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BTEC Entry

Edexcel Entry Level Certificate in Science (8938)

Teacher's guide

September 2006

360Science: The student - centred curriculum

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Introduction

This teacher's guide accompanies the Edexcel Entry Level Certificate in Science specification and has been designed to help teachers prepare for first teaching of the qualification.

This guide is designed to give further information on:

- specialist scientific language and scientific units used in each of the qualifications units and levels
- the assessment of practical skills
- how the specification relates to the Key Stage 4 Science subject criteria section 3.6 *How Science Works*
- specialist language and units, assessment of practical skills and 'How Science Works'.

The specialist language and units lists contain the language and units that the students are required to use in each unit. The information given on assessment of practical skills and 'How Science Works' are examples to illustrate how students could show progression through Entry Levels 1, 2 and 3.

Structure of the qualification

The Entry Level Certificate in Science consists of four biology, four chemistry and four physics units.

Entry Level Certificate in Science	
Unit	**Content**
Biology units	
1	Survival in Nature
2	Cells, DNA and Diseases
3	Sending Messages Around the Body
4	Staying Fit and Healthy
Chemistry units	
5	What are Things Made From?
6	Making Changes
7	There's One Earth
8	Properties of Materials and their Uses
Physics units	
9	Electricity — its Production and its Applications
10	Energy to Make Things Work
11	Electromagnetic Waves and their Uses
12	Exploring the Earth and Space

Links to GCSE Science

To facilitate co-teaching all units (except *Unit 10: Energy to Make Things Work)* map directly to the units in the Edexcel GCSE Science qualification.

Specialist scientific language, scientific units and conventions

The following tables show which specialist scientific language and scientific units students should be able to use at each of the Entry Levels 1, 2 and 3.

Each level shows the specialist language that the students are expected to understand, in addition to that of the earlier levels. For example, a student who is at Entry Level 3 would be expected to understand the specialist language for Entry Level 1, Entry Level 2 and Entry Level 3.

There is only one convention used within the Entry Level specification. This is conventional current, which states that current flows from the positive terminal of a battery to the negative terminal. This is a convention that is used because in a metallic conductor current actually flows from the negative to the positive terminal.

Unit 1: Survival in Nature

	Entry Level 1	Entry Level 2	Entry Level 3
Specialist scientific language	Characteristics Consumer Decay Photosynthesis Predator Prey Producer Quadrat	Food chains Habitats	Evolution Intensities Organic farming Survival
Scientific units			°C – centigrade (temperature) % humidity (moisture) Lux (light)

Unit 2: Cells, DNA and Diseases

	Entry Level 1	Entry Level 2	Entry Level 3
Specialist scientific language	Cell	Symptoms	Asexual reproduction
	Differences	Variations	Chromosomes
	Disease		Cloning
	Egg		Ethical
	Inherited		Genetic diseases
	Organs		Social
	Tissues		
	Sexual reproduction		

Unit 3: Sending Messages Around the Body

	Entry Level 1	Entry Level 2	Entry Level 3
Specialist scientific language	Brain Hormones Manufactured Muscles Senses Simulation	Blood sugar levels Kidney Reaction time Reflex reaction	Contraception Diabetic Infertility Insulin Iris Lens Nerve cell Optic nerve Pancreas Pupil Retina
Units	s – seconds (time)		m – metres (length)

Unit 4: Staying Fit and Healthy

	Entry Level 1	Entry Level 2	Entry Level 3
Specialist scientific language	Alcohol Cigarettes Drugs Infection Lung cancer Nicotine Plasma Pulse rate Reaction Red blood cells Tar Tobacco White blood cells	Breathing rate Heart disease	Circulatory system Microbes Recovery rate
Units	bpm – beats per minute (pulse rate)		°C – centigrade (temperature)

Unit 5: What are Things Made From?

	Entry Level 1	Entry Level 2	Entry Level 3
Specialist scientific language	Atoms Compounds Metals Mixtures Molecules Non-metals	Conduct Separation	Chemical reaction Concentration Periodic table Surface area
Units	mins – minutes, s – seconds (time)		

Unit 6: Making Changes

	Entry Level 1	Entry Level 2	Entry Level 3
Specialist scientific language	Bunsen burner	Chemical change	Extract
	Carbon dioxide	Corrosive	Flame test
	Hazard symbols	Explosive	Irritant
	Hydrogen	Flammable	Metal salts
	Physical change	Harmful	Neutralisation reaction
	Reaction	Toxic	Ores
	Rusting		Radioactive

Unit 7: There's One Earth

	Entry Level 1	Entry Level 2	Entry Level 3
Specialist scientific language	Coal Environment Fire extinguisher Fossil fuels Fuel Gas Global warming Oil Recycling	Fire blanket Sea water Rock salt Noise	Bio-fuels Combustion Droughts Pollutants Radiation

Unit 8: Properties of Materials and their Uses

	Entry Level 1	Entry Level 2	Entry Level 3
Specialist scientific language	Bending	Magnetism	Fermentation
	Ceramic	Synthetic	Flexibility
	Fibre		Texture
	Glass		Transparency
	Magnet		Yeast
	Metal		
	Packaging		
	Plastic		
	Properties		
	Stretching		

Unit 9: Electricity – its Production and its Applications

	Entry Level 1	Entry Level 2	Entry Level 3
Specialist scientific language	Electricity Power Current Circuit Meter	Fuse Mains electricity Live Neutral Earth Series Parallel	Alternating current Ammeter Direct current Resistance Resistor Solar cells Voltage Voltmeter Wind turbines
Units	£ – pounds (money)		A – amperes (current) Ω – ohms (resistance) V – volts (voltage) W – watts (power)

Unit 10: Energy to Make Things Work

	Entry Level 1	Entry Level 2	Entry Level 3
Specialist scientific language	Coal Energy Environment Energy losses Energy resources Gas Oil Temperature Thermal energy	Conductor Insulator Solar Tidal Wave Wind	Biomass Efficiency Geothermal Hydro Kinetic Nuclear Transformation
Units			°C – centigrade (temperature)

Unit 11: Electromagnetic Waves and their Uses

	Entry Level 1	Entry Level 2	Entry Level 3
Specialist scientific language	Focal length Lens Mirror Reflection Waves	Microwaves Plane mirror Radio waves Telescope X-rays	Converging Electromagnetic spectrum Focal point Gamma rays Ionising radiation Optic fibres Pinhole camera Prisms Refraction Total internal reflection
Units			m – metres, cm – centimetres (length)

Unit 12: Exploring the Earth and Space

	Entry Level 1	Entry Level 2	Entry Level 3
Specialist scientific language	Solar system Planet Volcano Earthquake	Cone Core Crater Crust Lava Telescope	Magma Magma chamber Mantle Radiation Weightlessness

Assessment of practical skills

The assessment of practical skills can be carried out over a number of different practicals that the students carry out throughout the year. This section of the *Teacher's guide* gives some examples of how students could achieve medium- and higher-level practical skills. The practicals given here as examples are taken from various units within the entry level specification.

For all practicals it is expected that the students will be given instructions by the teacher on what they need to do. The guidance referred to in the mark scheme is additional guidance that can be given by the teacher to the learners, while the learners complete the practical assessment.

Record sheet for the assessment of practical skills

	Marks	Total
Identifying/selecting equipment		
Cannot identify/select equipment, even with help	0	
Can identify/select equipment with help	1	
Can identify/select equipment without help	2	
Using equipment		
Cannot set up simple equipment, even with guidance	0	
Can set up simple equipment with guidance	1	
Can set up simple equipment without guidance	2	
Cannot set up several pieces of equipment, even with guidance	0	
Can set up several pieces of equipment with guidance	1	
Can set up several pieces of equipment without guidance	2	
Cannot adjust equipment even with guidance	0	
Can adjust equipment when necessary with guidance	1	
Can adjust equipment when necessary without guidance	2	
Following procedures		
Cannot follow procedures, even with help	0	
Can follow procedures involving one stage with help	1	
Can follow procedures involving one stage without help	2	
Can follow procedures involving more than one stage with help	3	
Can follow procedures involving more than one stage without help	4	
Data collection		
Cannot make simple readings/observations/measurements, even with help	0	
Can make simple readings/observations/measurements with help	1	
Can make simple readings/observations/measurements without help	2	
Readings/observations/measurements are normally accurate	1	
Can identify erroneous readings/observations/measurements and retake the readings/observations/measurements	1	
Can identify a minimum number of readings/observations/measurements required to be able to reach a satisfactory conclusion	1	
Presentation of results		
Cannot complete a given table of results, even with help	0	
Can complete a table of results with help	1	
Can complete a table of results without help	2	
Working responsibly		
Works safely to avoid accidents and health risks	1	
Total:	**20 (max)**	

This sheet can also be found on page 112 of the Entry Level specification.

1 Identifying/selecting equipment

Identifying/selecting equipment		
Cannot identify/select equipment, even with help	0	
Can identify/select equipment with help	1	
Can identify/select equipment without help	2	

Practical carried out: Investigating series and parallel circuits, varying the number of bulbs in the circuit and seeing what effect they have on the current flowing around the circuit.

For 1 mark: Students can choose the correct meter to measure the current, out of a choice of voltmeters and ammeters, when helped to remember the units for current (amps) by the teacher. The students can then match the symbol for amperes (A) to the symbol on the meter.

For 2 marks: Students can choose the correct meter, out of a selection of voltmeters and ammeters, and the rest of the equipment needed to set up both series and parallel circuits correctly.

2 Using equipment

Using equipment		
Cannot set up simple equipment, even with guidance	0	
Can set up simple equipment with guidance	1	
Can set up simple equipment without guidance	2	
Cannot set up several pieces of equipment, even with guidance	0	
Can set up several pieces of equipment with guidance	1	
Can set up several pieces of equipment without guidance	2	
Cannot adjust equipment even with guidance	0	
Can adjust equipment when necessary with guidance	1	
Can adjust equipment when necessary without guidance	2	

a Simple equipment

Cannot set up simple equipment, even with guidance	0	
Can set up simple equipment with guidance	1	
Can set up simple equipment without guidance	2	

Practical carried out: Heating metal and non-metal rods with pins stuck to one end with wax. The pin that falls off first shows which rod is the best conducting material. The pins should be pre-stuck to the rods.

For 1 mark: Students can balance the rods on the tripod, but they need help to position them correctly so that they are being heated in the same place as each other by the Bunsen burner. Students need to be reminded which flame to use on the Bunsen burner.

For 2 marks: Students can set up the rods correctly and can select the correct flame on the Bunsen burner.

b Several pieces of equipment

Cannot set up several pieces of equipment, even with guidance	0	
Can set up several pieces of equipment with guidance	1	
Can set up several pieces of equipment without guidance	2	

Practical carried out: Measuring the angle of incidence and reflection, using a plane mirror, a ray box with a single slit, a power supply and a protractor.

For 1 mark: Students can set up the mirror and ray box correctly, with the correct slit, but they need guidance on how to connect the ray box to the power supply. Students also need guidance on how to position the ray box relative to the mirror.

For 2 marks: Students can correctly set up the mirror, ray box, with a single slit, and power supply. They can also position the ray box correctly, relative to the mirror.

c Adjusting equipment

Cannot adjust equipment even with guidance	0	
Can adjust equipment when necessary with guidance	1	
Can adjust equipment when necessary without guidance	2	

Practical carried out: Investigating how light affects photosynthesis by varying how close a lamp is to a piece of pond weed in a test tube and counting the number of oxygen bubbles produced.

For 1 mark: Students have difficulty correctly repositioning the lamp at the different distances from the pond weed and need guidance to do so. Students may also need to be reminded to reset the stopwatch to time the experiment at each distance from the lamp.

For 2 marks: Students can correctly reposition the lamp and reset the stopwatch to accurately count the oxygen bubbles at each distance from the lamp.

3 Following procedures

Following procedures		
Cannot follow procedures, even with help	0	
Can follow procedures involving one stage with help	1	
Can follow procedures involving one stage without help	2	
Can follow procedures involving more than one stage with help	3	
Can follow procedures involving more than one stage without help	4	

Practical: Building a pinhole camera. This can be a simple one-stage practical, where a pinhole is punched through one sheet of paper and the image is formed on a second piece of paper (screen). Or this could be a multistage practical where a box is constructed and the pinhole and the screen are housed within the box, similar to a standard camera.

For 1 mark: Students punch the hole in the sheet of paper, but need guidance to use a second piece of paper as the screen.

For 2 marks: Students correctly produce a pinhole camera with two sheets of paper.

For 3 marks: Students construct the box part of the camera, but need guidance to fit the paper with the pinhole, and the screen, to the box.

For 4 marks: Students can correctly construct a box pinhole camera.

4 Data collection

Data collection		
Cannot make simple readings/observations/measurements, even with help	0	
Can make simple readings/observations/measurements with help	1	
Can make simple readings/observations/measurements without help	2	
Readings/observations/measurements are normally accurate	1	
Can identify erroneous readings/observations/measurements and retake the readings/observations/measurements	1	
Can identify a minimum number of readings/observations/measurements required to be able to reach a satisfactory conclusion	1	

Practical: An investigation into which brand of kitchen towel is the strongest. Testing a brand of kitchen towel by fixing three sheets' thickness of it to the top of a metal beaker (or a calorimeter beaker), with an elastic band. Wet the top of the towel with 3–5 ml of water, to simulate kitchen towel working conditions. Add masses to the top of the kitchen towel, in intervals, eg intervals of 50 g. Smaller masses, such as 10 g, could be used to make the experiment more precise. Measure the mass required to break the towel to see which brand is the strongest.

a Make simple readings/observations/measurements

Cannot make simple readings/observations/measurements, even with help	0	
Can make simple readings/observations/measurements with help	1	
Can make simple readings/observations/measurements without help	2	

For 1 mark: Students carry out the practical, but need guidance to add up the amount of mass used to break the towel.

For 2 marks: Students can add up the mass used to break the towel.

b Accuracy

Readings/observations/measurements are normally accurate	1	

For 1 mark: Students use smaller masses (eg 10 g) and can accurately add up the mass used in each experiment, for each brand of kitchen towel. The smaller masses used give a more precise experiment.

c Erroneous readings

Can identify erroneous readings/observations/measurements and retake the readings/observations/measurements	1	

For 1 mark: Students can identify any results that are not typical of the rest of the results. The students will then conduct these experiments again, the appropriate number of times, eg take the reading three times and calculate the average of these readings.

d Minimum number of readings

Can identify a minimum number of readings/observations/measurements required to be able to reach a satisfactory conclusion	1	

For 1 mark: Students decide to use at least four brands of kitchen towel in the experiment. They also decide how many times to carry out the experiment on each brand of kitchen towel, eg three times. These steps ensure that the students reach a satisfactory conclusion.

5 Presentation of results

Presentation of results		
Cannot complete a given table of results, even with help	0	
Can complete a table of results with help	1	
Can complete a table of results without help	2	

Practical: Measuring reaction times by asking fellow students to hold a ruler, at the bottom, and release it, then re-catch it as fast as possible. This should be timed and recorded, along with the distance the ruler travelled.

For 1 mark: Students can complete the results table when they receive guidance on how to construct it, with sections for time (s) and distance (cm).

For 2 marks: Students can complete the results table and use the correct sections for time (s) and distance (cm).

6 Working responsibly

Working responsibly		
Works safely to avoid accidents and health risks	1	

Practical: Making hydrogen and oxygen gas.

For 1 mark: Students carry out the practical safely, wearing safety goggles and being careful with the chemicals that are being used.

How Science Works

How Science Works is taken from the Key Stage 4 Science subject criteria section 3.6 and is a new requirement for all Key Stage 4 science specifications. It is primarily about helping students to engage with and challenge the science they meet in everyday life. Students need to adopt a critical, questioning frame of mind, going 'behind the scenes' to understand the workings of science and how it impacts on society and their lives.

It will help students to:

- identify questions that science can and cannot address and how scientists look for the answers
- evaluate scientific claims by judging the reliability and validity of the evidence appropriately
- consider scientific reports they see in the media and communicate their thoughts
- make informed judgements about science and technology, including any ethical issues that may arise.

How Science Works from Key Stage 4 Science subject criteria section 3.6

(i) data, evidence, theories and explanations

a the collection and analysis of scientific data

b the interpretation of data, using creative thought, to provide evidence for testing ideas and developing theories

c many phenomena can be explained by developing and using scientific theories, models and ideas

d there are some questions that science cannot currently answer, and some that science cannot address

(ii) practical and enquiry skills

a planning to test a scientific idea, answer a scientific question, or solve a scientific problem

b collecting data from primary or secondary sources, including the use of ICT sources and tools

c working accurately and safely, individually and with others, when collecting first-hand data

d evaluating methods of data collection, and considering their validity and reliability as evidence

(iii) communication skills

a recalling, analysing, interpreting, applying and questioning scientific information or ideas

b using both qualitative and quantitative approaches

c presenting information, developing an argument and drawing a conclusion, using scientific, technical and mathematical language, conventions and symbols and ICT tools

(iv) applications and implications of science

a the use of contemporary scientific and technological developments and their benefits, drawbacks and risks

b how and why decisions about science and technology are made, including those that raise ethical issues, and about the social, economic and environmental effects of such decisions

c how uncertainties in scientific knowledge and scientific ideas change over time and the role of the scientific community in validating these changes

The following tables give examples of how students at the three different levels within Entry Level could develop the skills needed to address the criteria within How Science Works.

How Science Works

(i) data, evidence, theories and explanations		
Entry Level 1	**Entry Level 2**	**Entry Level 3**
a the collection and analysis of scientific data		
Students need guidance to collect evidence from a practical, eg the mass needed to break different brands of kitchen towel, when wet.	Students can collect evidence from a practical.	Students can collect evidence from a practical and analyse it to draw valid conclusions, eg work out which brand of kitchen towel is the strongest when wet.
b the interpretation of data, using creative thought, to provide evidence for testing ideas and developing theories		
Use information on rusting to think about how we can prevent it from happening.	Use information about how we currently try to prevent rusting to think about how we could test which method is most effective.	Use information about how we currently try to prevent rusting to plan an experiment to see what is needed for rusting to occur (water and oxygen). Use this information to think of better methods of prevention.
c many phenomena can be explained by developing and using scientific theories, models and ideas		
Animals and plants are different as they have adapted to their environment.	Animals and plants have evolved to adapt better to their environment and increase their chances of survival.	Animals and plants have evolved and are continuing to evolve. Some are not surviving well as they have adapted to a specific environment that is now under threat, eg polar bears.
d there are some questions that science cannot currently answer, and some that science cannot address		
Science cannot yet answer what happened before the big bang.	Science cannot yet address whether clones will think the same way as each other.	Science cannot yet answer how intelligent animals are and it cannot address whether animal or human testing is right.

(ii) practical and enquiry skills		
Entry Level 1	**Entry Level 2**	**Entry Level 3**
a planning to test a scientific idea, answer a scientific question, or solve a scientific problem		
Compare how many daisy plants there are in a grassy and a paved area of the school.	Find out how the type of environment affects the number of daisy plants.	Find out what factors affect the number of daisy plants found around the school.
b collecting data from primary or secondary sources, including the use of ICT sources and tools		
Collect practical data in an experiment investigating how the amount of light affects the photosynthesis of pond weed.	Use a computer simulation of an experiment investigating how the amount of light affects the photosynthesis of pond weed and collect data.	Collect data from an experiment investigating how the amount of light affects the photosynthesis of pond weed, using data-logging equipment.
c working accurately and safely, individually and with others, when collecting first-hand data		
Work safely in simple practicals, in groups and individually.	Work safely and accurately in simple practicals, in groups and individually.	Work safely and accurately in more demanding practicals, in groups and individually.
d evaluating methods of data collection, and considering their validity and reliability as evidence		
Be able to recognise a measurement that is not following the trend of the rest of the results.	Be able to explain how the practical could be improved to give more reliable data, eg use more precise equipment.	Be able to suggest how to improve the practical to make the results collected more reliable and valid, eg use more precise equipment, repeat each reading three times and take the average, etc.

(iii) communication skills		
Entry Level 1	**Entry Level 2**	**Entry Level 3**
a recalling, analysing, interpreting, applying and questioning scientific information or ideas		
Recall facts about metals and non-metals and use these to explain why we use them in specific situations, eg wooden spoon when stirring hot baked beans.	Recall facts about metals and non-metals and use these to predict whether an unknown material is a metal or a non-metal.	Recall facts about metals and non-metals and use these to explain why some materials are difficult to classify into these groups.
b using both qualitative and quantitative approaches		
Use qualitative approaches with guidance, eg when carrying out a survey of differences in students, collecting information on eye colour.	Use qualitative and quantitative approaches with guidance, eg when carrying out a survey of differences in students, collecting information on length of feet and left or right handedness.	Use qualitative and quantitative approaches, eg when carrying out a survey of differences in students, collecting information on height and hair colour.
c presenting information, developing an argument and drawing a conclusion, using scientific, technical and mathematical language, conventions and symbols and ICT tools		
Record data in a simple table with guidance. Be able to put forward their own ideas, when given suggestions. Can use limited specialist vocabulary and mathematical language. Are able to input data into a simple spreadsheet.	Record data in simple tables or on simple graphs. Be able to give some explanation for the trends in the collected results. Can make some use of specialist vocabulary and mathematical language. Are able to input data into the correct parts of a spreadsheet, which contains existing formulae and performs calculations.	Record data in tables and graphs. Be able to explain what the collected results show. Can make use of a range of specialist vocabulary and mathematical language. Able to input data into the correct cells of a spreadsheet, which contains existing formulae and performs calculations. Can use these values to draw graphs in the spreadsheet.

(iv) applications and implications of science		
Entry Level 1	**Entry Level 2**	**Entry Level 3**
a the use of contemporary scientific and technological developments and their benefits, drawbacks and risks		
Why we use different materials for different purposes, eg using plastic for carrier bags as it is strong and flexible.	Why we use some materials for specific purposes and the drawbacks of these materials, eg using plastic for soft drinks bottles, as it is strong and can be shaped into a bottle easily however, it is not biodegradable.	Why we use some pesticides to produce more crops, to make more money. But they can be harmful to the environment and to us if we eat too much food containing these pesticides.
b how and why decisions about science and technology are made, including those that raise ethical issues, and about the social, economic and environmental effects of such decisions		
Why scientists decide to breed different types of animals, eg different types of cows for milk and for meat.	Why scientists are growing animals to produce organs for use in human transplant operations, eg pigs grown for their hearts. Discuss the issues involved with this.	Why scientists have decided to ban human cloning at the moment. What the issues are with this and whether it should be allowed in the future.
c how uncertainties in scientific knowledge and scientific ideas change over time and the role of the scientific community in validating these changes.		
People used to think that the Earth was at the centre of the Universe, but now we know that it is not true.	Observations of objects in space relative to the Earth demonstrate that the Earth is not at the centre of the Universe.	Scientists observe space and have determined that our galaxy is one of many similar galaxies, and their ideas are validated by other scientists making similar observations.

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