cold, and condensation' and Lynne selects from these suggestions, 'condensation'. At this point moisture, condensation, rain, damp, and wet are all underlined on the board and Lynne asks what they have in common. She is searching for the term 'water'.

4. Teacher: ...what have we got in common perhaps with all the things we've underlined. What is it Kevin?

5. Kevin: They're all wet.

6. Teacher: Well - they're all wet - so what do we mean by wet then? Is there something else about wet?

4. Students: No - wet [other mutters]

7. Teacher: What is wet perhaps?

8. Student: [chorus] Water!! [laughter]

9. Teacher: Water! So is that the key thing? Ketan what do you think? Is water the key thing here that's linking all of these...

10. Ketan: Yes.

11. Teacher: You've said rain, damp, moisture, wet, oh...condensation and what I'm asking you is 'what do you mean by that?' So what is the common link perhaps?

12. Ketan: S'all different forms of water.

13. Teacher: Water. Yeah? Anyone disagree with that? That sounds reasonable? OK, so we've all of those things we can link up and say that water is important.

In contrast to the previous episode, Lynne starts here by asking the kind of instructional question, 'what have we got in common…?' to which she already knows the answer ('water'). When 'water' is suggested, Lynne seizes the word and initiates a confirmatory exchange with Ketan (Turns 9-12). It is clear, therefore, that the talk, although interactive in nature, is controlled by the teacher and is located towards the authoritative end of the dialogic-authoritative dimension.

(Interactive/Authortative communicative approach)

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Episode 3: What we’ve done is…

The list on the board now includes 7 items and reads:

water, salt, vinegar, air, cold, dark, dry

Lynne turns to the class and motions for silence. Her voice takes on a formal tone and as she speaks she looks around and raises a finger to indicate that she does not want to be interrupted. The students recognise the gesture and remain quiet and attentive:

1. Teacher: Right - OK - fine. Think what we've done now. What we've actually done is try to draw together the reasons why you think your nails have gone rusty. And we've actually tried to tease out what are the main factors.

In reviewing, ‘what we’ve done now’ Lynne makes a subtle retrospective shift. From the students' point of view, they had been engaged in describing the things in the places where their nails rusted. Lynne now refers not to describing things in particular situations but to identifying the 'reasons' and 'main factors', which led to rusting. Lynne continues:

2. Teacher: Maybe, even within this list here [water, salt, vinegar, air, cold, dark, dry], it's just perhaps one or two of those that are the really essential things - the real things that we need for something to rust.

The idea of 'essential things' is thus introduced to the classroom talk. A scientific view of rusting involves not only knowing that iron, air and water are involved, but also that they are the essential things. This idea is presented, by Lynne, in such a way that there are no invitations to discussion, the students recognise the authoritative nature of her approach and remain quiet.

(non-Interactive/Authortative communicative approach)

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Episode 8: Let’s just think back again

Lynne concludes with a final statement:

Teacher: Let's just think back again. At the start, you were suggesting that it was cold, it was warm, it was dark, it was light, it was acids, or it was - water and air. All those things that were causing rust. That's what we started off thinking. And what we've done now - we've now come to the point where you've decided and you've proved in fact that it's just two things, with the iron.

Lynne finally refers back to the student thinking at the start of the lessons and draws attention to the difference between the scientific view and the students’ initial spontaneous thinking. This is a dialogic statement, in that it represents different points of view. It is also presented in a non-interactive manner, thus providing the first, and last, example in this sequence of lessons of a non-interactive/dialogic communicative approach.

(non-Interactive/dialogic communicative approach)

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Examples of Questions on ‘eclectic circuits’ and ‘substance changes’

Q. Some sodium chloride is added to a beaker of water, and left to dissolve:

Changes5a

Before

Changes5b

After

Is this a Physical or Chemical Change? ……………………..

Explain your answer:

………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………

Q. When a change involves a chemical reaction, we call it a chemical change.

Think about each of the changes described below. For each, tick one box (√) to show if you think this is an example of a chemical change.

a) When an ice-cube dissolves Tick one box (√)

A chemical change 

Not a chemical change q Explain why you think so: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

b) When you put bicarbonate of soda into vinegar and it fizzes Tick one box (√)

A chemical change.

Not a chemical change

Explain why you think so: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

c) When you stir sugar into your tea Tick one box (√)



 A chemical change. q

 Not a chemical change. q

Explain why you think so: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

d) When a piece of wood burns Tick one box (√)

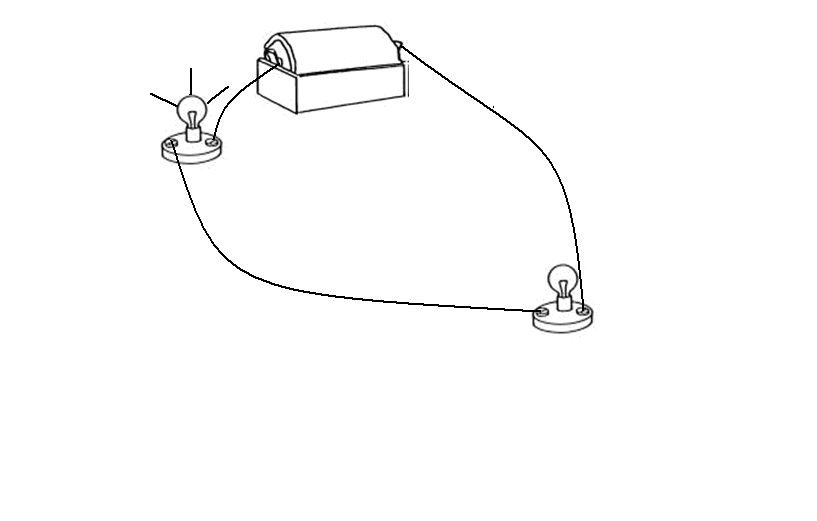
A chemical change.

 Not a chemical change.

Explain why you think so: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Q. In this circuit, the red bulb is bright and the green bulb is dim.



red bulb

green bulb

Sara decides to swap the two bulbs over:

How bright will the bulbs be now?

Tick ONE box ( √ ):

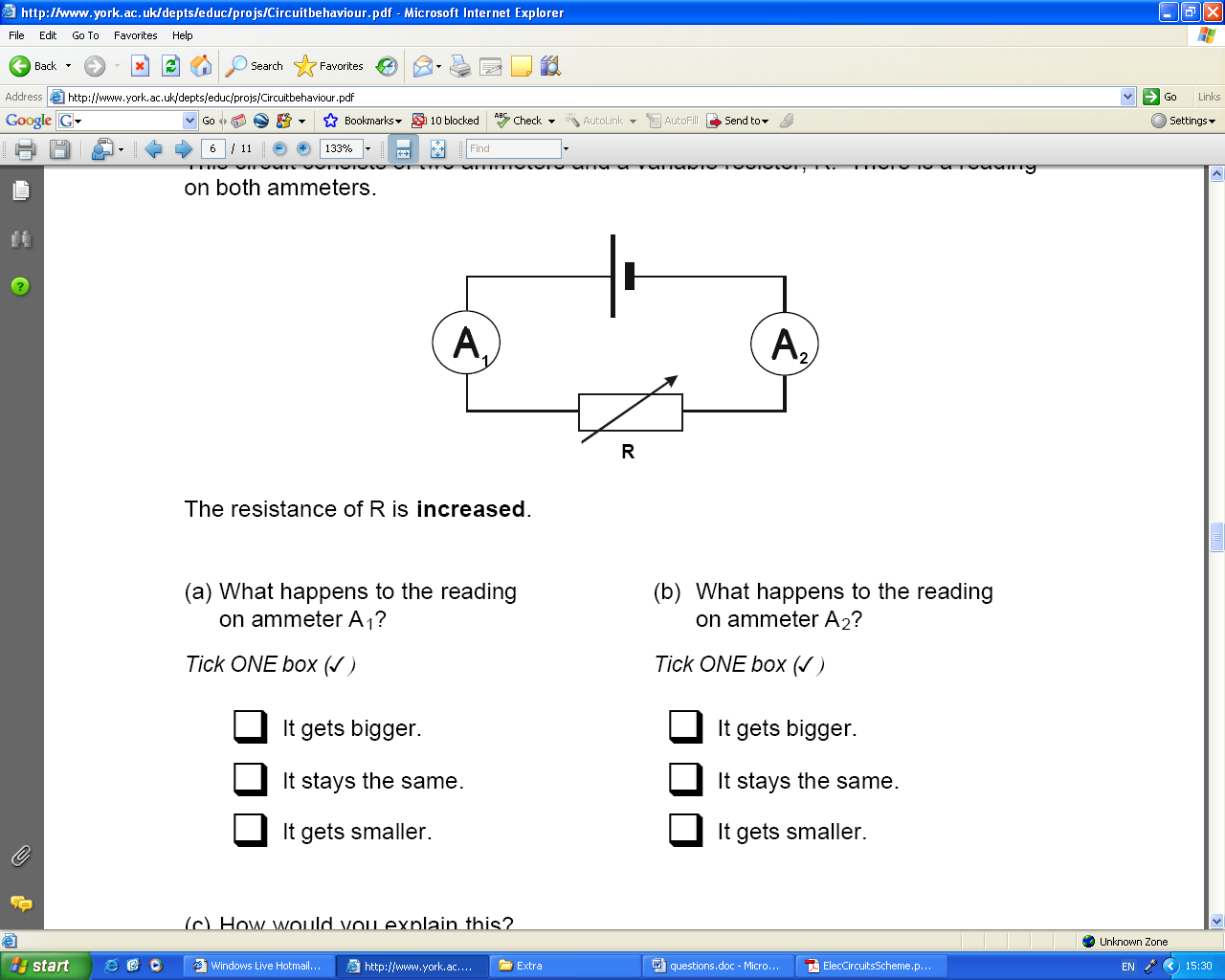
Same as before. The red bulb is bright. The green bulb is dim.

They change over. The red bulb is now dim. The green bulb is bright.

Both bulbs are now bright.

Both bulbs are now dim.

Explain your answer: …………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………

Q. This circuit consists of two ammeters and a variable resistor, R. There is a reading on both ammeters.

The resistance of R is increased.

(a) What happens to the reading (b) What happens to the reading

on ammeter A1? on ammeter A2?

Tick ONE box (√) Tick ONE box (√)

It gets bigger.  It gets bigger.

It stays the same.  It stays the same.

It gets smaller.  It gets smaller.

(c) How would you explain this?

Tick ONE box (√)

A large resistance needs more current than a small resistance.

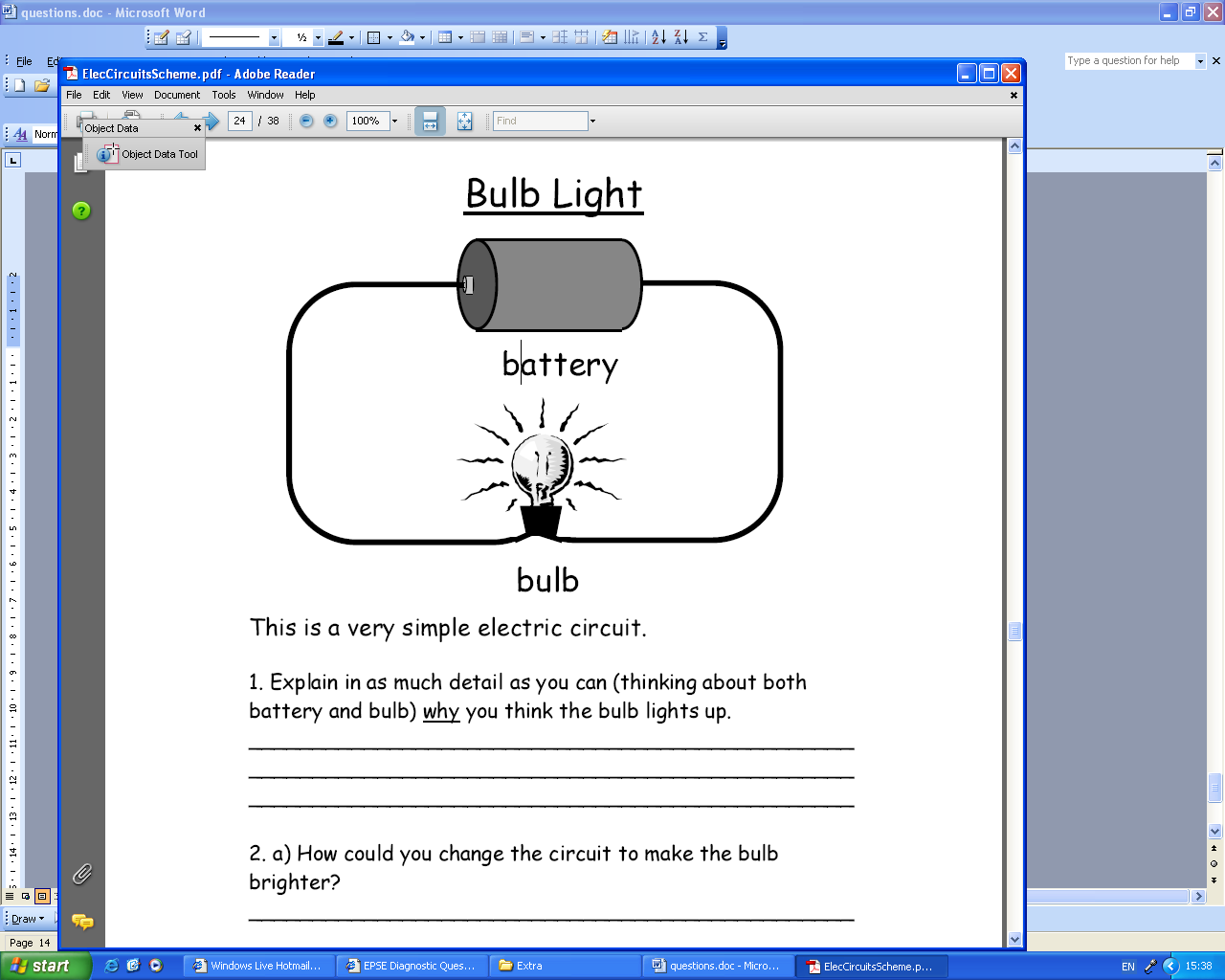
It is the same battery, so it supplies the same current.

Increasing the resistance makes the current smaller everywhere in the circuit.

Increasing the resistance makes the current smaller after the resistor. It has no effect on the current before it.

 Increasing the resistance makes the current smaller after the resistor. So the current before it gets bigger.

Q. This is a very simple electric circuit



Explain in as much detail as you can (thinking about both battery and bulb) why you think the bulb lights up.

………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………

a) How could you change the circuit to make the bulb lighter?

……………………………………………………………………………………………………………………………………………………………………………………

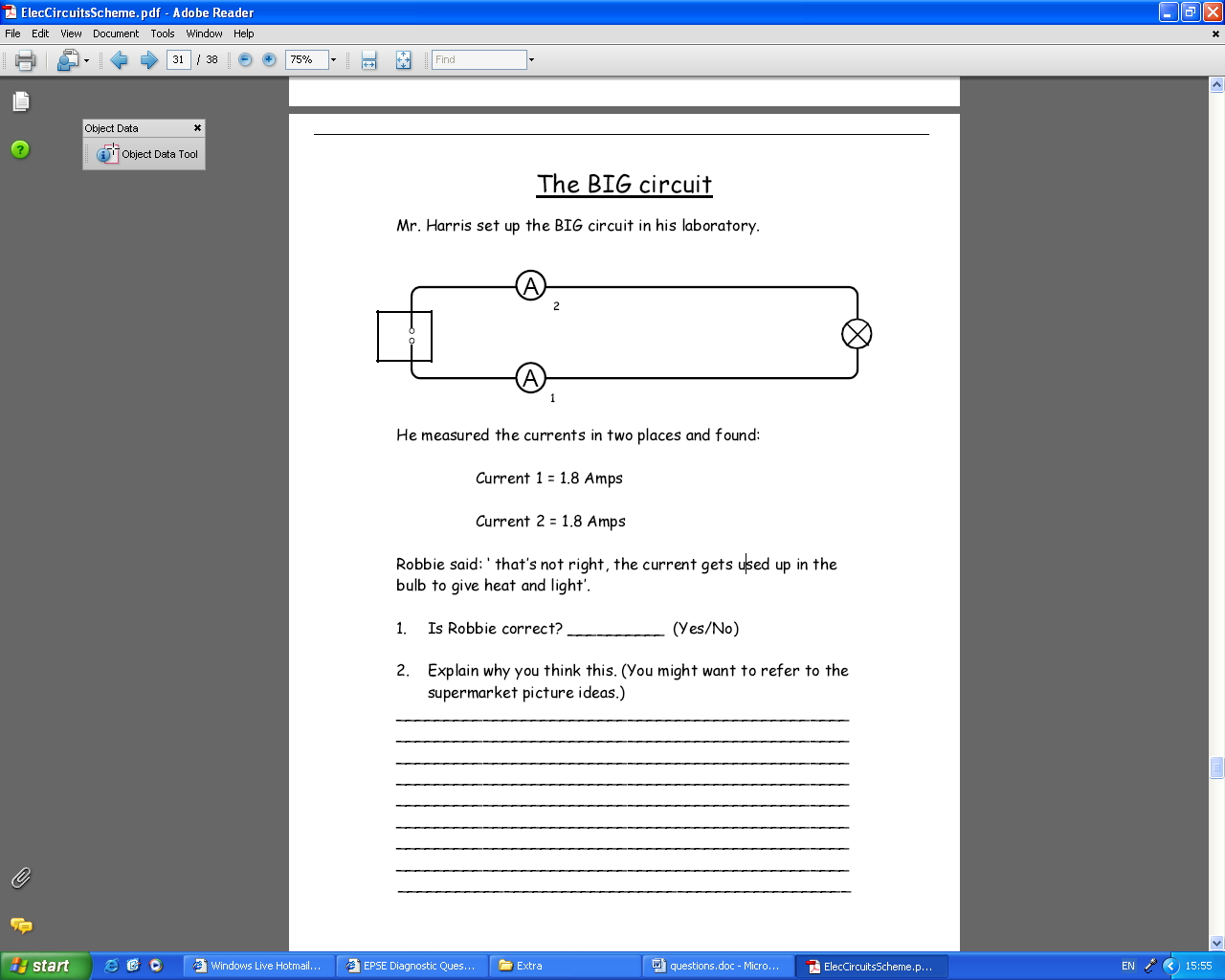
b) Explain why this would work

……………………………………………………………………………………………………………………………………………………………………………………

c) If the circuit is left, why will the battery go FLAT eventually? ……………………………………………………………………………………………………………………………………………………………………………………

The Big Circuit

Q. Mr Harris set up the BIG circuit in his laboratory



He measured the currents in two places and found:

Current 1 = 1.8 Amps

Current 2 = 1.8 Amps

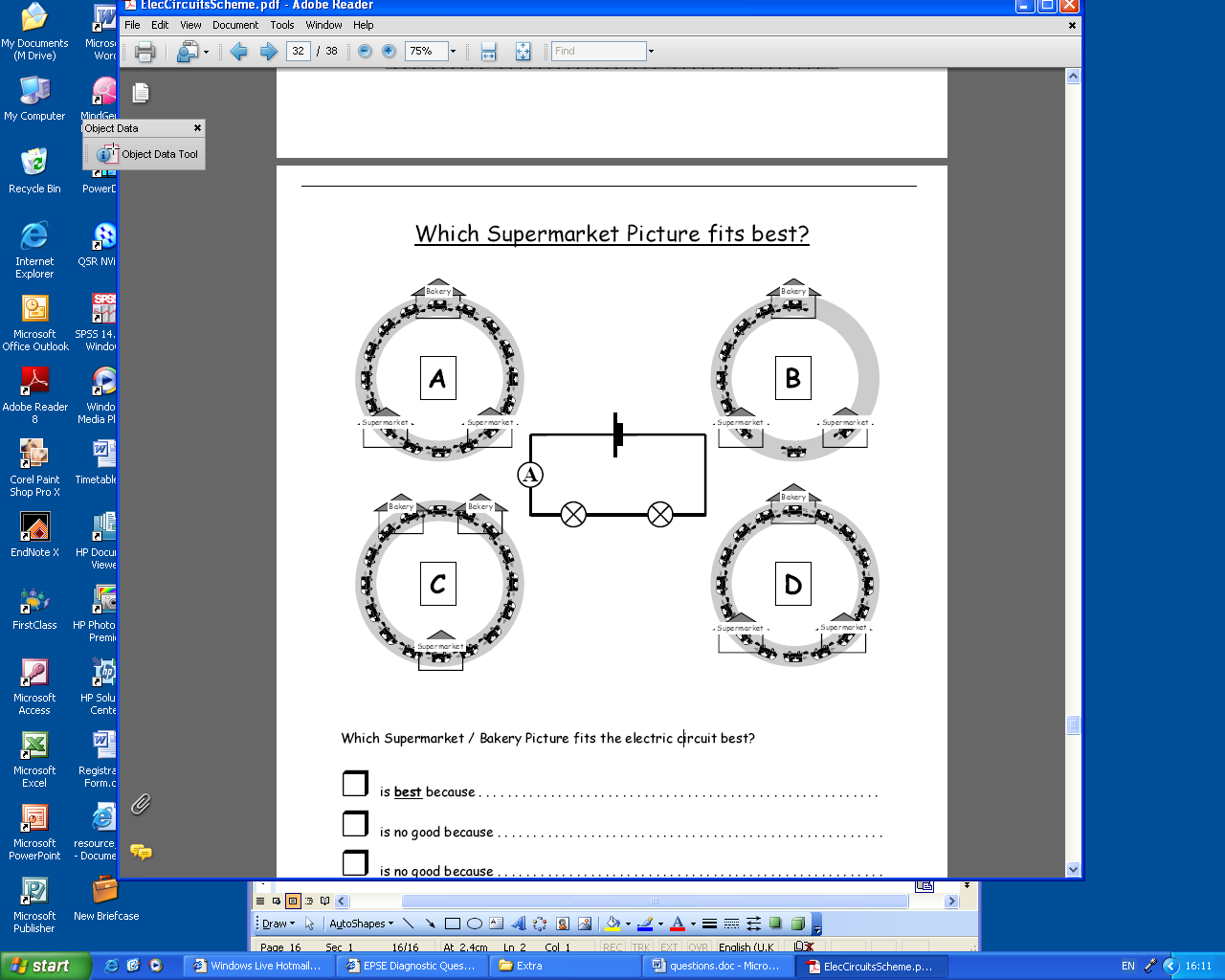
Robbie said: that is not right; the current gets used up in the bulb to give heat and light.

Is Robbie correct? ……………(Yes/No)

Explain why you think this.

…………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………

Q. Which Supermarket Picture fits best?



Which Supermarket / Bakery Picture fits the electric circuit best?

……. Is best because ………………………………………………………………......

……. Is no good because ………………………………………………………………

……. Is no good because ………………………………………………………………

……. Is no good because ………………………………………………………………