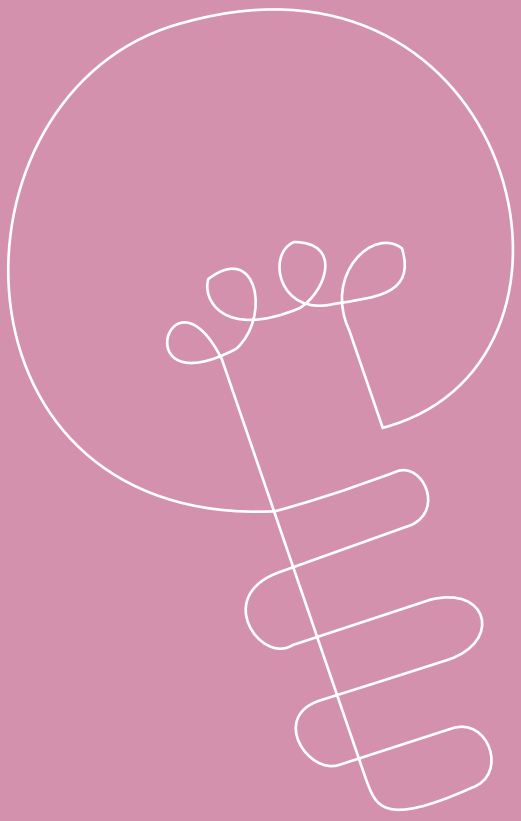
POST-PRIMARY

Science

Guidelines for Teachers of Students with

MILD

General Learning Disabilities



NCCA
National Council for Curriculum and Assessment
An Chomhairle Náisiúnta Curaclaim agus Measúnachta

Contents

Introduction

These guidelines are designed to support teachers of students with mild general learning disabilities who are accessing the junior cycle curriculum.

They are part of a suite of guidelines produced by the National Council for Curriculum and Assessment and are designed to support teachers in meeting the needs of students with special educational needs. Each set of guidelines corresponds to an area of experience of the junior cycle curriculum and offers exemplars of good classroom practice in support of the knowledge and skills associated with that area of experience.

Introduction

This volume is designed to support the science teacher within the context of a whole-school plan for students with special educational needs.

A full account of each area of experience is presented in the introductory volume accompanying this set of materials along with useful guidelines on school and classroom planning. In addition to the guidelines presented here, similar materials have been prepared for teachers working with students accessing the *Primary School Curriculum.* In order to provide continuity and progression in the learning experiences of students with mild general learning disabilities, these guidelines are linked to prior learning in the *Primary School Curriculum*.

In *Approaches and methodologies* individual differences are emphasised and potential areas of difficulty and their implications for learning are outlined and linked with suggestions for possible teaching strategies.

The exemplars in these guidelines are based on the Junior Certificate syllabus for science. The checklist for teacher observation and the table of potential areas of difficulty have relevance for all teachers of students with mild general learning disabilities.

The exemplars have been prepared to show how students with mild general learning disabilities can access a broad, balanced and relevant curriculum through differentiated approaches and methodologies. It is hoped that these exemplars will enable teachers to provide further access to the remaining areas of the science curriculum. A strong emphasis is placed on using an active approach to learning and the use of concrete experiences that relate to the students' environment and prior learning. A range of assessment strategies is identified in order to ensure that students can receive meaningful feedback and experience success in learning.

Approaches and methodologies

The Junior Certificate science Syllabus suggests the use of a variety of approaches and methodologies in the mediation of science. A distinction is made between the student conducting an investigation and the student conducting an experiment.[1]

The term investigation represents an experience in which the student seeks information about a particular object, process or event in a manner that is not pre-determined in either procedure or outcome.

In conducting an experiment the student follows a prescribed procedure in order to test a theory, to confirm a hypothesis, or to discover something that is unknown.

Both approaches play an important role in presenting learning experiences that take cognisance of the specific needs of students with mild general learning disabilities.

A number of key considerations must be kept in mind by the teacher either in using the investigative approach or in conducting an experiment. These include the following:

Starting with the students' own ideas and experiences

The constructivist view of learning on which the science curriculum is based, emphasises building on students' current levels of experience and understanding. Through engaging in practical activities, students with mild general learning disabilities encounter new ideas and ways of thinking. These in turn challenge and alter their existing knowledge and understanding. However, accessing these students' existing ideas can be difficult. Students can lack the confidence to express their ideas for fear of failure or rejection. Likewise, they can experience difficulty in verbalising their own ideas, particularly in the case of students with delayed language development or poor vocabulary. Teachers need to employ certain strategies to elicit students' ideas on a given topic or issue. A comfortable, supportive learning environment will encourage students with mild general learning disabilities to express these ideas. The teacher acting as a learning partner can, through questioning, suggesting, explaining, inferring, etc., better facilitate the students in communicating their ideas. It may also be important to utilise alternative modes of communication. For example, students with mild general learning disabilities may prefer to express their ideas through drawings, constructions, modelling, or writing. These different communicative modes should be accommodated.

1. Junior Certificate Science Syllabus

Encouraging and facilitating practical activity

Opportunities to engage physically with objects and the environment are pivotal to supporting learning in science for students with mild general learning disabilities.

Providing opportunities to work in the environment

Opportunities to work in the environment are particularly important for students with mild general learning disabilities. They help them to develop a stronger sense of identity and to make connections with their locality and community. They also bring enjoyable, exciting, and discovery-based dimensions to learning, which are important for the continued motivation of these students.

Applying new information and ideas to everyday experiences

Science, like all other areas of learning, must have a strong sense of relevance for students with mild general learning disabilities. As many of these students have below-average intellectual functioning and delayed cognitive and conceptual development, this relevance is central in sustaining their interest and in demonstrating to them the value of learning.

Providing opportunities for students to work together in sharing ideas, discoveries and findings

The sense of security and support provided by collaborative learning can be very important to students with mild general learning disabilities. However, careful consideration is needed in the allocation of working partners, since these students can easily feel intimidated by a more competent learner.

An investigative approach

Using an investigative approach, students seek to solve problems and raise questions through a combination of closed activities and open-ended investigations.

Open investigations

Open investigations are investigations that arise from the students' own questions. The teacher, acting as a facilitator, provides the opportunities for the exploration of these questions. This methodology, while central to the problem-solving model of science education, poses particular challenges for students with mild general learning disabilities. Reluctance to take risks, to offer elaboration, to accept that a problem may have more than one solution, to anticipate or predict what might happen next, and to interpret what information is relevant to the problem all make this methodology challenging for them. If students with mild general learning disabilities are to benefit from open investigations in science the investigations should be kept simple. If the area of knowledge or the process relating to the investigation becomes too complex, then the student will lose focus and the purpose of the investigation will become lost. As open investigations are driven by the students' own ideas, the teacher will need to support them in the articulation of those ideas. The teacher will also need to play a supportive and creative role in facilitating the learning process by modelling appropriate skills and behaviours, by making constructive and helpful suggestions, and by verbalising the process for the students. Skills and behaviour associated with scaffolding open investigations include

- questioning out loud
- speculating
- demonstrating trial and error
- providing a range of possible answers to questions.

These can be done at various stages in an investigation, but particularly in the planning stage.

Conducting experiments following prescribed procedures

The science syllabus suggests this approach for certain aspects of the course that do not lend themselves to investigative work, for demonstrating skills and the use of equipment and materials that involve the teacher in presenting students with data and materials, and in guiding them towards the discovery of a pre-determined idea or concept. This approach has a number of benefits for the student with mild general learning disabilities.

It is highly structured, planned from start to finish, and can be broken into controlled steps through which the student can observe and measure progress. It also allows the teacher to strike a balance between the learning process and the content. Conducting experiments can enable these students to gain confidence in the practice of scientific skills and to experience success.

The frequent use of written instructions should be avoided in dealing with students with mild general learning disabilities. The use of commercially produced worksheets may expose students to unfamiliar language, making the task/activity more difficult. It is important to give them the encouragement, the guidance, and the scaffolding that they need to enjoy and to benefit from learning opportunities in science.

Skills development

Skills in science

Through following the Junior Certificate science syllabus the student will learn skills associated with

- the manipulation of equipment, and manual dexterity that takes account of issues of health and safety
- procedural plans and the use of the scientific method in problem-solving
- observation, measurement, and the accurate recording of data
- obtaining and using information from a variety of sources
- numeracy and the manipulation and interpretation of data in a variety of forms, including the use of symbols, charts and graphs
- logical thinking, inductive and deductive reasoning, and the formation of opinions and judgements based on evidence and experiment
- the preparation and presentation of reports on scientific topics, experiments, etc.
- independent study and cooperative learning
- the application of scientific knowledge to everyday life experiences.[2]

When planning science activities for students with mild general learning disabilities a number of issues need to be considered.

Skills development

The development of relevant skills may show a very uneven pattern. While students may display particular strengths in one skill area, other areas may be quite underdeveloped. Careful planning on the teacher's part can enable these students to engage with the curriculum with real purpose.

Oral language

Oral language development can pose challenges for the student and teacher in relation to science. Skills development can be impeded because of delay in oral language development, and learning *through* language may not occur to the degree that it might for other students of the same age. In order to assist these students to benefit fully from scientific activities teachers need to refer to guidelines relating to oral language development. The science curriculum can, in fact, be used as a vehicle to develop the oral communication and critical thinking skills outlined in that section.

Communication

It is important that the teacher sees beyond communication difficulties in order to enable students to display and develop skills in science to their full potential. Some students will have considerable aptitudes and skills which they cannot communicate orally. The teacher should facilitate these students by allowing them to demonstrate, to draw, to make models, or to use gestures or symbols to communicate their ideas. The teacher can then talk through demonstrations for the student.

Working scientifically

Practical engagement with the biological and physical aspects of the world is particularly important for students with mild general learning disabilities. Through these 'hands-on' experiences they can develop more easily a clear understanding of how things work and why things act as they do. Without these experiences, students with mild general learning disabilities can encounter great difficulty in acquiring new knowledge and in forming new concepts.

2. Junior Certificate Science Syllabus

Dealing with concepts and knowledge in an abstract manner can also be extremely challenging in the absence of practical everyday experiences. Practical activity is, therefore, central to the science curriculum for students with mild general learning disabilities. Working scientifically describes the process of scientific enquiry through which the students interact with their environment and its components in gaining new knowledge and understanding. This entails the development of particular skills. The students can develop these skills through their scientific investigations and activities. They include

- questioning
- observing
- predicting
- investigating and experimenting
- estimating and measuring
- analysing
- recording and communicating.

Through successful planning students begin to understand that there are steps to be followed in the learning process. As they are guided through them they begin to recognise the steps, and are less likely to become frustrated and to give up on a task because each step will have been identified at the planning stage. Understanding that trial and error are necessary aspects of learning will encourage these students to take risks and to accept that a given problem may have a number of solutions rather than a right or wrong answer. In this way practical, problem-solving aspects of design in the science curriculum integrate with the construction strands of the technologies and art, craft, design syllabuses. Such cross-curricular learning is especially important and beneficial for students with mild general learning disabilities.

In addition to the above approaches and methodologies it is essential, when planning a science curriculum for students with mild general learning disabilities, to provide lessons and activities that allow students to practice skills and experience aspects of the 'process' relating to science to a far greater degree than would be the case with mainstream students. While all students need opportunities to learn to handle equipment and to carry out certain procedures, students with mild general learning disabilities need to over-learn skills in order to avoid becoming frustrated when involved in investigative work. Short and very regular practice sessions on new skills will help them to develop their skills to a more sophisticated level. This in turn will enable the students to focus more directly on gaining knowledge when involved in activities.

All of the above methodologies should be used in teaching any of the sections of the science curriculum to students with mild general learning disabilities.

Individual differences in talents, strengths and needs

All students will benefit from a variety of teaching styles and classroom activities. Students with mild general learning disabilities will benefit particularly if the teacher is aware of their individual talents, strengths and needs before embarking on a new activity. Consultation with and/or involvement in the Individual Education Planning process as well as teacher observation will assist the science teacher in organising an appropriate learning programme for a student with mild general learning disabilities. Such an approach will assist the teacher in selecting suitably differentiated methods for the class. If learning activities are to be made meaningful, relevant and achievable for all students then the teacher needs to find ways to respond to that diversity by using differentiating approaches and methodologies. This can be achieved by

- ensuring that objectives are realistic for the students
- ensuring that the learning task is compatible with prior learning
- providing opportunities for interacting and working with other students in small groups
- spending more time on tasks
- organising the learning task into small stages
- ensuring that the language used is pitched at the students' level of understanding and does not hinder them in understanding the activity
- using task analysis outlining the steps to be learned/completed in any given task

- posing key questions to guide students through the stages/processes and to assist in self-direction and correction
- using graphic symbols as reminders to assist in understanding the sequence/steps in any given task/problem
- modelling task analysis by talking through the steps of a task as it is being done
- providing short and varied tasks
- creating a congenial learning environment through the use of concrete and, where possible, everyday materials, and by displaying word lists laminated charts with pictures.

Teaching strategies

When planning for teaching and learning in the area of science a variety of teaching strategies needs to be considered.

These will respond to potential areas of difficulty faced by students with mild general learning disabilities in engaging fully in, for example, scientific language, oral and written communication, problem-solving, and the retention of facts and concepts. The table below lists some of these, and suggests appropriate strategies for classroom use.

It is important to remember that not all students with mild general learning difficulties face all of these challenges. Neither is it an exhaustive list. These are strategies which help overcome some commonly found potential areas of difficulty.

Addressing potential areas of difficulty for students with mild general learning disabilities

▲ Potential area of difficulty	= Implications for learning
Safety	• Students may not be familiar with the laboratory equipment and may not have experience in a practical environment. • Students may display delayed functional response to potential hazards. • It may be necessary to adjust work areas to match students' optimum comfort and operational functioning.

+ Possible strategies

- Strong emphasis is needed on safety and building up confidence to participate in the practical environment.
- Keep all exits and pathways clear.
- Evacuation drill should be practiced regularly (at least once a term).
- Involve students in making safety signs for the laboratory.
- Students should practice turning on and off equipment, must know where the main power and gas switches are, and be able to use them.

▲ Potential area of difficulty	= Implications for learning
Fear of using new apparatus	• Safety is of the utmost importance. • Students must be confident that they can use the apparatus and associated chemicals safely.

+ Possible strategies

- Students need opportunities to practise and develop skills with security and confidence.
- Strong emphasis is needed on accuracy and on the practise of correct procedure.
- If using group work, ensure that roles in the group are clearly assigned and that the task is sufficiently structured to support the participation of a student with motor difficulties.

▲ Potential area of difficulty	= Implications for learning
Developing ideas for an investigation	• Students may need to be encouraged to examine other investigations already completed by peers. • The teacher may need to guide students towards developing a clear focus for their own investigations.

+ Possible strategies

- An emphasis should be placed on keeping the ideas as simple as possible.
- Discuss ideas with the whole group.
- Repeat and record suggestions from students and refer back to them.
- Encourage work in small group and in pairs.

▲ Potential area of difficulty	= Implications for learning
Communicating ideas	Students may not participate in discussion and may not get the opportunity to develop their own response to questions posed.

+ Possible strategies

- Encourage students to talk through listening to other students' contributions.
- Allow plenty of answer time.
- Do not talk for the student.
- Emphasise that every contribution is useful.
- Break the whole class into pairs or threes, and encourage contributions from all.
- Encourage statements of preference for various solutions, for example '*What I like*', *'What I don't like'*.

▲ Potential area of difficulty	= Implications for learning
Being overwhelmed by the learning process	The student becomes overwhelmed when presented with new information or skills and consequently cannot learn.

+ Possible strategies

- Provide alternative forms of information, for example using visual presentations of material.
- Ask students to pick out the parts of the text they can read and to focus on relevant information.
- Use a highlighter for important sections/words. (There is often there a lot of redundant information.)
- Avoid presenting the student with pages of textbook problems by giving modified worksheets (with diagrams) or verbally delivered instructions.

▲ Potential area of difficulty	= Implications for learning
Vocabulary/language	Students may have difficulty • following a sequence of ideas/instructions • expressing their own ideas • understanding/retrieving appropriate terms, predicting, analysing, etc.

+ Possible strategies

- Teach the language of science, demonstrating meaning and/or using visual aids.
- Have the students demonstrate scientific phenomena, for example floating/sinking, using *'give me, show me, make me'* as much as possible.
- Assist students in expressing ideas, through scaffolding or verbalising a demonstration.
- Use wall charts of keywords.
- Model posing questions.
- Communicate clearly to both students and parents the language that is being covered each week.
- Encourage the student to build up a dictionary of scientific terms.

▲ Potential area of difficulty	= Implications for learning
Motor skills and dexterity	Students can easily give up when they cannot hold a piece of equipment.

+ Possible strategies

- Choose resources/equipment appropriate to the student, bearing in mind safety issues as well as the student's dexterity.
- Allow students very regular short practice sessions with new equipment.
- Break the activity into steps, and plan intervention with the students at particular stages.
- Identify the stages for students, acknowledging progression from one stage to the next.
- Use teacher demonstration.
- Keep step by step instructions posted near equipment.
- Allow one student to hold the equipment while another continues with measuring and recording.

▲ Potential area of difficulty	= Implications for learning
Short attention span, lack of concentration and application	• The student may have problems in completing his/her task. • The student may find it difficult to stay on-task, may take a long time to complete a task, or may rush a task. • The standard of finished work may be poor.

+ Possible strategies

- Organise interesting tasks that require a short timescale in the early stages of the science programme.
- Vary the processes and move students to new and achievable tasks if concentration is seen to diminish.
- Group/pair work and division of tasks can help hold interest as experiments and investigations can be done jointly in a shorter time span.

▲ Potential area of difficulty	= Implications for learning
Writing up pro forma reports on mandatory experiments and investigations	• Students may find it difficult to write up long passages to describe the whole investigative process. • Students may have difficulty drawing accurate diagrams and graphs.

+ Possible strategies

- Provide a pro forma sheet with the required headings and some guiding questions.
- Encourage students to complete each stage in the report as it is being done.
- The computer could be used to word process if the student finds this easier than writing.
- The student should be encouraged to sketch and glue in pictures.

▲ Potential area of difficulty	= Implications for learning
Time	Students may have difficulty with the measurement of time and the concept of time passing.

+ Possible strategies

- Science provides endless opportunities to focus the students' attention on the passing of time.
- Measurement of time should be built into investigations, where possible.
- Observations of changes occurring over a day, a week, a month, and the seasons should be planned.
- Plan to record time passing in a way that provides a visual image for the student, for example, colouring days on a calendar or parts of a clock face.

▲ Potential area of difficulty	= Implications for learning
Poor self-esteem and a fear of failure	• Students feel helplessness and constantly seek help or refuse to proceed with even the simplest of tasks. • Students may get trapped in the *'I can't do Science'* barrier.

+ Possible strategies

- It is important for students to experience success as often as possible.
- Both teacher and students should set realistic and achievable targets.
- Tasks should be relevant to the students' day-to-day reality, and have a clear meaning and purpose for them.
- Develop a culture in the classroom where mistakes are seen as an integral part of the learning process.

Exemplars

The exemplars presented here are designed to show how the strategies outlined above can work in classrooms, to model practice that can meet the needs of junior cycle courses, and to serve the particular learning needs of students with mild general learning disabilities.

Structure

Each of the exemplars is preceded by a summary in the form of two tables. The first table is an introduction to the exemplar. It outlines the relevant sections of the *Primary School Curriculum*, Junior Certificate (Ordinary level), and Junior Certificate School Programme (JCSP) curriculum. It also highlights some of the characteristics of students with mild general learning disabilities that relate specifically to the area covered in the exemplar and lists some of the strategies used. In addition, a time scale and a list of resources are provided. The second table outlines the exemplar in more detail by providing suggested outcomes, supporting activities, and assessment strategies for a lesson/series of lessons.

Exemplar 1: **Science**

Syllabus topic: Physics 3B : Heat, Light and Sound | Heat, changes of state

Primary School Curriculum (5th and 6th classes)	Junior Certificate (Ordinary level)	Junior Certificate School Programme
Science Strand: Energy and Forces **Mathematics** Strand: Measurement	3B **Heat** OP22 Understand that heat is a form of energy and that it can be converted into other forms of energy. OP23 Investigate and describe the expansion of solids, liquids and gases when heated, and contraction when cooled. OP24 Demonstrate the expansion of water when freezing.	**Science 4:** Energy and control.

Time scale: The full range of learning and assessment activities presented in this exemplar may take from six to eight class periods, for example:

- introduction to the concept of energy and heat and the change of energy to other forms—one period
- expansion and contraction of gases—double period
- expansion and contraction of solids and liquids—double period
- demonstration of the expansion of water on freezing—one period

Potential areas of difficulty

- Difficulty with terms such as contraction, expansion
- Retaining a clear grasp of energy changing to other forms
- Transferring learning to everyday situations
- Transferring material from the blackboard to worksheets or charts
- Reading and writing at speed
- Handling the pieces of equipment
- Writing the report on investigations

Strategies used in this exemplar

- Planning for investigation
- Designing the investigation with clear instructions
- Carrying out the investigation
- Recording the investigation using key words
- Giving language support by matching words with their correct meaning
- Sentence completion exercises
- Group discussion, involving asking questions, listening and explaining

Exemplar 1: **Science**

Resources

- Necessary laboratory equipment
- List of key words
- Worksheets
- Photographs of different forms of transport (cars, planes, etc.)
- Photographs, newspaper cuttings, and magazine cuttings to show the application of the expansion of solids, liquids and gases in everyday life

Suggested outcomes	Supporting activities	Assessment strategies
As a result of engaging in these activities students should be enabled to • explain that heat is a form of energy and name other forms of energy • complete a worksheet on examples of heat energy changed to other forms of energy • complete cloze assignments on the expansion and contraction of solids, liquids and gases • explain how to demonstrate that water expands when frozen • plan investigations, record results, interpret results, draw conclusions, use lab equipment safely, measure temperature, ask questions on the expansion and contraction of solids, liquids and gases • provide an example relating their knowledge on heat to technology and society.	• Group discussion, involving asking questions, listening and explaining • Planning investigations • Conducting investigations • Reporting on investigations • Matching words with their correct meaning	The teacher can assess students' knowledge and skills through • worksheets • cloze exercises • demonstrations by the student • oral discussions and explanations.

Exemplar 1: **Science**

Activity 1

Measure the temperature of various solids at above and below room temperature
Aim: To understand and develop skills in measurement of temperature

See Worksheet 1 for Activity 1 for students to use when measuring temperature of different materials.

Equipment
Samples of materials whose temperature will be measured, for example a beaker of tap water, beaker of ice, beaker of sugar.

A thermometer (using a thermometer in this investigation means that the thermometer can then be examined to show the expansion of liquids when heated.)

Activity 2

Fuel as a source of energy
Aim
To understand that

- heat is a form of energy
- heat is got from burning fuels
- heat can be changed into other forms of energy such as movement energy.

Provide students with pictures of different forms of transport, on worksheets, pages 21,22, or on Powerpoint, overheads, etc.

Discuss the following questions in relation to each of the different modes of transport:

- What is the source of energy?
- Why is the energy necessary?
- What has the energy been changed into?
- What would happen if there was not a supply of energy?

Activity 3

Investigate and describe what happens when liquids are heated and then cooled.
Aim
To show that a liquid expands when heated and contracts when cooled

Use *Worksheet for Activity 3* to discuss what happens when a liquid is heated. Refer back to *Activity 1* above.

Exemplar 1: **Science**

Activity 4

Investigate and describe what happens when gases are heated and then cooled.

Aim
To show the expansion and contraction of air.

Use *Worksheet for Activity 4* for this investigation.

Discuss with the students ways to conduct this investigation.

In this case the gas being used is air, so it is necessary to steer the class discussion towards the use of air in conducting the investigation.

Ask guiding questions, such as:

- What gas is the safest for use in the investigation?
- How can the gas be trapped?

Then ask the students the question: If given a balloon, a glass bottle, a Bunsen burner, a tripod stand and wire gauze how could you conduct this investigation?

Ask the students to complete *Section 1* of *Worksheet for Activity 4*.

Materials required for each group of two students
Balloons, a conical flask, a Bunsen burner, a tripod stand and wire gauze, large beakers.

Procedure
- Stretch a balloon over the neck of the empty conical flask.
- Place the flask in a beaker of hot water.
- Leave the flask in the water for a few minutes and observe what happens.
- Light the Bunsen burner and heat the water in the beaker. Observe what happens.
- Place the flask in a beaker of cold water and observe any changes in the balloon.

Depending on the ability of the students either provide them with diagrams of each piece of equipment and ask them to name them, or ask them to draw a diagram of each piece of equipment used. Provide a list of the relevant pieces of equipment.

Results
Ask students to complete the sentences in *Section 3* (the case of the balloon and the flask – what happened?) of the *Worksheet for Activity 4* to record the result of the investigation.

Encourage the students to think of an everyday example of the expansion of gases, or of contraction of gases.

Exemplar 1: **Science**

Activity 5

To show the expansion of solids

Aim
To show that solids expand when they are heated.

Discuss with the students ways to conduct this investigation.
Introduce the ball and ring apparatus, showing how the ball fits into the ring.
Engage the students in predicting what would happen if the ball is heated or if the ball is cooled.

Demonstrate what happens by heating the ball using the Bunsen burner.
Discuss some applications of this knowledge, for example how the metal lid of a jam jar can be easily loosened and why this works.

After observing the demonstration get students to complete *Worksheet for Activity 5* in small groups of two or three.

Activity 6

To demonstrate the expansion of water on freezing

Aim
To show that water expands on freezing

This demonstration can be done in small groups of students or by the teacher.
Whichever way is chosen it is important to involve the students in the planning process.

Discuss the plan with the students and ask them to complete *Section 1* (Planning) of the *Worksheet for Activity 6*.
If the students are doing the experiment themselves it would be better to use a plastic bottle.

Equipment
Small bottles (0.5l plastic or glass), a plastic bag large enough to contain the bottle of water.

Method
Fill the bottle with water and screw the cap on tightly.
Place it in the freezer long enough for the water to freeze or leave it overnight.

Result
Observe what has happened when the bottle is removed. Students can then complete the *Worksheet for Activity 5*.

Discuss with the students ways in which this knowledge can be used in everyday life.

Exemplar 1: **Science**

Worksheet for Activity 1

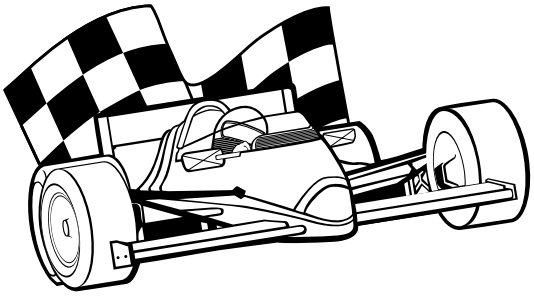
Temperature – how hot are different things?

Substance	**Guess temperature (°C)**	**Actual temperature (°C)**
Air in the classroom		
Tap water		
Ice		
Milk from the fridge		
Table salt		
Sugar		

Exemplar 1: **Science**

Worksheet for Activity 2

Fuel as a source of energy

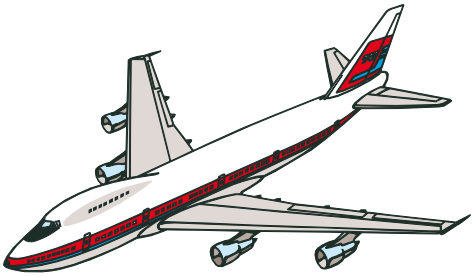


What fuel is burned in the sports car? _____

Is the fuel a solid or a liquid? _____

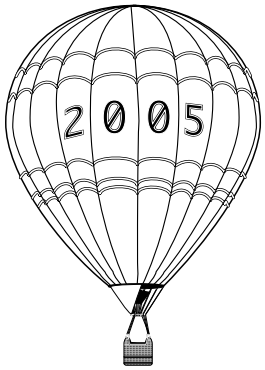
When the fuel is burned what is it changed into? _____

Why is the fuel used? _____



Where does the energy for the plane come from? _____

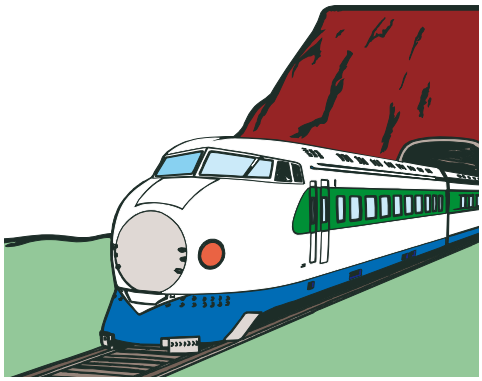
Is the fuel a solid or a liquid? _____



Where does the energy for the hot air balloon come from? _____

Is the fuel a solid, a liquid or a gas? _____

Exemplar 1: **Science**



Where does the energy for the train come from? _____

Where is the energy made for running the train? _____

Name a fuel that could be used to make the energy supply for the train? _____

What is heat energy changed to in the electricity power station? _____

Energy to move

Fill in the blanks using the correct words from the following list:

move, energy, burned, vehicles, heat, moving

The fuel is _____and it gives off _____energy.

The heat energy is changed into _____ energy in the transport _____.

If the fuel runs out the vehicle will not _____.

Exemplar 1: **Science**

Worksheet for Activity 3

What liquid is used in the thermometer in the picture? _____

What other liquid could be used for a thermometer? _____

What happens when the thermometer is put into warm water? _____

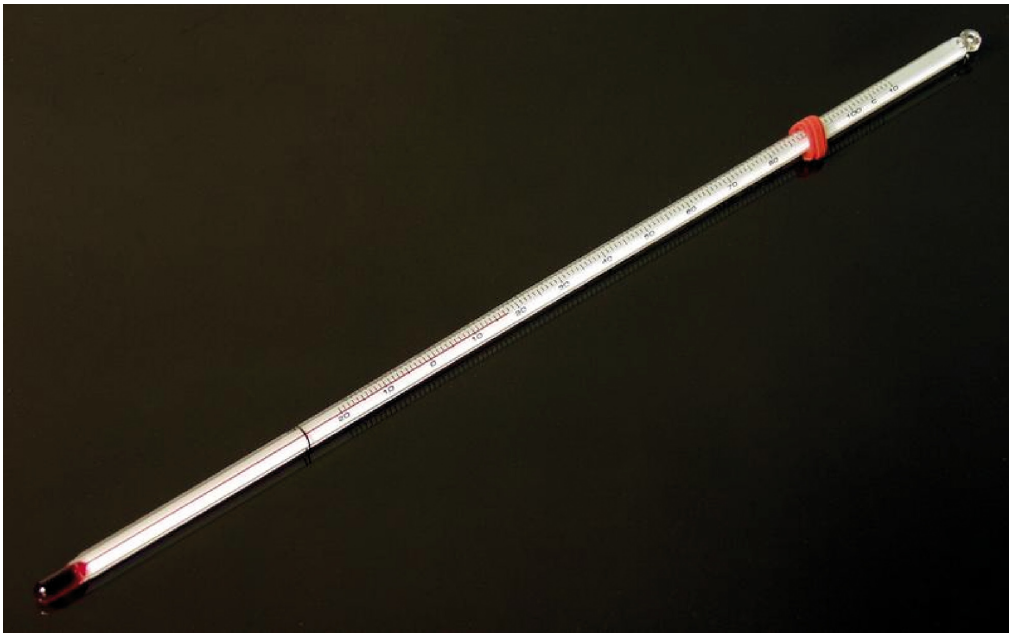
What will happen if the thermometer is then put into cold water? _____

Put the correct word in the sentences below:

EXPANDS **CONTRACTS**

A liquid _____ when it is heated.

A liquid _____ when cooled.



Exemplar 1: **Science**

Worksheet for Activity 4

What happens when a gas is heated, and then cooled?

Section 1

Planning

What gas will you use? _____

Where is the gas? _____

What will be changed? _____

How can you know a change has taken place? _____

Safety issues? _____

Section 2

The balloon on the flask!

Equipment

A balloon, a conical flask, a beaker of hot water, a tripod stand and wire gauze, a beaker of cold water.

Heated balloon and bottle

Cool balloon and bottle

Exemplar 1: **Science**

Section 3

The case of the balloon on the flask - what happened?

What gas was heated in the investigation? _____

Where was the gas? _____

What happened the gas when it was heated? _____

What happened the balloon then? _____

How did you cool the flask? _____

What happened the gas when it was cooled? _____

What happened the balloon then? _____

How is this information useful in everyday life? _____

Everyday use? (Use a picture or write about it.)

Think: What happens to a balloon on a hot day? What might happen if it got too hot?

Exemplar 1: **Science**

Worksheet for Activity 5

Section 1

What happened with the ball and ring

Choose the right word for each of the sentences from the following:

expanded, ball, solid, ring, bigger, contract, smaller, heated, bigger, cooled, contracted

The ball is a _____.

At first the ball fitted through the _____.

Then the _____ was heated.

After it was _____ the ball would not fit through the ring.

The solid ball _____ when it was heated.

This means it got _____.

The opposite to expand is _____.

When the ball was _____ it fitted through the ring.

This is because the solid _____ when it was cooled down.

Exemplar 1: **Science**

Section 2

Everyday use? (Use a picture or write about it.)

1. Why do the radiators in your house sometimes click and make noise when the central heating starts up?

2. Why do you think a glass bottle cracks when boiling water is poured into it?

Exemplar 1: **Science**

Worksheet for Activity 6

Section 1

What happens when water freezes? _____

Planning:

(i) What am I going to change? _____

(ii) How will I change it/where will I put it? _____

_____

(iii) Safety issues? _____

_____

_____

Section 2

List the materials needed. Draw diagrams.

List of key words: ***water, bottle, plastic bag***

Exemplar 1: **Science**

Section 3

What was done?

1. _____

_____

2. _____

_____

3. _____

_____

4. _____

_____

5. _____

_____

Results: What happened?

_____

_____

_____

_____

Exemplar 1: **Science**

Conclusion: What does this result tell you?

_____

_____

_____

_____

Everyday use? (Use a picture or write about it.)

Exemplar 2: **Science**

Syllabus topic: Biology 1A: Human Biology	Enzyme action and the breathing system

Primary School Curriculum (5th and 6th classes)	**Junior Certificate (Ordinary level)**	**Junior Certificate School Programme**
Science Strand: Living things Strand units: Plant and animal life, Processes of life **SPHE** Strand: Myself Strand units: Taking care of my body, *Food and nutrition* Safety and protection, *Personal safety*	1A3 **Enzymes** OB8 Investigate the action of amylase on starch; identify the substrate, product and enzyme. OB5 Investigate the conversion of chemical energy in food to heat energy. 1A4 **Aerobic respiration** OB9 Describe the process of aerobic respiration by means of a word equation and understand that aerobic respiration requires the presence of oxygen. OB10 Demonstrate the products of aerobic respiration. OB11 Carry out qualitative tests to compare the CO_2 levels of inhaled and exhaled air. OB12 Describe how oxygen is taken into the bloodstream from the lungs and how carbon dioxide is taken into the lungs to form the blood stream during gaseous exchange and how these processes are affected by smoking.	The Human Body Describe some of the major systems of the human body and explain their links with health.

Time scale: The full range of learning and assessment presented in this exemplar will take eight class periods devoted to *Food as a source of energy*, comprising

- energy conversion from chemical energy to heat energy—2 periods
- human breathing system and breathing rate—2 periods
- investigating the action of amylase on starch—2 periods
- the effects of smoking—2 periods.

Exemplar 2: **Science**

Potential areas of difficulty

- Learning, retaining and understanding terms such as enzymes, gaseous exchange, and the names of the parts of the breathing system
- Retaining details of the type of test conducted to show the presence of starch and of CO2
- Retaining a clear grasp of energy changes in the human body
- Transferring material from the blackboard/whiteboard to a worksheet or chart
- Reading and writing at speed
- Handling the different pieces of equipment

Strategies used in this exemplar

- Planning for investigation
- Designing the investigation with clear instructions
- Carrying out the investigation
- Recording the investigation using key words
- Giving language support by matching words with their correct meaning
- Sentence completion exercises
- Group discussion that involves asking questions, listening, and explaining

Resources

- The necessary laboratory equipment
- A list of key words
- Worksheets
- Posters to discourage smoking
- Newspaper/magazine cuttings

Exemplar 2: **Science**

Suggested outcomes	Supporting activities	Assessment strategies
As a result of these activities the student should be enabled to • explain that food is a fuel and that it provides heat energy • explain that the chemical fuel of food can be burned and heat given off • use the term breathing rate and explain what changes it • complete worksheets/models on parts of the human breathing system • name the gases exchanged in the lungs • demonstrate the test for the presence of carbon dioxide, showing that exhaled air contains more carbon dioxide than inhaled air • compose the word equation for aerobic respiration • give an example of a starch-containing food • name the tests for starch and CO_2.	• Group discussions, involving asking questions, listening and explaining. • Planning investigations. • Conducting investigations. • Reporting on investigations. • Matching words with their correct meanings.	The teacher observes whether • students can explain that food is a fuel and that it provides heat and energy • students can complete worksheets/models on parts of the human breathing system • students can name the gases exchanged in the lungs and compose the word equation for aerobic respiration • students can name the tests for starch and CO_2 • students can explain how to investigate the action of amylase on starch and name the enzyme and product • students can name two effects of smoking on the body and two ways of keeping the body healthy.

Exemplar 2: **Science**

Activity 1

1A3: Enzymes

What happens the food we eat?
Discuss with the students what happens to the food we eat. If they have already covered the sections on food and digestion this discussion will not require much time.

The following questions might be helpful:

- Do we keep all the food that we eat in the body?
- Do we get rid of waste food from the body?
- What breaks up the food so that it can go into the blood?

Use *Worksheet for Activity 1* to help focus the discussion.

Activity 2

OB5: Investigate the conversion of chemical energy into heat energy.

Burning food and getting heat from food
In preparing for this investigation reference could be made to work completed on the energy value of different foods – OB4.

Conduct the mandatory investigation with the students. See *Worksheet for Activity 2*.

It may be a good idea to use more than one food sample with the group so that the results can be compared.

Discuss how the heat given off by burning food could be measured, considering different options.

Activity 3

OB8: Investigate the action of the enzyme amylase on starch.

Digesting food: changing food into smaller chemicals
Conduct the mandatory investigation with the students. See *Worksheet for Activity 3*.

Consider whether it is best to use saliva from the students or amylase from a chemical supplier. Proper safety and hygiene procedures need to be observed.

Exemplar 2: **Science**

Activity 4

OB12: Describe how oxygen is taken into the bloodstream from the lungs and how carbon dioxide is taken into the lungs from the blood stream during gaseous exchange.

Getting oxygen in place of carbon dioxide

Use a wall chart, Powerpoint, or the internet to show the parts of the human breathing system.

Use secondary sources to tell the story of gaseous exchange in the blood.

Ask students to complete in pairs *Worksheet for Activity 4* on inhaling and exhaling air.

Activity 5

OB11: Carry out qualitative tests to compare the CO_2 levels of inhaled and exhaled air.

Getting oxygen in place of carbon dioxide

Discuss with students the use of limewater to test for the presence of CO_2.

Conduct the investigation on testing for CO_2 in inhaled air and in exhaled air. See Work sheet for Activity 5.

Activity 6

OB9: Describe the process of aerobic respiration by means of a word equation and understand that aerobic respiration requires the presence of oxygen.

Word equation for aerobic respiration

Discuss with students the concept of getting energy from food and that there are waste products in the form of gas and water.

Guide them towards writing a word equation for the process of aerobic respiration by providing them with words on laminated cards and asking them to write an equation of what happens with food. See *Worksheet for Activity 6*.

Exemplar 2: **Science**

Activity 6

OB9: Describe the process of aerobic respiration by means of a word equation and understand that aerobic respiration requires the presence of oxygen.

Word equation for aerobic respiration
Discuss with students the concept of getting energy from food and that there are waste products in the form of gas and water.

Guide them towards writing a word equation for the process of aerobic respiration by providing them with words on laminated cards and asking them to write an equation of what happens with food. See *Worksheet for Activity 6*.

Activity 7

How are the processes of gaseous exchange affected by smoking?
Discuss with the students why people are not allowed to smoke in cafes, pubs, schools, hospitals, etc.

Use classroom discussion to encourage students to create a poster about the harmful effects of smoking. This could be done with newspaper/magazine cuttings in conjunction with contributions from the students.

Some of the harmful effects are outlined below. See the websites www.scoilnet.ie and http://www.bhf.org.uk/smoking.

Complete the cloze exercise on what happens to our lungs when we smoke.

When you smoke

- → the amount of mucus increases and it also gets thicker.
- → the extra mucus makes you _____.
- → the extra mucus _____ become infected.
- → the cleaning system in your lungs does not work as well as before.
- → your lungs and _____ get irritated and inflamed. They then become narrow so less air gets in and out. So less_____ is carried to your body.
- → cigarette smoke has chemicals that can make normal cells change into _____cells.

cancer **cough** **can** **oxygen** **airways**

Set up an experiment to demonstrate what happens to cotton wool when it is exposed to smoke.

- It may be a good idea to do this as a demonstration. However it makes an important impact if the students are allowed to do it in small groups. See *Worksheet for Activity 7*.

Exemplar 2: **Science**

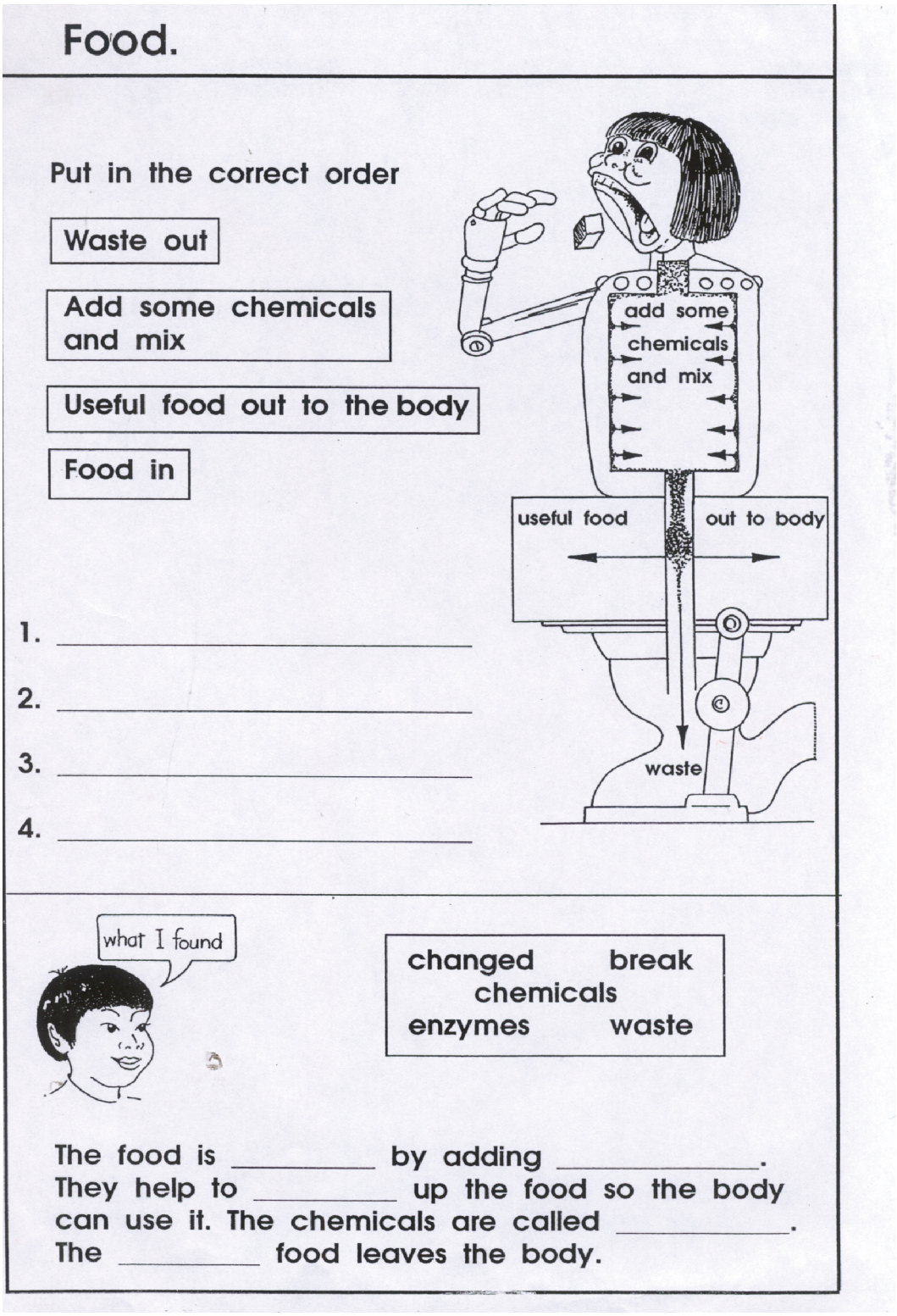
Activity 8

Show the effect of smoke on cotton wool.
Use an empty half litre plastic bottle. Place a small number (perhaps six) of small cotton wool balls in the bottom of it. Plug the top of it with Plasticine. Make a hole through the Plasticine with a pencil, remove the pencil and place the cigarette in its place.

When the bottle is sealed with the Plasticine on the top squeeze the bottle and draw the smoke into the bottle. Observe what happens.

Exemplar 2: **Science**

Worksheet for Activity 1



Page 95 from the NI Education and Library Board's SNAP Science 1995

Exemplar 2: **Science**

Worksheet for Activity 2

Burning food

Planning

(i) What am I going to show?

_____

_____

(ii) What food will I use?

_____

_____

(ii) What am I going to change? _____

(iii) How will I change it?

_____

_____

(iv) Safety issues?

_____

_____

Exemplar 2: **Science**

Draw a diagram of the equipment needed.

List of key words: ***Bunsen burner, tongs, test-tube***

What was done?

1. _____

_____

2. _____

_____

3. _____

_____

4. _____

_____

5. _____

_____

Results: What happened?

_____

_____

_____

Exemplar 2: **Science**

Conclusion: What does this result tell you?

_____

_____

_____

_____

_____

_____

How is this information useful in everyday life?

Everyday use? (Use a picture or write about it.)

Exemplar 2: **Science**

Worksheet for Activity 3

Digesting food: changing food into smaller chemicals

Planning

(i) What am I going to show?

(ii) What food will I use that has a lot of starch?

(iii) Where will I get the enzyme amylase?

(iv) What will the enzyme work on?

(iv) Safety issues?

Exemplar 2: **Science**

Draw a diagram of what you will do with the equipment.

List of key words:

test-tube for spit, test-tube for food sample, test-tube for putting spit and food sample in together, test-tube rack, iodine, dropper

What was done?

1. _____

_____

2. _____

_____

3. _____

_____

4. _____

_____

5. _____

_____

Results: What happened?

_____

_____

_____

Exemplar 2: **Science**

Conclusion: What does this result tell you?

How is this information useful in everyday life?

Everyday use? (Use a picture or write about it.)

Exemplar 2: **Science**

Worksheet for Activity 4

Getting oxygen in place of carbon dioxide

Planning

(i) What am I going to show?

(ii) How will I collect the gas I breathe out?

(iii) How will I collect the gas I breathe in?

(iv) What will I change?

(v) How will I change it?

(vi) Safety issues?

Exemplar 2: **Science**

Draw a diagram of the equipment and materials needed.

List of key words: ***test-tubes (use for blowing exhaled air into, and the other for sucking air through), glass tubing, limewater***

Method: What was done?

1. _____

_____

2. _____

_____

3. _____

_____

Results: What happened?

_____

_____

_____

Exemplar 2: **Science**

Conclusion: What does this result tell you?

_____

_____

_____

_____

_____

How is this information useful in everyday life?

Everyday use? (Use a picture or write about it.)

Use these words to tell the story of the journey of air:

Mouth and nose, windpipe, ribs, diaphragm.

The air enters our bodies through the _____.

The air passes down the _____ to the lungs.

The lungs are protected by the bones called the _____ .

There is a sheet of muscle at the base of the cavity called the _____ .

Exemplar 2: **Science**

Worksheet for Activity 5

Getting oxygen in place of carbon dioxide

Planning

(i) What am I going to show?

(ii) How will I collect the gas I breathe out?

(iii) How will I collect the gas I breathe in?

(iv) What will I change?

(v) How will I change it?

(vi) Safety issues?

Exemplar 2: **Science**

Draw a diagram of the equipment and materials needed.

Method: What was done?

1. _____

_____

2. _____

_____

3. _____

_____

Results: What happened?

_____

_____

_____

Exemplar 2: **Science**

Conclusion: What does this result tell you?

_____

_____

_____

_____

_____

How is this information useful in everyday life?

Everyday use? (Use a picture or write about it.)

Exemplar 2: **Science**

Worksheet for Activity 6

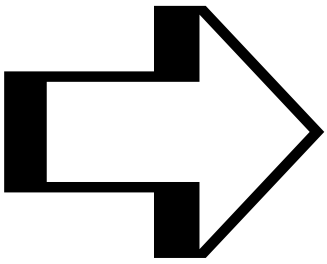
Word equation for aerobic respiration:

Photocopy words and arrow, laminate them, and store them in an envelope for re-use.

Ask the students to write the words in an equation form showing what happens to food in the body.

Food

Oxygen



Energy

$C0_2$

Exemplar 2: **Science**

Worksheet for Activity 7

Show the effect of smoke on cotton wool and compare it with the effect on our lungs.

Students complete the worksheet when conducting the investigation.

Planning

(i) What am I going to show?

(ii) What will I use to represent the lungs and the ribcage?

(ii) What am I going to change?

(iii) How will I change it?

(iv) Safety issues?

Exemplar 1: **Science**

Draw a diagram of the equipment and materials needed.

List of key words: ***cigarette, plastic bottle, plasticine, cotton wool***

Method: What was done?

1. _____

_____

2. _____

_____

3. _____

_____

4. _____

_____

5. _____

_____

Results: What happened to the cotton wool?

_____

_____

_____

Exemplar 2: **Science**

Conclusion: What does this result tell you about cigarettes?

_____

_____

_____

_____

_____

How is this information useful in everyday life?

Write a slogan to help people not to smoke, or use pictures to show the harmful effects of smoking.

Exemplar 3: **Science**

Syllabus topic: Chemistry 2A4: Metals | Metals

Primary School Curriculum (5th and 6th classes)	Junior Certificate (Ordinary level)	Junior Certificate School Programme
Science Strand: Materials Strand unit: Properties and characteristics of materials Strand: Energy and forces Strand unit: Magnetism and electricity	2A4 **Chemistry** OC5 List the physical properties (state and colour only) of two examples of metallic and two examples of non-metallic elements. OC6 Recall that metals conduct electricity and heat. OC7 Identify everyday applications of metals, for example in the making of jewellery. OC8 Recall the symbols of the metallic elements Cu, Zn, Al, Fe, Ag, and Au.	Science and technology: Non-Living Environment

Time scale: The full range of curriculum and assessment activity in this exemplar will take five class periods.

Potential areas of difficulty

- Transferring material from the blackboard/whiteboard to a worksheet or chart
- Reading and writing at speed
- Handling the different pieces of equipment

Strategies used in this exemplar

- Giving language support through matching words with their correct meaning
- Sentence completion exercises
- Group discussion
- Asking questions, listening and explaining

Resources

- The necessary laboratory equipment
- A list of key words
- Worksheets
- Newspaper/magazine cuttings

Exemplar 3: **Science**

Suggested outcomes	Supporting activities	Assessment strategies
As a result of engaging in these activities students should be enabled to • list the physical properties (state and colour) of two examples of metallic and two examples of non-metallic elements • use a simple circuit to test the conductivity of the materials • complete the cloze exercises in relation to the properties of metals • identify everyday applications of metals, for example in the making of jewellery • demonstrate that metals are represented by symbols on the Periodic Table on *Worksheet for Activity 3* • complete the table matching pictures with alloyed metals, and provide example from everyday life • complete cloze exercise on properties of metals and alloys.	• Group discussion, that involves asking questions, listening and explaining. • Planning investigations. • Conducting investigations. • Reporting on investigations. • Matching words with their correct meanings.	The teacher assesses students by observing whether they can • complete worksheets • complete cloze exercises • mount demonstrations • give oral explanations • participate in discussion.

Exemplar 3: **Science**

Activity 1

List the physical properties (state and colour) of two examples of metallic and two examples of non-metallic elements.

Provide the students with sample materials, for example paper clips, aluminium foil, sulphur, and charcoal. Ask them to complete *Worksheet for Activity 1* in relation to the sample materials they have been given.

Use a simple circuit to test the conductivity of the materials.

Ask students to complete the cloze exercises in relation to the properties of metals.

Activity 2

Identify everyday applications of metals, for example in the making of jewellery.

Activity 3

Recall the symbols of the metallic elements.

Go to the website of Chemcomics: http://www.uky.edu/Projects/Chemcomics/ and follow a cartoon strip for any one of the metals or for all of them.

Go to the website http://www.schoolscience.co.uk/periodictable.html. Ask students to follow the metals Cu, Zn, Al, Fe, Ag, and Au.

Provide the table in *Worksheet for Activity 3* for them to complete.
http://www.chemicalelements.com/elements/k.html

Activity 4

Understand that solder, steel, brass, and bronze are alloys and state one use of each alloy.
Present students with the pictures and ask them to identify the alloy in each case. Ask them to complete *Worksheet for Activity 4.*

Exemplar 3: **Science**

Worksheet for Activity 1

What can we say about these materials?

Material	**Colour**	**Solid, liquid, gas**	**Can the material be stretched?**	**Can you make it into different shapes?**
Charcoal				
Paper clips				
Sulphur				
Aluminium foil				

Exemplar 3: **Science**

Worksheet for Activity 2

What are metals used to make?











Exemplar 3: **Science**

Key words:

dental mirror, golf clubs, car, bicycle, sports helmet, football, beaded necklace, watch, ring, perfume bottle, toaster

Object/Item	**Any part(s) made from metal?**	**Other comments:** **Why is it good to use metal in this object?** **Why is it not a good idea?**

Exemplar 3: **Science**

Worksheet for Activity 3

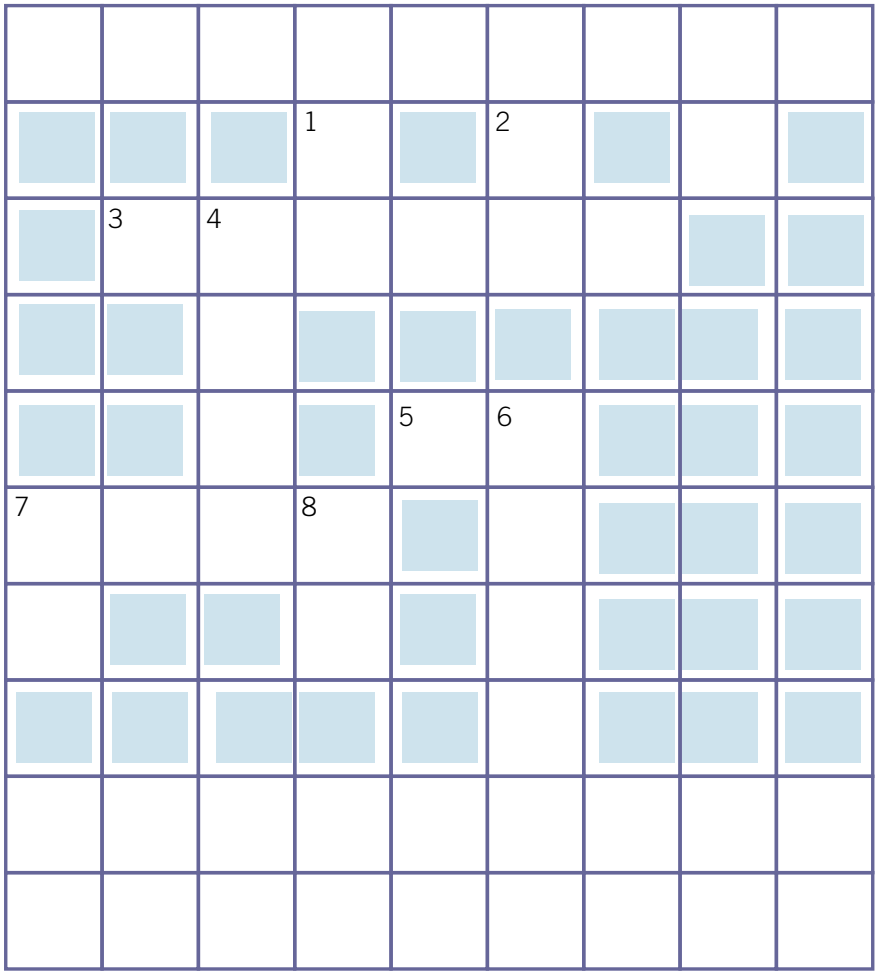
Signs and symbols—Know your metals

Down

1. Big_ _!
2. The symbol for iron.
4. It rusts.
6. The most precious metal.
7. The symbol for zinc.
8. The symbol for copper.

Across

3. The type of medal for the person who comes second in the Olympics.
5. The symbol for silver.
7. These mines are located in Navan.



Exemplar 3: **Science**

Worksheet for Activity 4

Alloys

Read the information in the box at the top of the page, examine the pictures and then fill in the table.

An alloy is a mixture of metals.

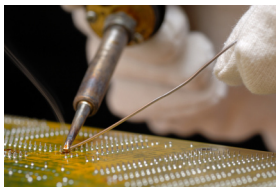
Solder, steel, brass, and bronze are alloys.

Brass is an alloy of copper and zinc.

Bronze is an alloy of copper, zinc and tin. The earliest copper alloys date back to the 4th millennium BC. Copper coins are also alloys of copper. They are not pure copper.

Solder is an alloy of lead and tin.

Steel is an alloy of iron and carbon. Steel is often recycled. For example, the steel in a car body might have been a panel from a washing machine in a previous life.



Exemplar 3: **Science**

Material	**Matching Picture**	**Alloy—what metals?**	**Other example of everyday use**
Solder			
Brass			
Bronze			
Steel			

Fill in the missing words.

Metals can conduct _____ and _____.

Two examples of metals are_____ and _____.

Metals have a _____ appearance.

Metals can be _____ into shape.

An _____ is a mixture of metals. An example of an alloy is _____

and it is used to make _____.

iron	copper	shiny
bridges	**heat**	**hammered**
alloy	**electricity**	**steel**