NECT

Grade 4 - 9

SCIENCE

TERM 1&2 2019

TRAINING HANDOUT

CONTENTS

TRAINING PROGRAMME

- Welcome to the Term 1 and 2 Training!
- Please go through this programme with your trainer to see which activities will be done.

	TIME	ACTIVITY	TRAINER WORKSHOP	TEACHER WORKSHOP
1	15 minutes	Welcome, housekeeping and updates		
2	30 minutes	Pre-test		
3	1 hour	Guidelines for facilitators and participants: Importance of Critical Outcomes/Cross Curricular skills		
4	30 minutes	Introductions, reflections and agenda		
5	1 hour	Orientation to lesson plans (including CAPS and the lesson plans) DBE Assessment guidelines		
6	1 hour	Content Development: Explaining and implementing the scientific method		
7	1 hour	Conceptual Activity 1: Food Webs		
8	1 hour	Conceptual Activity 2: Photosynthesis		
9	1 hour	Conceptual Activity 3: The Periodic Table		
10	1 hour	Reading for Meaning		
11	1 hour	Questioning at Different Levels		
12	1 hour	Lesson Demonstration: Briefing and Preparation		
13	2 hours	Lesson Demonstrations		
14	30 minutes	Orientation to the trainers guide		
15	30 minutes	Final questions and answers		
16	30 minutes	Training of teachers: planning session		
17	30 minutes	Post Test		
18	15 minutes	Closure and evaluation		

SECTION 1

1. CHAPTER 1 OF CAPS DOCUMENT: CRITICAL OUTCOMES

The following are the Critical Outcomes that underpin all teaching and learning in South Africa.

These are presented in the first chapter of the CAPS documents.

1. Identify and solve problems in which responses display that responsible decisions using critical and creative thinking have been made.

2. Work effectively with others as a member of a team, group, organisation, or community.

3. Organise and manage oneself and one's activities responsibly and effectively.

4. Collect, analyse, organise and critically evaluate information.

5. Communicate effectively using visual, mathematical and/or language skills in the modes of oral and / or written presentation.

6. Use science and technology effectively and critically, showing responsibility towards the environment and health of others.

7. Demonstrate an understanding of the world as a set of related systems by recognising that problem-solving contexts do not exist in isolation.

2. ORIENTATION TO THE LESSON PLANS

Lesson Plan Structure

1. The Term 1 lesson plans are structured to run for 9 weeks; and the Term 2 lesson plans are structured to run for 8 weeks.
2. The last weeks of the term are reserved for revision and examinations.
3. Each week, there are three lessons, of the following notional time:

   Intermediate Phase:

   - 1 x 1 hour 30 minutes
   - 2 x 1 hour

   Senior Phase

   - 3 x 1 hour

Lesson Plan Contents

1. The lesson plan starts with a **CONTENTS PAGE** that lists all the topics for the term, together with a breakdown of the lessons for that topic. You will notice that lessons are named by the week and lesson number, for example, Week 8 Lesson 8C.
2. Every topic begins with a 2 - 4 page **TOPIC OVERVIEW**. The topic overview pages are grey, making them easy to identify. The topic overview can be used to introduce the topic to learners. The topic overview includes:
   a. A ***general introduction*** to the topic that states how long the topic runs for, the value of the topic in the final exam and the number of lessons in the topic.
   b. A table showing the ***position of the topic*** in the term.
   c. A ***sequential table*** that shows the prior knowledge required for this topic, the current knowledge and skills that will be covered, and how this topic will be built on in future years. Use this table to give learners an informal quiz to test their prior knowledge. If learners are clearly lacking in the knowledge and skills required, you may need to take a lesson to cover some of the essential content and skills. It is also useful to see what you are preparing learners for next, by closely examining the 'looking forward' column.
   d. A glossary of ***scientific and technological vocabulary***, together with an explanation of each word or phrase. It is a good idea to display these words and their definitions somewhere in the classroom, for the duration of the topic. It is also a good idea to allow learners some time to copy down these words into their personal dictionaries or science

exercise books. You must explicitly teach the words and their meanings as and when you encounter these words in the topic. A good way to teach learners new vocabulary is to use '**PATS**':

- POINT – if the word is a noun, point at the object or at a picture of the object as you say the word.
- ACT – if the word is a verb, try to act out or gesture to explain the meaning of the word, as you say it.
- TELL – if the word has a more abstract meaning, then tell the learners the meaning of the word. You may need to code switch at this point, but also try to provide a simple English explanation.
- SAY – say the word in a sentence to reinforce the meaning.

e. ***Understanding the uses / value of science.*** It is very important to give learners a sense of how science applies to their daily lives, and of the value that science adds to their lives. Hold a brief discussion on this point when introducing the topic, and invite learners to elaborate on the uses and value that this topic will have to their lives.

f. ***Personal reflection.*** At the end of every topic, come back to the topic overview, and complete this table. In particular, it is important to note your challenges and ideas for future improvement, so that you can improve your teaching the next year.

3. After the topic overview, you will find the **INDIVIDUAL LESSONS.** Every lesson is structured in exactly the same way. This helps you and the learners to anticipate what is coming next, so that you can focus on the content and skills. Together with the title, each lesson plan includes the following:

a. ***Policy and Outcomes.*** This provides you with the CAPS reference, and an overview of the skills that will be covered in the lesson. You can immediately see the science process skills that will be covered, and whether they are lower or higher order skills.

b. ***Possible Resources.*** Here, you will see the resources that you should ideally have for the lesson. If you need to use the poster or pages from the resource pack, this will be listed here. There is also a space for improvised resources, and you are invited to add your own ideas here.

c. ***Classroom Management.*** Every lesson starts in the same way. Before the lesson, you must write a question that relates to the previous lesson on the chalkboard. Train your learners to come in to the classroom, to take out their exercise books, and to immediately try to answer this question. This links your lesson to the previous lesson, and it effectively settles your learners.

Once learners have had a few minutes to answer, read the question and discuss the answer. You may want to offer a small reward to the learner who answers first, or best. Get your learners used to this routine.

Next, make sure that you are ready to begin your lesson, have all your resources ready, have notes written up on the chalkboard, and be fully prepared to start. Remember, learners will get restless and misbehave if you do not keep them busy and focussed.

d. ***Accessing Information***. This section contains the key content that you need to share with learners. Generally, it involves sharing some new information that is written on the chalkboard, explaining this information, and allowing learners some time to copy the information into their exercise books. Train learners to do this quickly and efficiently. Learners must anticipate this part of the lesson, and must have their books, pens, pencils and rulers ready. Explain to learners that this is an important resource for them, because these are the notes they will revise when preparing for tests and exams.

   Checkpoint 1. Straight after 'Accessing Information', you will find two checkpoint questions. These questions help you to check that learners understand the new content thus far.

e. ***Conceptual Development***. At this point, learners will have to complete an activity to think about and apply their new knowledge, or to learn a new skill. This is the most challenging part of the lesson. Make sure that you fully understand what is required, and give learners clear instructions.

   Checkpoint 2. Straight after 'Conceptual Development, you will find two checkpoint questions. These questions help you to check that learners understand the new concepts and skills that they have engaged with.

f. ***Reference Points for Further Development***. This is a useful table that lists the relevant sections in each approved textbook. You may choose to do a textbook activity with learners in addition to the lesson plan activity, or even in place of the lesson plan activity. You may also want to give learners an additional activity to do for homework.

g. ***Additional Activities / Reading***. This is the final section of the lesson plan. This section provides you with web links related to the topic. Try to get into the habit of visiting these links as part of your lesson preparation. As a teacher, it is always a good idea to be more informed than your learners.

4. At the end of the week, make sure that you turn to the **TRACKER,** and make note of your progress. This helps you to monitor your pacing and curriculum coverage. If you fall behind, make a plan to catch up.
5. **POSTER AND RESOURCE PACK.** You will have seen that the *Possible Resource* section in the lesson plan will let you know which poster or reference pages you will need to use in a lesson.

   Please note that you will only be given these resources once. It is important for you to manage and store these resources properly. Do this by:

   - Writing your name on all resources
   - Sticking resource pages onto cardboard or paper
   - Laminating all resources, or covering them in contact paper
   - Filing the resource papers in plastic sleeves once you have completed a topic

   Have a dedicated wall or notice board in your classroom for Natural Science and Technology.

   - Use this space to display the resources for the topic
   - Display the vocabulary words and meaning here, as well as the resources
   - Try to make this an attractive and interesting space
   - Display learners' work on this wall – this gives learners a sense of ownership and pride
6. **ASSESSMENT.** At the end of the lesson plans, you will find the CAPS assessment requirements for the term. You should refer to your prescribed textbooks and departmental resources for examples of the relevant assessments.

SECTION 2

3. LESSON PLAN ROUTINE

Lesson Plan Routine

Train your learners to know and anticipate the routine of Natural Science and Technology lessons. You will soon see that a good knowledge of this routine will improve time-on-task and general classroom discipline and that you will manage to work at a quicker pace.

Remember, every Natural Science and Technology; and Science lesson follows this routine:

1. **Classroom Management**: settle learners by having two questions written on the chalkboard. Learners take out their exercise books and pens, and immediately answer the questions. Discuss the answers to the questions, and reward the successful learner.

2. **Accessing Information:** have key information written on the chalkboard. Explain this to learners. Allow learners to copy this information into their books.

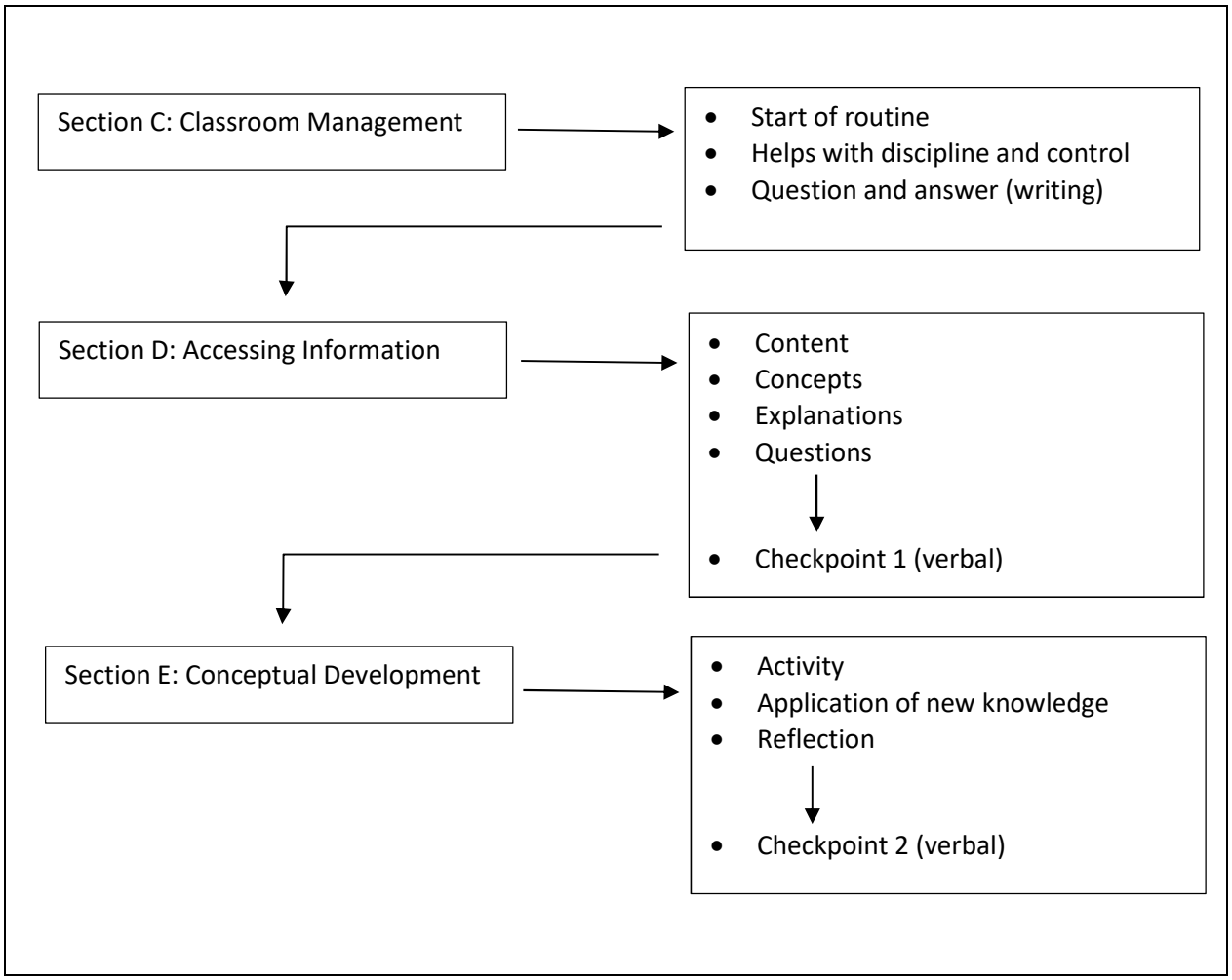
3. **Checkpoint 1:** ask learners two questions to check their understanding.

4. **Conceptual Development:** complete an activity to apply new knowledge or skills.

5. **Checkpoint 2:** ask learners two questions to check their understanding.

6. **Reference Points for Further Development:** links to textbook activities – you may choose to use these activities as additional classwork activities, or as homework activities.

7. **Tracker:** fill in your tracker at the end of the week to track your progress


Section C: Classroom Management
Start of routine
Helps with discipline and control
Question and answer (writing)
Section D: Accessing Information
Content
Concepts
Explanations
Questions
Checkpoint 1 (verbal)
Section E: Conceptual Development
Activity
Application of new knowledge
Reflection
Checkpoint 2 (verbal)

SECTION 3

4. THE LESSON PLANS AND POLICY

A vehicle to implement CAPS

Teaching Natural Sciences and Technology can be exciting and rewarding. These lesson plans have been designed to guide you to implement the CAPS policy in a way that makes the teaching and learning experience rewarding for both the teacher and the learners.

To support the policy's fundamentals of teaching Natural Sciences and Technology (Grade 4 – 6) and Science (Grade 7 – 9), these lesson plans use the CAPS content as a basis and:

- provide a variety of teaching techniques and approaches
- promote enjoyment and curiosity
- highlight the relationship between Natural Science and Technology and other subjects
- where appropriate, draw on and emphasise cultural contexts and indigenous knowledge systems
- show the relationship between science, learners, their societies and their environments
- aim to prepare learners for economic activity and self-expression

Content and Time Allocation

These lessons plans have been developed to comply with CAPS in respect of both content and time allocation. In developing these lesson plans, we took into consideration the realities of teachers and to this end, we made some simple adjustments, without deviating from policy, to make the teaching of these lesson plans more achievable. The kinds of adjustments made include using some of the practical tasks in the lesson plans for assessment purposes; and building in time for revision and exams during terms 2 and 4.

CAPS assigns one knowledge strand to form the basis of content in each term. These strands are as follows:

- Term 1: ***Life and Living***
- Term 2: ***Matter and Materials***
- Term 3: ***Energy and Change***
- Term 4: ***Planet Earth and Beyond***

In most terms (for Grades 4 – 6), there are Technology knowledge strands that complement the Natural Sciences strands. There are three Technology strands, they are:

- ***Structures***
- ***Systems and Control***
- ***Processing***

The distribution of these strands across the year is summarised in the tables below:

Grade 4							
Term 1		**Term 2**		**Term 3**		**Term 4**	
Strands NS & Tech		**Strands NS & Tech**		**Strands NS & Tech**		**Strands NS & Tech**	
Life and Living	**Structures**	**Matter and Materials**	**Structures**	**Energy and Change**	**Systems and Control**	**Planet Earth and Beyond**	**Systems and Control**
Living and non-living things Structures of plants and animals What plants need to grow Habitats of animals	Structures for animal shelters	Materials around us Solid materials	Strengthening materials Strong frame structures	Energy and Energy transfer Energy around us Energy and sound	Movement energy in a system	Planet Earth The Sun The Earth & the Sun The Moon	Rocket Systems

Grade 5							
Term 1		**Term 2**		**Term 3**		**Term 4**	
Strands NS & Tech		**Strands NS & Tech**		**Strands NS & Tech**		**Strands NS & Tech**	
Life and Living	**Structures**	**Matter and Materials**	**Processing**	**Energy and Change**	**Systems and Control**	**Planet Earth and Beyond**	**Systems and Control**
Plants and animals on Earth Animal Skeletons Food Chains Life cycles	Skeletons and structures	Metals and non-metals Uses of metals	Processing materials Processed materials	Stored energy in fuels Energy and electricity Energy and movement	Systems for moving things	Planet Earth Surface of the Earth Sedimentary Rocks Fossils	-

Grade 6							
Term 1		**Term 2**		**Term 3**		**Term 4**	
Strands NS & Tech		**Strands NS & Tech**		**Strands NS & Tech**		**Strands NS & Tech**	
Life and Living	**Processing**	**Matter and Materials**	**Processing**	**Energy and Change**	**Systems and Control**	**Planet Earth and Beyond**	**Systems and Control**
Photosynthesis Nutrients in Food Nutrition Eco Systems and food webs	Food Processing	Solids, liquids and gases Mixtures Solutions as special mixtures Mixtures and water resources	Processes to purify water	Electric circuits Electrical conductors and insulators Mains electricity	Systems to solve problems	The solar system Movements of the earth and planets The movement of the Moon	Systems looking into space Systems to explore the Moon and Mars

Grade 7			
Term 1	**Term 2**	**Term 3**	**Term 4**
NS Strand	**NS Strand**	**NS Strand**	**NS Strand**
Life and Living	**Matter and Materials**	**Energy and Change**	**Planet Earth and Beyond**
The biosphere Biodiversity Sexual Reproduction Variation	Properties of materials Separating mixtures Acids, bases and neutrals Introduction to the periodic table of the elements	Sources of energy Potential and Kinetic energy Heat transfer Insulation and energy saving Energy transfer to surroundings The national electricity supply system	Relationship of the Sun and the Earth Relationship of the Moon and the Earth Historical development of astronomy

Grade 8			
Term 1	**Term 2**	**Term 3**	**Term 4**
NS Strand	**NS Strand**	**NS Strand**	**NS Strand**
Life and Living	**Matter and Materials**	**Energy and Change**	**Planet Earth and Beyond**
Photosynthesis and respiration Interactions and interdependence within the environment Micro-organisms	Atoms Particle model of matter Chemical reactions	Static electricity Energy transfer in electrical systems Series and parallel circuits Visible light	The Solar System Beyond the Solar System Looking into space

Grade 9			
Term 1	**Term 2**	**Term 3**	**Term 4**
NS Strand	**NS Strand**	**NS Strand**	**NS Strand**
Life and Living	**Matter and Materials**	**Energy and Change**	**Planet Earth and Beyond**
Cells as the basic units of life Systems in the human body Human Reproduction Circulatory and respiratory systems Digestive system	Compounds Chemical reactions Reactions of metals with oxygen Reactions of non-metals with oxygen Acids, bases and pH value Reactions of acids with bases Reactions of acids with metals	Forces Electric cells as energy systems Resistance Series and parallel circuits Safety with electricity Energy and the national electricity grid Cost of electrical power	The Earth as a system Mining of mineral resources Atmosphere Birth, life and death of stars

These lesson plans have been designed against the stipulated CAPS requirements with topics being allocated for the time prescribed by CAPS. (Remember that some slight changes have been incorporated to accommodate time for revision, tests and examinations).

The time allocation by topic is summarised in the table below.

- In the Intermediate Phase, one week equates to 3,5 hours or three lessons: two lessons of 1 hour each; and one lesson of 1½ hours
- In the Senior Phase, one week equates to 3 hours or three lessons: three lessons of 1 hour each.

	GRADE 4		GRADE 5		GRADE 6	
TERM	**Topic**	**Time in weeks**	**Topic**	**Time in weeks**	**Topic**	**Time in weeks**
Term 1: Life and Living	• Living and non-living things • Structures of plants and animals • What plants need to grow • Habitats of animals • Structures for animal shelters	2 2½ 1 1 2½ (10 wks)	• Plants and animals on Earth • Animal Skeletons • Food Chains • Life cycles • Skeletons and Structures	2½ 1½ 2½ 1½ 2 (10 wks)	• Photosynthesis • Nutrients in Food • Nutrition • Food Processing • Eco Systems and food webs	2½ 1½ 1½ 2½ 2 (10 wks)
Term 2: Matter and Materials	• Materials around us • Solid materials • Strengthening materials • Strong frame structures	3½ 2 2 2½ (10 wks)	• Metals and non-metals • Uses of metals • Processing materials • Processed materials	2 2½ 3½ 2 (10 wks)	• Solids, liquids and gases • Mixtures • Solutions as special mixtures • Dissolving • Mixtures and water resources • Processes to purify water	½ 1 2½ 1 2½ 2½ (10 wks)
Term 3: Energy and Change	• Energy and Energy transfer • Energy around us • Movement energy in a system • Energy and sound	2½ 2½ 2½ 2½ (10 wks)	• Stored energy in fuels • Energy and electricity • Energy and movement • Systems for moving things	3 3 1 3 (10 wks)	• Electric circuits • Electrical conductors and insulators • Systems to solve problems • Mains electricity	2½ 2 2½ 3 (10 wks)
Term 4: Planet Earth and Beyond	• Planet Earth • The Sun • The Earth & the Sun • The Moon • Rocket Systems	2 1 1 2 2 (8 wks)	• Planet Earth • Surface of the Earth • Sedimentary Rocks • Fossils	1 2½ 2 2½ (8 wks)	• The solar system • Movements of the earth and planets • The movement of the Moon • Systems looking into space • Systems to explore the Moon and Mars	2½ 1 1 1 2½ (8 wks)
TOTALS	38 weeks		38 weeks		38 weeks	

	GRADE 7		GRADE 8		GRADE 9	
TERM	**Topic**	**Time in weeks**	**Topic**	**Time in weeks**	**Topic**	**Time in weeks**
Term 1: Life and Living	• The biosphere • Biodiversity • Sexual Reproduction • Variation	1 3½ 3½ 1 (9 wks)	• Photosynthesis and respiration • Interactions and interdependence within the environment • Micro-organisms	2 5 2 (9 wks)	• Cells as the basic units of life • Systems in the human body • Human Reproduction • Circulatory and respiratory systems • Digestive system	2 2 2 1½ 1½ (9 wks)
Term 2: Matter and Materials	• Properties of materials • Separating mixtures • Acids, bases and neutrals • Introduction to the periodic table of the elements	2 2 2 2 (8 wks)	• Atoms • Particle model of matter • Chemical reactions	2 5 1 (8 wks)	• Compounds • Chemical reactions • Reactions of metals with oxygen • Reactions of non-metals with oxygen • Acids, bases and pH value • Reactions of acids with bases (I) • Reactions of acids with bases (II) • Reactions of acids with bases (III) • Reactions of acids with metals	1 1 1½ 1 1 ½ 1 ½ 1 (8 wks)
Term 3: Energy and Change	• Sources of energy • Potential and Kinetic energy • Heat transfer • Insulation and energy saving • Energy transfer to surroundings • The national electricity supply system	1 2 2 2 1 1 (9 wks)	• Static electricity • Energy transfer in electrical systems • Series and parallel circuits • Visible light	1 3 2 3 (9 wks)	• Forces • Electric cells as energy systems • Resistance • Series and parallel circuits • Safety with electricity • Energy and the national electricity grid • Cost of electrical power	2 ½ 1 2 ½ 1 2 (9 wks)
Term 4: Planet Earth and Beyond	• Relationship of the Sun and the Earth • Relationship of the Moon and the Earth • Historical development of astronomy	4 2 2 (8 wks)	• The Solar System • Beyond the Solar System • Looking into space	3 3 2 (8 wks)	• The Earth as a system • The Lithosphere • Mining of mineral resources • Atmosphere • Birth, life and death of stars	1 2 2 2 1 (8 wks)
TOTALS	34 weeks		34 weeks		34 weeks	

CAPS Assessment

Assessment is a continuous planned process that involves identifying, gathering, interpreting and diagnosing information about the performance of learners.

Assessment involves generating and collecting evidence of learner achievement and progress, and using this information to understand and provide assistance to the learner during the process of teaching and learning. Assessment should be both *formal* and *informal*:

a. ***Informal Assessment*** involves regular checking of learners' class work and practical tasks; asking questions; discussions; informal classroom interactions; and giving constructive feedback. Informal assessment marks do not need to be recorded, but the teacher can make notes for future reference.

b. ***Formal Assessment*** provides teachers with a systematic way of evaluating how well learners are progressing. Formal Assessment consists of selected assessment tasks. These tasks are stipulated by CAPS and the marks need to be recorded. These tasks are done throughout the year, and include practical tasks, tests and examinations.

1. Tests and Examinations

Examinations must include questions on both Natural Sciences and Technology. The weighting of the marks should reflect the time allocated to each section in the curriculum content. Tests and exams should consist of a range of questions that cover different cognitive levels: recall; understanding; application; evaluation; analysis; and synthesis. CAPS aligned tests and examinations, with accompanying memoranda, are provided with these lesson plans.

2. Practical Tasks

Practical tasks give learners the opportunity to demonstrate knowledge, skills and understanding. Practical tasks form part of the activities included in these lesson plans. Each term, one practical task has been selected for assessment. A rubric is provided to conduct the assessment.

A minimum mark allocation is prescribed in CAPS for tests, practical tasks and examinations for each grade. These are summarised, by grade, in the tables below:

SECTION 4

4. EXPLAINING THE SCIENTIFIC METHOD

From: https://scienceexplorers.com/teaching-scientific-method-kids/

Think Like a Scientist: Teaching the Scientific Method to Learners

If we want to teach learners to think like a scientist, we must teach them the scientific method. While that may seem easy on the surface, introducing the scientific method for learners in a way that will make the scientific method stick in their minds is often challenging.

Merriam-Webster defines the scientific method as follows:

"Principles and procedures for the systematic pursuit of knowledge involving the recognition and formulation of a problem, the collection of data through observation and experiment, and the formulation and testing of hypotheses."

While that may make sense to scientists and many adults, some learners may be confused by the definition, or they may not be able to recall all of the steps involved in the scientific method. Although some learners may be a bit overwhelmed by the scientific method, they still have to learn what it is and how it can be applied in scientific settings as well as the real world.

It is very important for learners to have a practical knowledge of the scientific method because it is the foundation of all scientific discoveries and science classes. It's also the standard for how professional scientists conduct their research and resolve problems. Just as importantly, the scientific method enables learners to solve problems on their own and understand their surroundings better.

Teaching the Scientific Method

One of the easiest ways you can do to help learners remember the scientific method is to make a visual that breaks it down into a series of steps that are easy to recall. Here are the steps that make up the scientific method, expressed in basic terms, that learners should be able to understand:

Steps in the Scientific Method

1. **Question or Problem**: The question that needs to be answered or a problem that has to be solved.
2. **Hypothesis**: The best guess for how your question will be answered or your problem will be solved.
3. **Materials**: List the materials you will need to complete the experiment or investigation
4. **Experiment or Investigation**: The test of your hypothesis. Observing and collecting evidence in an attempt to answer your question or investigate the problem identified in the first step.
5. **Results**: The analysis or evaluation of the information you recorded during your experiment or investigation.
6. **Conclusion**: Your final response to step 1. What is the answer to your question or the resolution for your problem?

While breaking the methodology into individual steps makes it easier for learners to remember, it may not be enough for some learners to remember the scientific method. If that is the case, you may have to take things a bit further. One of the easy ways to teach the scientific method is to use a mnemonic trick to make the steps easy to recall.

Try making a sentence out of words that begin with the letters representing each step in the scientific method. It's okay if your sentence is silly or lacks real sense. In fact, that might make it even easier for kids to remember.

Here's an example of a sentence you may want to use:

Queenie **H**as **M**any **E**lephants **R**unning **C**arefully.

THE SCIENTIFIC METHOD: WORKSHEET

The Scientific Method

There are six steps in the scientific method. Use the scientific method to review the steps and fill in the names in the first column. In the second column, explain what each step means. Use the last column to organize your own experiment.

STEPS	**What do you do at this step? Why do you do it?**	**Example of this step** (You can use this to review an experiment or plan your own!)
1.		
2.		
3.		
4.		
5.		
6.		

SECTION 5

5. FOOD CHAINS AND WEBS

BACKGROUND

Every living plant and animal must have energy to survive. Plants rely on the soil, water, and the sun for energy. Animals rely on plants as well as other animals for energy.

In an ecosystem, plants and animals all rely on each other to live. Scientists sometimes describe this dependence using a food chain or a food web.

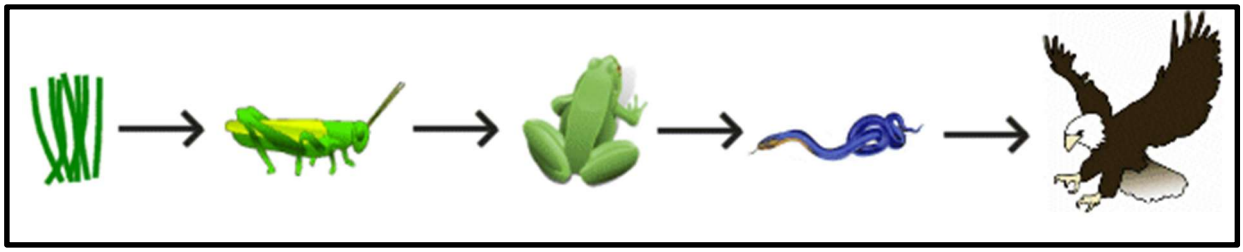
Food Chain

A food chain describes how different organisms eat each other, starting out with a plant and ending with an animal. For example, you could write the food chain for a lion like this:

grass ---> zebra ---> lion

The lion eats the zebra, which eats the grass.

Here is another example in picture form:



The grasshopper eats grass, the frog eats the grasshopper, the snake eats the frog, and the eagle eats the snake.

Links of the Chain

There are names to help describe each link of the food chain. The names depend mostly on what the organism eats and how it contributes to the energy of the ecosystem.

- Producers - Plants are producers. This is because they produce energy for the ecosystem. They do this because they absorb energy from sunlight through photosynthesis. They also need water and nutrients from the soil, but plants are the only place where new energy is made.

- Consumers - Animals are consumers. This is because they don't produce energy, they just use it up. Animals that eat plants are called primary consumers or herbivores. Animals that eat other animals are called secondary consumers or carnivores. If a carnivore eats another carnivore, it is called a tertiary consumer. Some animals play both roles, eating both plants and animals. They are called omnivores.
- Decomposers - Decomposers eat decaying matter (like dead plants and animals). They help put nutrients back into the soil for plants to eat. Examples of decomposers are worms, bacteria, and fungi.

Let's look at this example again:

grass ---> zebra ---> lion

- grass = producer
- zebra = primary consumer
- lion = secondary consumer

Energy is Lost

All the energy made in the food chain comes from the producers, or plants. They convert sunlight into energy through photosynthesis. The rest of the food chain just uses energy. So as you move through the food chain there is less and less energy available. For this reason, there are less and less organisms the further along the food chain you go.

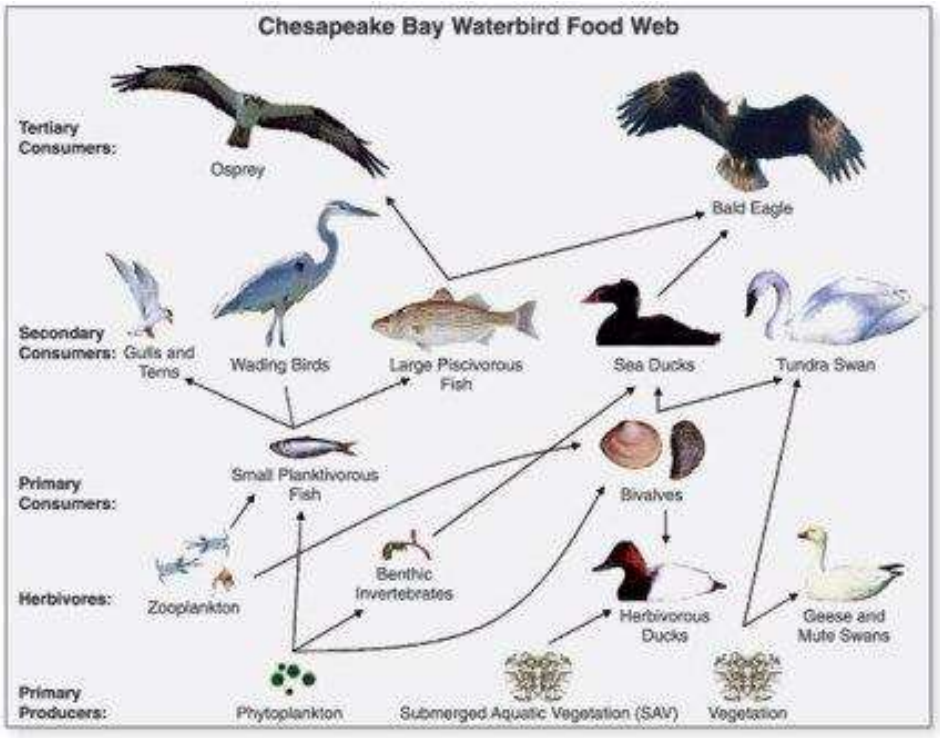
In our example above, there is more grass than zebras, and more zebras than lions. The zebras and lions use up energy by running, hunting, and breathing.

Each Link is Important

Links higher up in the food chain rely on the lower links. Even though lions don't eat grass, they wouldn't last long if there wasn't any grass because then the zebras wouldn't have anything to eat.

Food Web

In any ecosystem there are many food chains and, generally, most plants and animals are part of several chains. When you draw all the chains together you end up with a food web.



Example of a food web

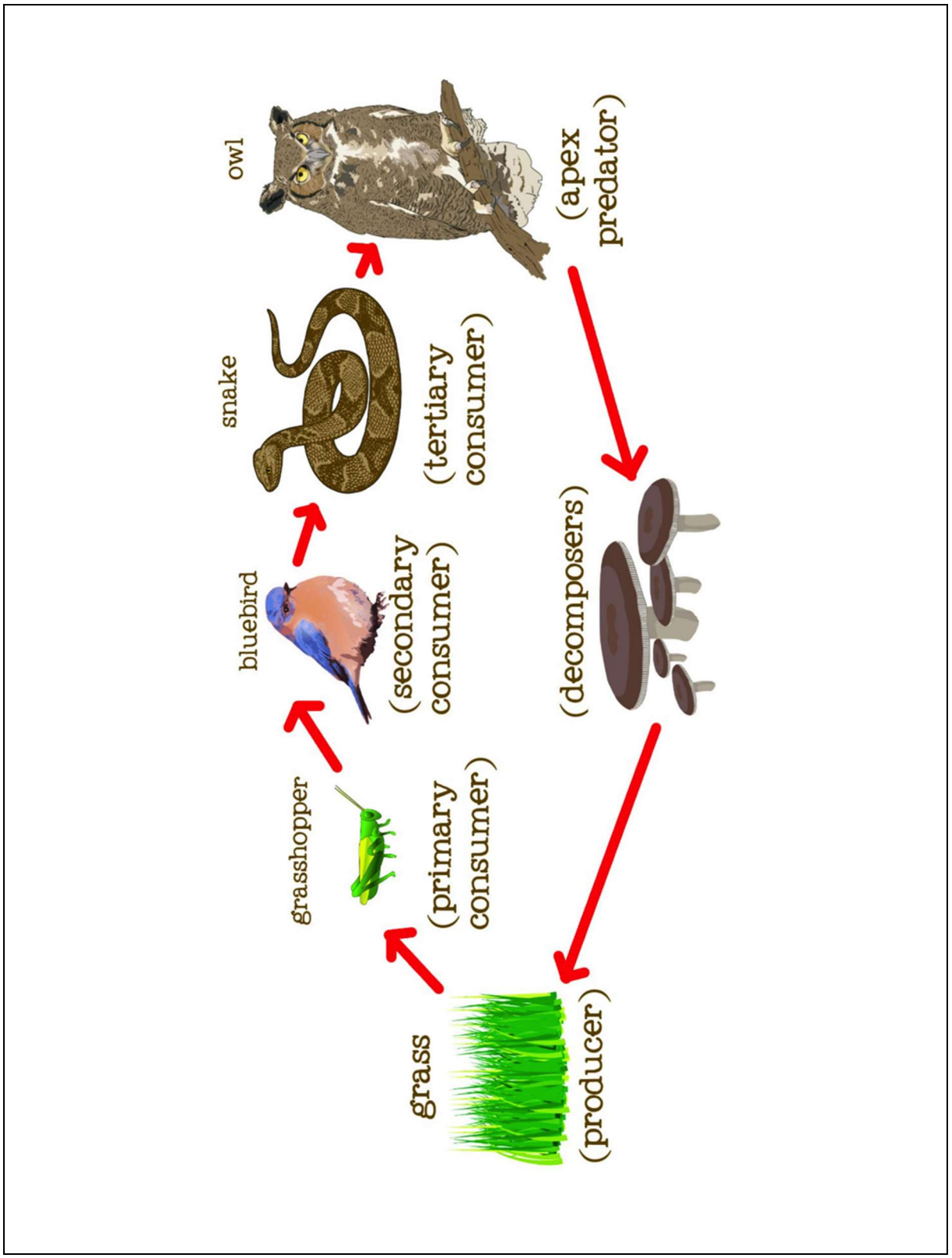
Levels

Sometimes scientists describe each level in a food. Here are the five levels:

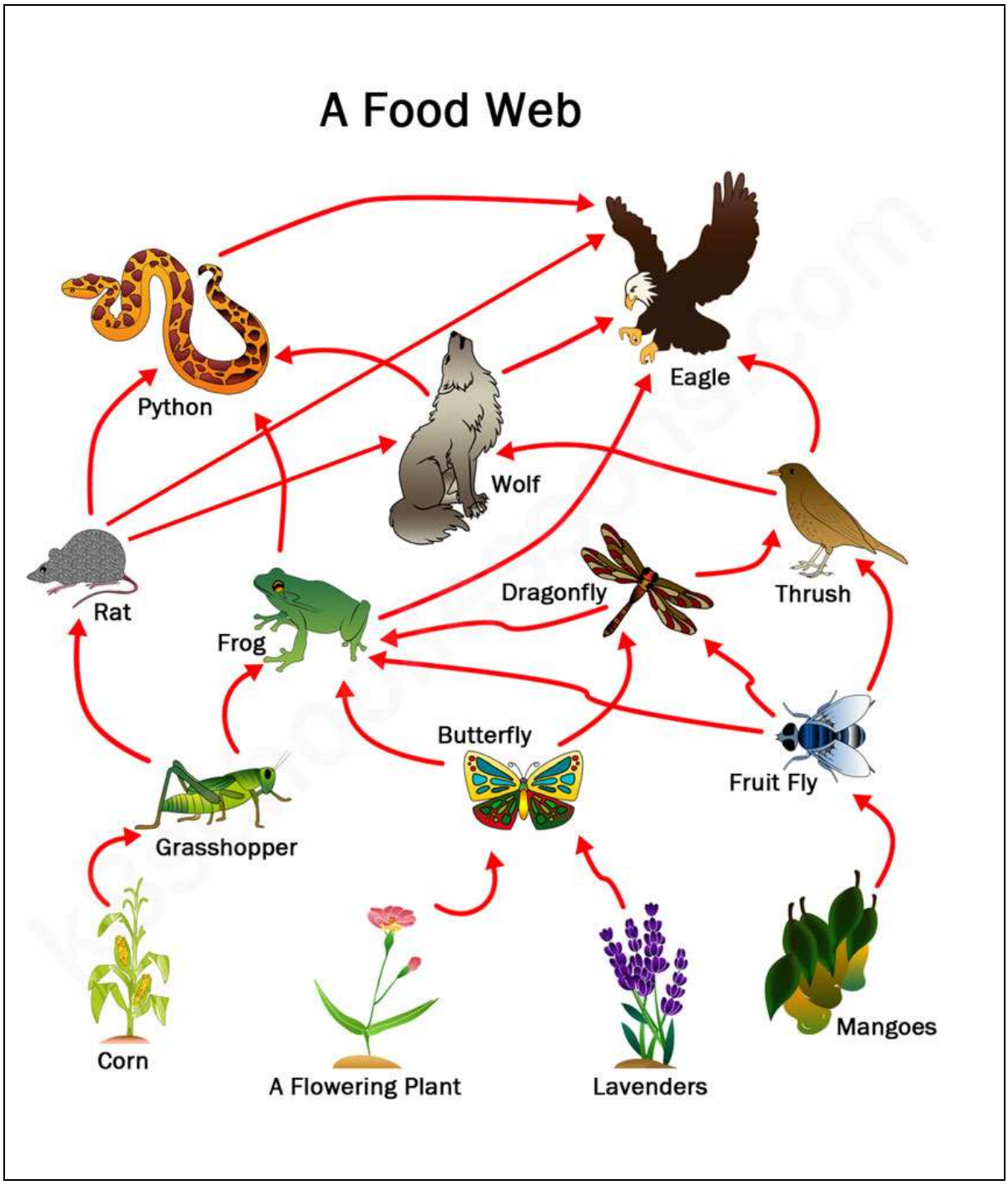
- Level 1: Plants (producers)
- Level 2: Animals that eat plants or herbivores (primary consumers)
- Level 3: Animals that eat herbivores (secondary consumers, carnivores)
- Level 4: Animals that eat carnivores (tertiary consumers, carnivores)
- Level 5: Animals at the top of the food chain are called apex predators. Nothing eats these animals.

FOOD CHAIN AND FOOD WEB ACTIVITY

FOOD CHAIN:



FOOD WEB:


A Food Web
Python
Eagle
Wolf
Rat
Frog
Dragonfly
Thrush
Butterfly
Fruit Fly
Grasshopper
Corn
A Flowering Plant
Lavenders
Mangoes

FOOD CHAIN AND FOOD WEB WORKSHEET

Worksheet

1. Using the food chain and the food web complete the table below:

Producer	Primary Consumer	Secondary Consumer	Tertiary Consumer	Apex (predator)

2. Using the food web. Draw two simple food chains:

SECTION 6

6. PHOTOSYNTHESIS

PHOTOSYNTHESIS BACKGROUND

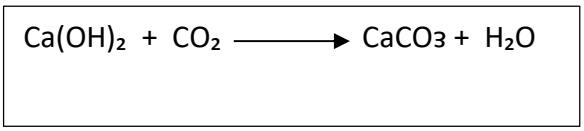
Photosynthesis

Photosynthesis begins with exposure to the sun's rays. Without the sun's rays, there would be no green plants, since the sun is an essential part of photosynthesis. Exposure to the sun's rays allows the chemical processes that drive plant food production to occur.

Absorbing the sun's rays is the function of chlorophyll, which can be found in the leaf's chloroplasts, which are small organelles in the leaves of plants. In turn, the chloroplasts, are responsible for taking in the energy from the sun and converting it to sugar that can be used as plant food.

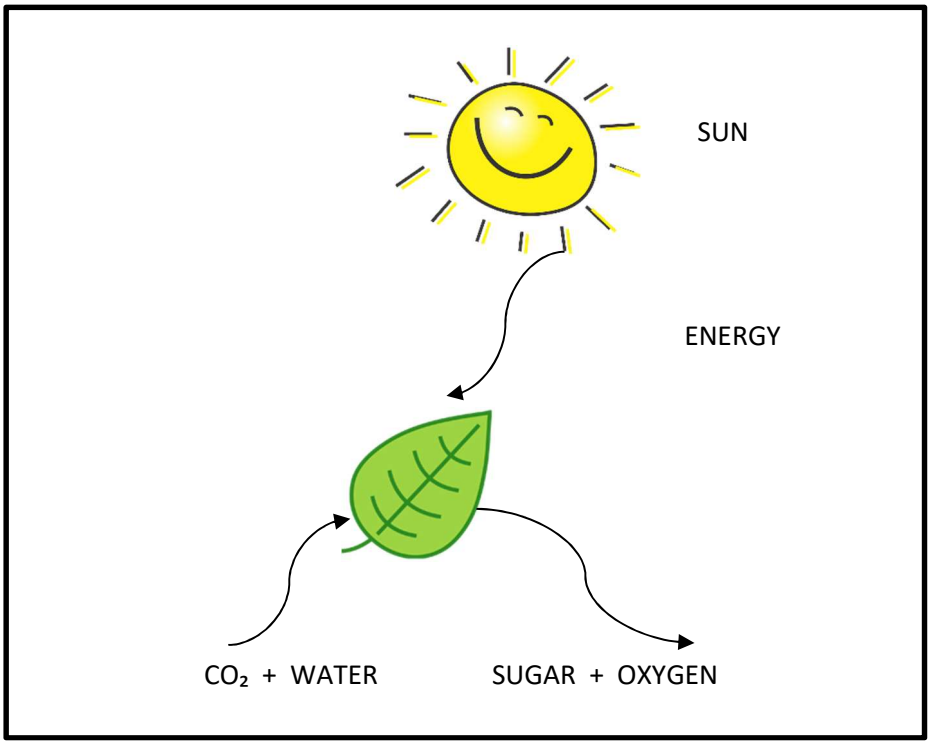
Water that has been absorbed through the root system travels through the plant and to the leaves. Chloroplasts destroy the integrity of the water molecule by splitting it into hydrogen and oxygen. Once these two atoms are free, hydrogen can be accessed to combine with carbon and produce sugar or plant food.

Sugar is transported throughout the plant by special transport cells called phloem. The phloem provides the sugar to the leaves and entire stem so that the energy, stored in the sugar can be used. The oxygen remaining from the split water molecule is released into the atmosphere. The release of oxygen, as a by-product of photosynthesis, helps provide other plants and animals with a renewable oxygen source. That is why the air is cleaner in rural areas, compared to urban areas.



Photosynthesis is the process by which plants make food.

Raw materials of photosynthesis are water and carbon dioxide. They combine in sunlight in the green parts of plants (leaves) to produce sugar and oxygen.



$6H_2O + 6CO_2 \longrightarrow CH12O6 + 6O_2$

PHOTOSYNTHESIS PRACTICAL

Equipment from the practical resource pack:

2 x glass bottles with lids	Plastic straws
Lime water	20ml syringe
2 plastic cups	4 green leaves

Check: Participants know that when we breathe in air (inhale), our body uses the oxygen to keep us alive and when we blow out the air (exhale), we blow out carbon dioxide.

Activity 1: Testing the presence of CO_2 with lime water

a. Put 15ml of lime water into each of two glass bottles.

b. Take 1st glass bottle and blow air into it through a straw. Close the lid quickly and tightly.

c. Take the 2nd glass bottle and close the lid tightly, without blowing into it.

d. Observe the colour of the lime water in each bottle.

1st bottle: milky
2nd bottle: clear

Conclusion: _____

_____

_____

_____

_____

_____

Activity 2: Testing if Carbon Dioxide is used in photosynthesis

a. Take 1st glass bottle and blow air into it through a straw for 30 secs. Close the lid quickly and tightly.
b. Take the 2nd glass bottle and blow air into it through a straw for 10 secs. Add about 4 or 5 green leaves. Blow air into the bottle again for about 30 secs. Close the lid quickly and tightly.
c. Place both bottles in sunlight for 1 hour.
d. After 1 hour, insert about 15ml of lime water into both bottles in turn. Close each lid quickly and shake the bottles.
e. Observe the colour of the lime water in each bottle.
   Bottle with leaves: clear
   Bottle with air: milky
f. Pour the lime water out of each bottle into a clear plastic cup to observe the colour clearly.

Conclusion: _____

_____

_____

_____

_____

_____

Note - *Lime water*

Lime water is the common name for saturated calcium hydroxide solution. The chemical formula is $Ca(OH)_2$.

Lime water is a clear solution and is used to detect carbon dioxide as lime water reacts with carbon dioxide to produce a precipitate of calcium carbonate. The lime water becomes milky because of the calcium carbonate produced.

SECTION 7

7. PERIODIC TABLE

PERIODIC TABLE BACKGROUND

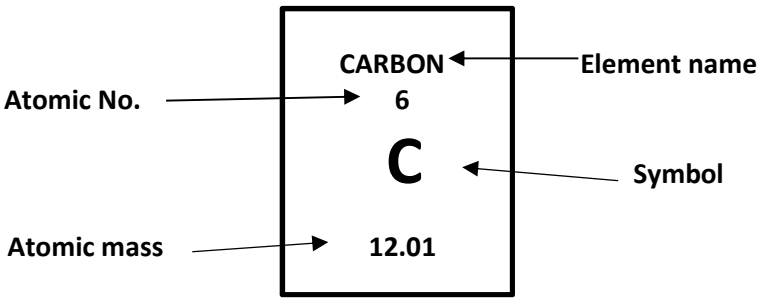
Introduce the periodic table by explaining the meaning of the symbols and numbers for an element

Show or give the learners a copy of the periodic table – preferably one in colour.

Tell learners that this is the periodic table. Explain that each box contains information about a different atom. The periodic table shows all the atoms that everything in the known universe is made from. It's like the alphabet in which only 26 letters make up many thousands of words. The 100 or so atoms of the periodic table, in different combinations, make up millions of different substances.

Note: It is often confusing for learners to see the terms "atom" and "element" used interchangeably as if they are the same thing. Explain to learners that an atom is the smallest particle or "building block" of a substance. An element is a substance made up of all the same type of atom. For instance, a piece of pure carbon is made up of only carbon atoms. This piece of pure carbon is a sample of the element carbon. The people who developed the periodic table could have called it the Periodic Table of the Atoms but they did not have a firm understanding of atoms at that time. Since they were working with actual samples of elements such as copper, mercury, sulfur, etc., they called it the periodic table of the elements.

- The periodic table is a chart containing information about the atoms that make up all matter.
- An element is a substance made up of only one type of atom.
- The atomic number of an atom is equal to the number of protons in its nucleus.
- The number of electrons surrounding the nucleus of an atom is equal to the number of protons in its nucleus.
- Different atoms of the same element can have a different number of neutrons.
- Atoms of the same element with different numbers of neutrons are called "isotopes" of that element.
- The atomic mass of an element is the average mass of the different isotopes of the element.
- The atoms in the periodic table are arranged to show characteristics and relationships between atoms and groups of atoms.



Introduce learners to the periodic table.

Provide a copy of the Periodic Table.

Parts of an Atom

- **Proton** Positively charged particle in the nucleus of the atom. The number of protons in an atom's nucleus is the atomic number.
- **Electron** Negatively charged particle surrounding the nucleus of the atom. The number of electrons surrounding the nucleus of an atom is equal to the number of protons in the atom's nucleus.
- **Neutron** Particle in the nucleus that has about the same mass as a proton but has no charge. For the atoms of the first 20 elements, the number of neutrons is either equal to or slightly greater than the number of protons.

Learners need to be able to identify different atoms by the number of protons in the nucleus and realize that the number of electrons equals the number of protons in a neutral atom. They will also need to understand the meaning of atomic number and atomic mass.

Explain atomic mass.

The atomic mass of an element is based on the mass of the protons, neutrons, and electrons of the atoms of that element. The mass of the proton and neutron are about the same, but the mass of the electron is much smaller (about 1/2000 the mass of the proton or neutron). The majority of the atomic mass is contributed by the protons and neutrons.

For any element in the periodic table, the number of electrons in an atom of that element always equals the number of protons in the nucleus. But this is not true for neutrons. Atoms of the same

element can have different numbers of neutrons than protons. Atoms of the same element with different numbers of neutrons are called isotopes of that element. The atomic mass in the periodic table is an average of the atomic mass of the isotopes of an element. For the atoms of the first 20 elements, the number of neutrons is either equal to or slightly greater than the number of protons.

For example, the vast majority of carbon atoms have 6 protons and 6 neutrons, but a small percentage have 6 protons and 7 neutrons, and an even smaller percentage have 6 protons and 8 neutrons. Since the majority of carbon atoms have a mass very close to 12, and only a small percentage are greater than 12, the average atomic mass is slightly greater than 12.

PERIODIC TABLE PRACTICAL

Equipment from the practical resource pack:

Elements Pictures - printed in colour

Periodic Table Wallpaper - the coloured cut-out element squares in the plastic packet.

Glue Stick	30cm ruler
Pair of cutting scissors	1 x sheet of A3 white paper

1 x black thick koki

Activity:

Instructions:

1. On the A3 sheet, learners must draw the outline of the periodic table, using the ruler and koki.
2. Using the cut-out element squares, learners must correctly place and stick down these squares on the drawn periodic chart.

SECTION 8

8. READING FOR MEANING

What is Reading?

Reading is the process of looking at a series of written symbols and getting meaning from them.

"When we read, we use our eyes to receive written symbols (letters, punctuation marks and spaces) and we use our brain to convert them into words, sentences and paragraphs that communicate something to us."

englishclub.com

"Reading is a complex, purposeful social and cognitive process in which readers simultaneously use their knowledge of spoken and written language, their knowledge of the topic of the text and their knowledge of culture to construct meaning.

Reading is not a technical skill acquired once and for all in the primary grades, but rather a developmental process."

But I'm Not a Reading Teacher: Strategies for Literacy Instruction in the Content Areas
Amy Benjamin

To comprehend successfully, readers must be able to:

- *decode* or pronounce words quickly and accurately.
- read with *fluency.*
- activate *vocabulary knowledge.*
- use text *comprehension strategies*

Factors influencing content literacy

- The learner's prior knowledge, attitude toward, and interest in the subject.
- The learner's purpose for engaging in reading, writing, and discussion.
- The language and conceptual difficulty of the text material.
- The assumptions that the text writers make about their audience of readers.
- The text structures that writers use to organize ideas and information.
- The teacher's beliefs about and attitude toward the use of texts in learning situations.

Disciplinary Literacy – Reading in the content areas

- understanding of the unique language of each subject area
- reflect on the unique learning demands of subject matter
- focus on the specific demands of each subject area
- Specific to a specific content area e.g. ecosystem, octagon
- skills needed, depend on the content and text.
- Content teachers are best qualified to help learners comprehend the material presented
- Learners do not always have the skills to read and comprehend content-based text. Content area teachers need to be skilled in content-based reading strategies
- Learners will become more skilled if all teachers provide reading opportunities

Reading in Natural Sciences

- Technical, abstract, tightly knit language
- Texts provide knowledge that allows for prediction of how the world works
- Close connections between prose, graphs, charts and formulae
- Full understanding of processes and experiments needed

Vocabulary Strategies

- intentionally teach academic vocabulary needed to read and comprehend content area texts and lean critical concepts
- provide multiple opportunities for learners to use academic vocabulary in writing reading listening and speaking
- teach learners how to analyse words in context

Comprehension Strategies

- Use prior knowledge
- Ask questions
- Make connections
- Identify the author's purpose
- Identify the main idea
- Find facts and details
- Recognise sequence, cause and effect
- Make inferences and predictions
- Summarise
- Distinguish between fact and opinion
- Have skill to compare and contrast
- Reread for clarity

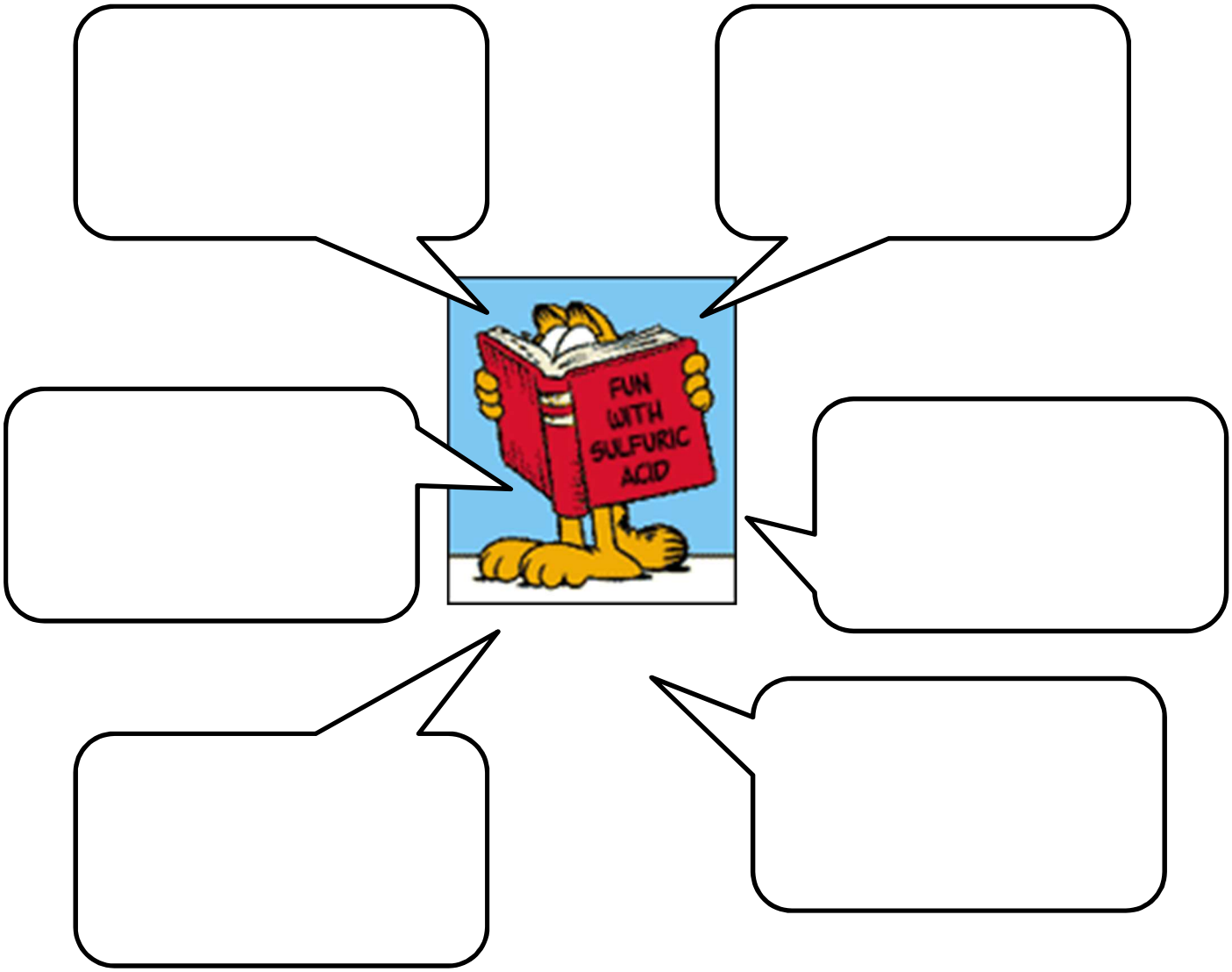
ACTIVITY: A READING SCIENCE PROBLEM

ACTIVITY: Reading a Science problem

Examine the following text and activities.

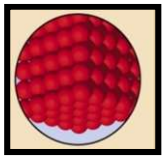
Identify the reading skills and comprehension strategies needed by learners to understand the activities and answer the questions.

Write the skills and strategies in the word boxes below.

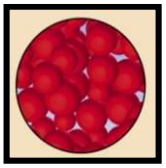


What dissolves?

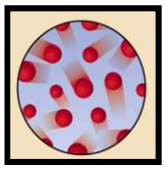
Everything around us is made of **particles.**



In a **solid** the particles find it difficult to move, that's why solids are **rigid.**



In a liquid the particles can move and **flow**. This is why liquids run.



In a gas the particles move the most and can continually **spread** if they are allowed to.

In the right conditions, when solid particles meet liquid particles, they can mix together to form a special mixture called a **solution**. This process is called **dissolving**.

This process does not happen when *any* solid or liquid meet (your glass does not dissolve when you put water in it), only when the right solid meets the right liquid. When they do dissolve, the solid part is called the **solute** and the liquid it dissolves in is called the **solvent**.

Which of the following do you think will dissolve in water?

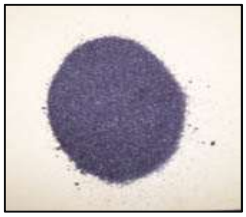
Discuss and record your predictions. Design an investigation to test your predictions.

Sugar

Salt

Coffee Powder

Wood Shavings

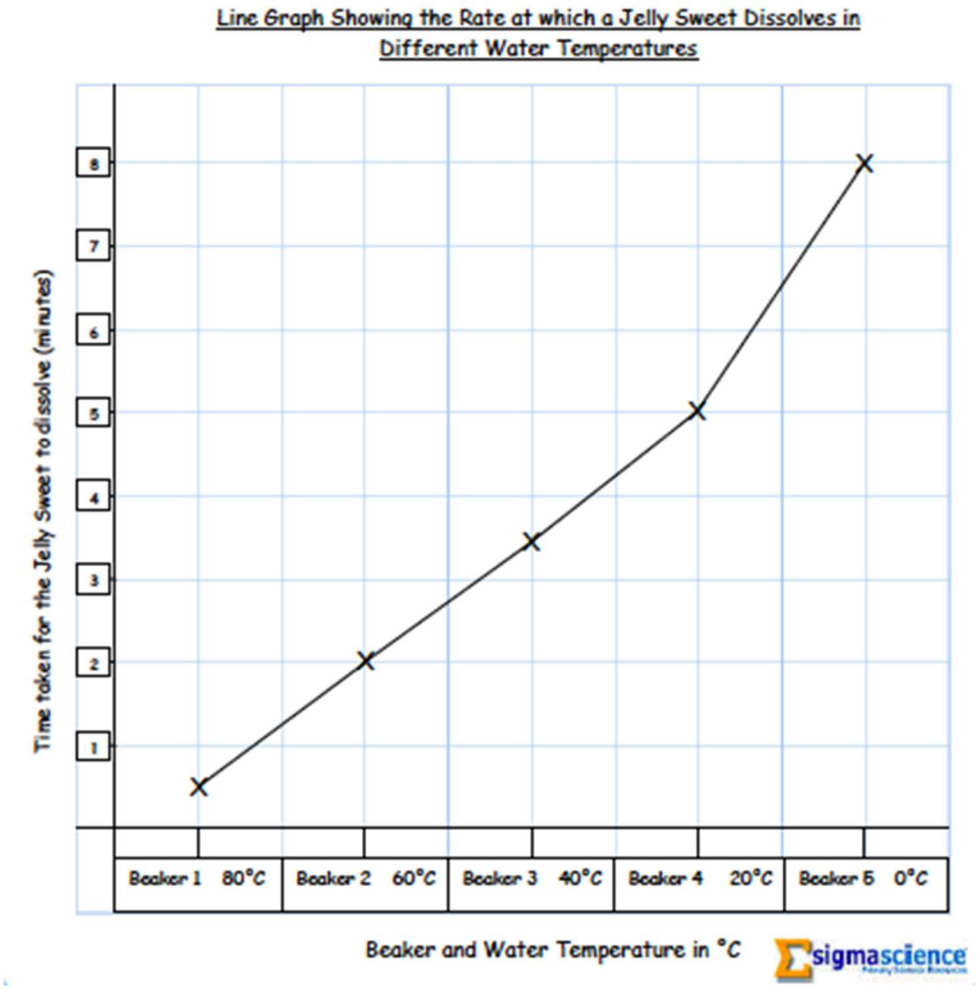


Iron Filings

Curry Powder

Andrew has been investigating whether water temperature affects the rate at which jelly-based sweet will dissolve. His results are shown below.

	Beaker 1	Beaker 2	Beaker 3	Beaker 4	Beaker 5
Temperature of the water in °C	80°C	60°C	40°C	20°C	0°C
Time it took the jelly sweets to dissolve	30 seconds	2 minutes	3 min30 sec	5 min	8 minutes



1. Identify at least three things Andrew would have had to do to make sure his investigation was fair.
2. Use the evidence recorded in the graph to explain how the temperature of the water affects the dissolving rate of the jelly sweets.
3. Carry out your own investigation to see if Andrew's findings were accurate. Place a jelly sweet into water at the following temperatures and record how long it takes them to dissolve. Before carrying out your investigation predict how long you think each sweet will take to dissolve.

Temperature of the water in °C	70°C	50°C	30°C	10°C	0°C
Predicted time taken for the jelly sweet to dissolve					
Actual time taken to dissolve					

SECTION 9

9. QUESTIONING AT DIFFERENT LEVELS

Cognitive levels for the assessment in Grades 4, 5 and 6

Low order questions 50%		Middle order questions 35%		High order questions 15%	
Leve1 Remembering	**Level 2 Understanding**	**Level 3 Applying**	**Level 4 Analysing**	**Level 5 Evaluating**	**Level 6 Creating**
Exhibit memory of previously learned material by recalling facts, terms, basic concepts, and answers.	Demonstrate understanding of facts and ideas by organizing, comparing, translating, interpreting, giving descriptions, and stating main ideas.	Solve problems to new situations by applying acquired knowledge, facts, techniques and rules in a different way.	Examine and break information into parts by identifying motives or causes. Make inferences and find evidence to support generalizations.	Present and defend opinions by making judgments about information, validity of ideas, or quality of work based on a set of criteria.	Compile information together in a different way by combining elements in a new pattern or proposing alternative solutions.
acquire categorise choose copy define describe find identify label list locate match memorise name omit point out quote recall	classify compare conclude contrast define demonstrate describe differentiate discuss distinguish draw estimate exemplify explain express extend identify illustrate	apply build calculate carry out change choose compute construct demonstrate develop dramatise employ execute exhibit experiment with identify illustrate implement	analyse assume attribute break down calculate categorise classify compare conclude contrast correlate criticise deconstruct deduce detect devise differentiate discover	appraise argue arrange assess choose compose conclude construct criticise critique decide deduct defend derive design detect determine develop	adapt appraise argue assess build change choose combine compare compile compose conclude consider construct create criticise decide deduce

recite	infer	interpret	discriminate	disprove	design
recognise	interpret	interview	dissect	document	develop
record	locate	make use of	distinguish	estimate	devise
relate	match	model	divide	evaluate	elaborate
repeat	outline	modify	examine	experiment	estimate
respond	paraphrase	operate	experiment	explain	evaluate
retrieve	recognise	organise	find	formulate	formulate
select	relate	plan	infer	generalise	generalise
show	rephrase	practice	inspect	hypothesise	hypothesise
state	report	predict	integrate	interpret	imagine
tabulate	represent	relate	investigate	judge	improve
tell	restate	restructure	motivate	justify	infer
trace	review	select	organise	measure	integrate
	show	sketch	outline	modify	invent
	summarise	solve	probe	order	judge
	translate		scrutinise	organise	measure
			separate	predict	modify
			simplify	prioritise	plan
			structure	produce	predict
			survey	propose	produce
			test for	prove	propose
				rank	rate
				rate	rearrange
				recommend	solve
				relate	suppose
				select	test
				test	validate

(Adapted from: Anderson, L. W., & Krathwohl, D. R. (2001). A taxonomy for learning, teaching, and assessing, Abridged Edition. Boston, MA: Allyn and Bacon.)

Cognitive levels for the assessment in Grades 7, 8 and 9

Low order questions 50%		Middle order questions 35%		High order questions 15%	
Leve1 Remembering	**Level 2 Understanding**	**Level 3 Applying**	**Level 4 Analysing**	**Level 5 Evaluating**	**Level 6 Creating**
Exhibit memory of previously learned material by recalling facts, terms, basic concepts, and answers.	Demonstrate understanding of facts and ideas by organizing, comparing, translating, interpreting, giving descriptions, and stating main ideas.	Solve problems to new situations by applying acquired knowledge, facts, techniques and rules in a different way.	Examine and break information into parts by identifying motives or causes. Make inferences and find evidence to support generalizations.	Present and defend opinions by making judgments about information, validity of ideas, or quality of work based on a set of criteria.	Compile information together in a different way by combining elements in a new pattern or proposing alternative solutions.
acquire categorise choose copy define describe find identify label list locate match memorise	classify compare conclude contrast define demonstrate describe differentiate discuss distinguish draw estimate exemplify	apply build calculate carry out change choose compute construct demonstrate develop dramatise employ execute	analyse assume attribute break down calculate categorise classify compare conclude contrast correlate criticise deconstruct	appraise argue arrange assess choose compose conclude construct criticise critique decide deduct defend	adapt appraise argue assess build change choose combine compare compile compose conclude consider

name	explain	exhibit	deduce	derive	construct
omit	express	experiment with	detect	design	create
point out	extend	identify	devise	detect	criticise
quote	identify	illustrate	differentiate	determine	decide
recall	illustrate	implement	discover	develop	deduce
recite	infer	interpret	discriminate	disprove	design
recognise	interpret	interview	dissect	document	develop
record	locate	make use of	distinguish	estimate	devise
relate	match	model	divide	evaluate	elaborate
repeat	outline	modify	examine	experiment	estimate
respond	paraphrase	operate	experiment	explain	evaluate
retrieve	recognise	organise	find	formulate	formulate
select	relate	plan	infer	generalise	generalise
show	rephrase	practice	inspect	hypothesise	hypothesise
state	report	predict	integrate	interpret	imagine
tabulate	represent	relate	investigate	judge	improve
tell	restate	restructure	motivate	justify	infer
trace	review	select	organise	measure	integrate
	show	sketch	outline	modify	invent
	summarise	solve	probe	order	judge
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			separate	predict	modify
			simplify	prioritise	plan
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			survey	propose	produce
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SECTION 10

10. LESSON DEMONSTRATIONS AND FEEDBACK

REFLECTING ON THE LESSONS THAT YOU TEACH

It is important to reflect on your teaching. Through reflection, we become aware of what is working and what is not, what we need to change and what we do not. Reflecting on your use of these lesson plans will also help you use them more effectively and efficiently.

These lesson plans have been designed to help you deliver the content and skills associated with CAPS. For this reason, it is very important that you stick to the format and flow of the lessons. CAPS requires a lot of content and skills to be covered – this makes preparation and following the lesson structure very important.

Use the tool below to help you reflect on the lessons that you teach. You do not need to use this for every lesson that you each – but it is a good idea to use it a few times when you start to use these lessons. This way, you can make sure that you are on track and that you and your learners are getting the most out of the lessons.

LESSON REFLECTION TOOL	
Preparation	
1.	What preparation was done?
2.	Was preparation sufficient?
3.	What could have been done better?
4.	Were all of the necessary resources available?

Classroom Management			
		Yes	**No**
5.	Was the question written in the board?		
6.	Was the answer written on the board?		
7.	Was the answer discussed with the learners in a meaningful way?		
8.	Overall reflection on this part of the lesson: What was done well? What could have been done better?		

Accessing Information			
		Yes	**No**
9.	Was the text and/ or diagrams written on the chalkboard before the lesson started?		
10.	Was the work on the board neat and easy for the learners to read?		
11.	Was the explanation on the content easy to follow?		
12.	Was the information on the board used effectively to help with the explanations?		
13.	Was any new vocabulary taught effectively? (in context and using strategies like PATS)		
14.	Were the learners actively engaged? (asked questions, asked for their opinions and to give ideas or suggestions)		
15.	Were the checklist questions used effectively?		
16.	Overall reflection on this part of the lesson: What was done well? What could have been done better?		

Conceptual Development			
		Yes	**No**
17.	Was the information taught in the 'Accessing Information' part of the lesson used to foreground the activity?		
18.	Were clear instructions given for the conceptual development activity?		
19.	Were the outcomes/answers to the activities explained to the learners?		
20.	Could the learners ask questions and were explanations given?		
21.	Was a model answer supplied to the learners? (written or drawn on the board)		
21.	Were the checklist questions used effectively?		
22.	At the end of the lesson, were the learners asked if they had questions or if they needed any explanations?		
23.	Overall reflection on this part of the lesson: What was done well? What could have been done better?		

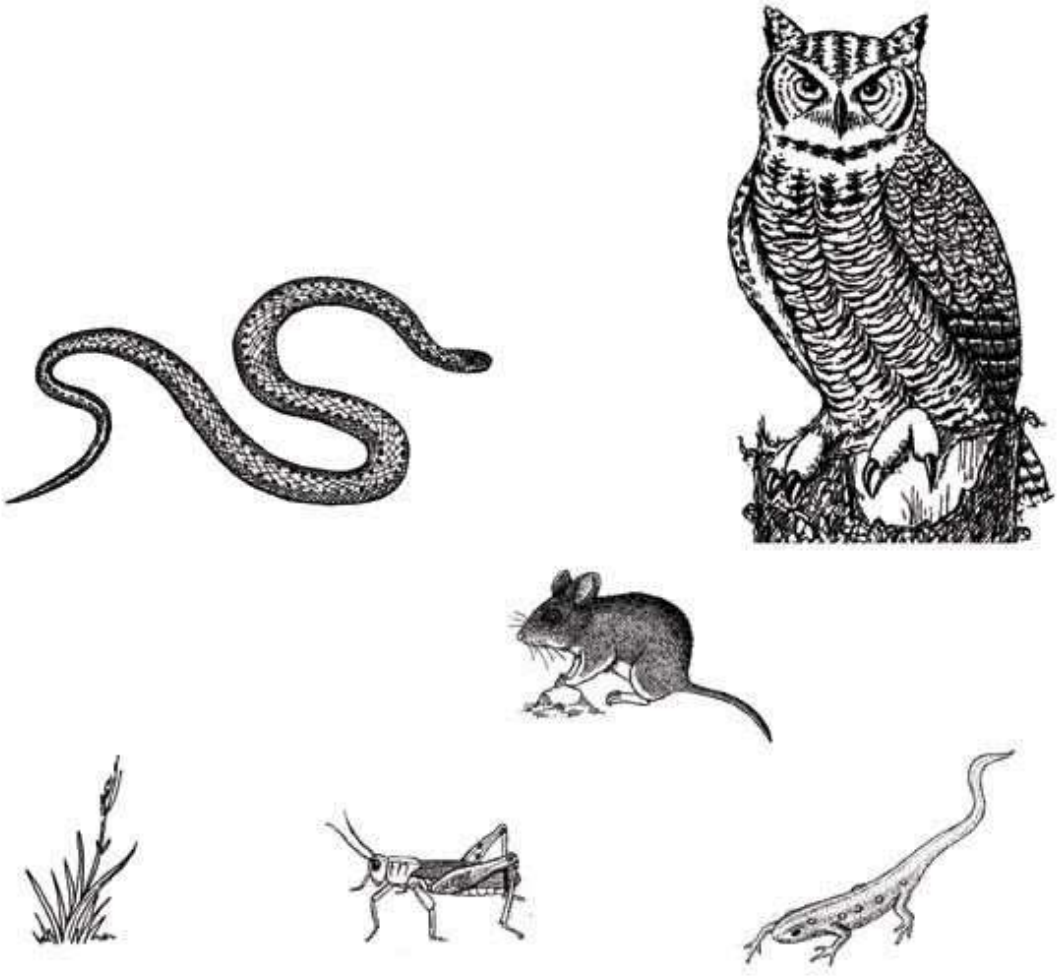
TRAINING HANDOUT: APPENDICES

APPENDIX 1: FOOD CHAINS AND FOOD WEBS

Chains and Food Webs

Creating a Food Web — Draw and Connect

Energy flows through an ecosystem as one animal eats another animal or plant. These food chains overlap in an ecosystem to form complex food webs. To help students understand how a foodweb works, direct them create their own. Draw a group of animals and arrange them on the page. (Use the "how to draw" pages to simplfy the animal art.) Include a plant, insect, amphibian, reptile, bird and mammal. Then draw lines from the predator to the prey. Note that some predators eat many prey forming the complex "web".



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APPENDIX 1: FOOD CHAINS AND FOOD WEBS

Chains and Food Webs

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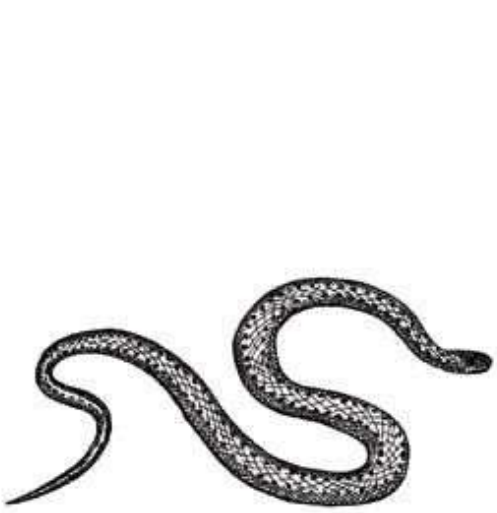

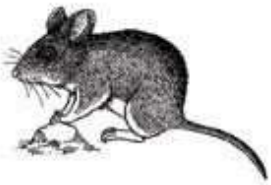

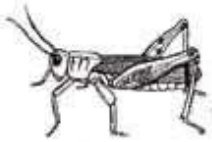

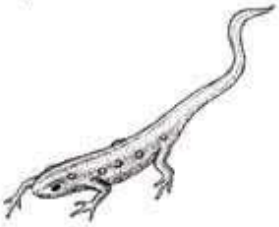

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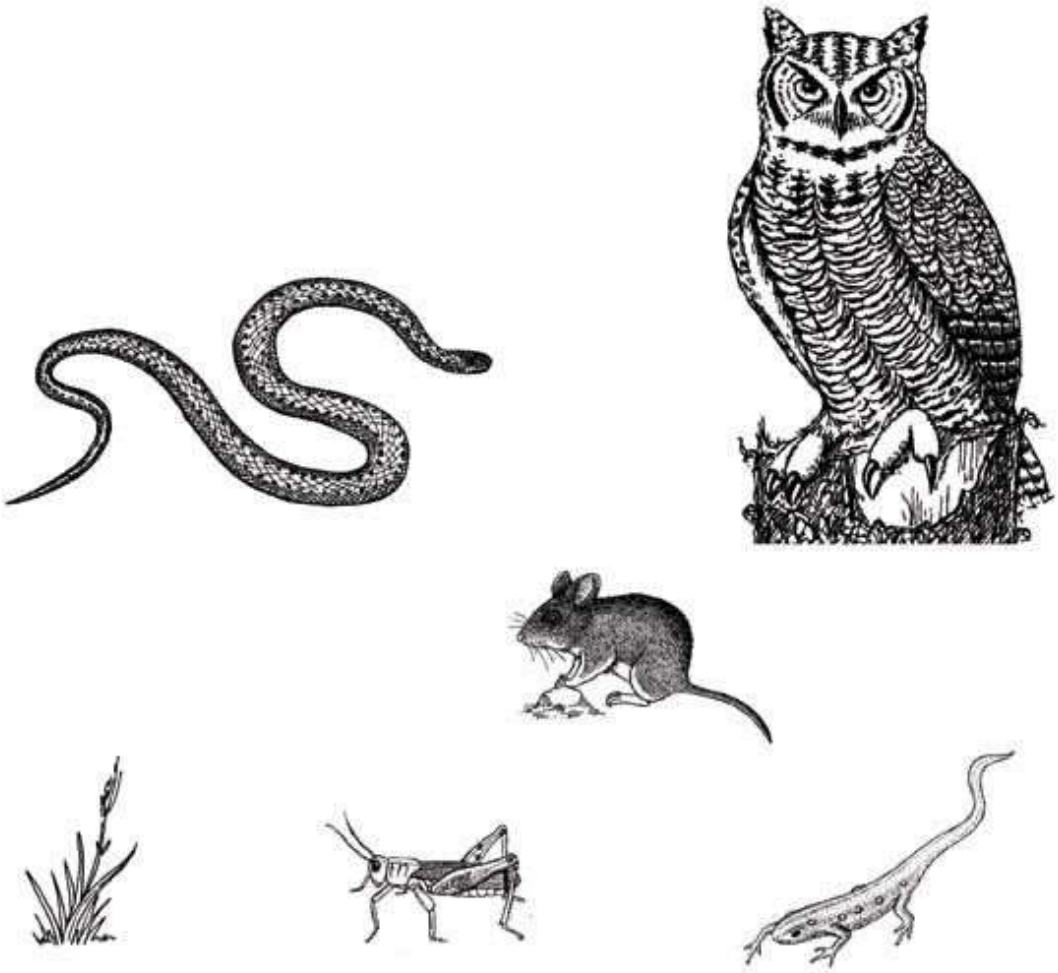
APPENDIX 1: FOOD CHAINS AND FOOD WEBS

Chains and Food Webs

Creating a Food Web — Draw and Connect

Energy flows through an ecosystem as one animal eats another animal or plant. These food chains overlap in an ecosystem to form complex food webs. To help students understand how a foodweb works, direct them create their own. Draw a group of animals and arrange them on the page. (Use the "how to draw" pages to simplfy the animal art.) Include a plant, insect, amphibian, reptile, bird and mammal. Then draw lines from the predator to the prey. Note that some predators eat many prey forming the complex "web".



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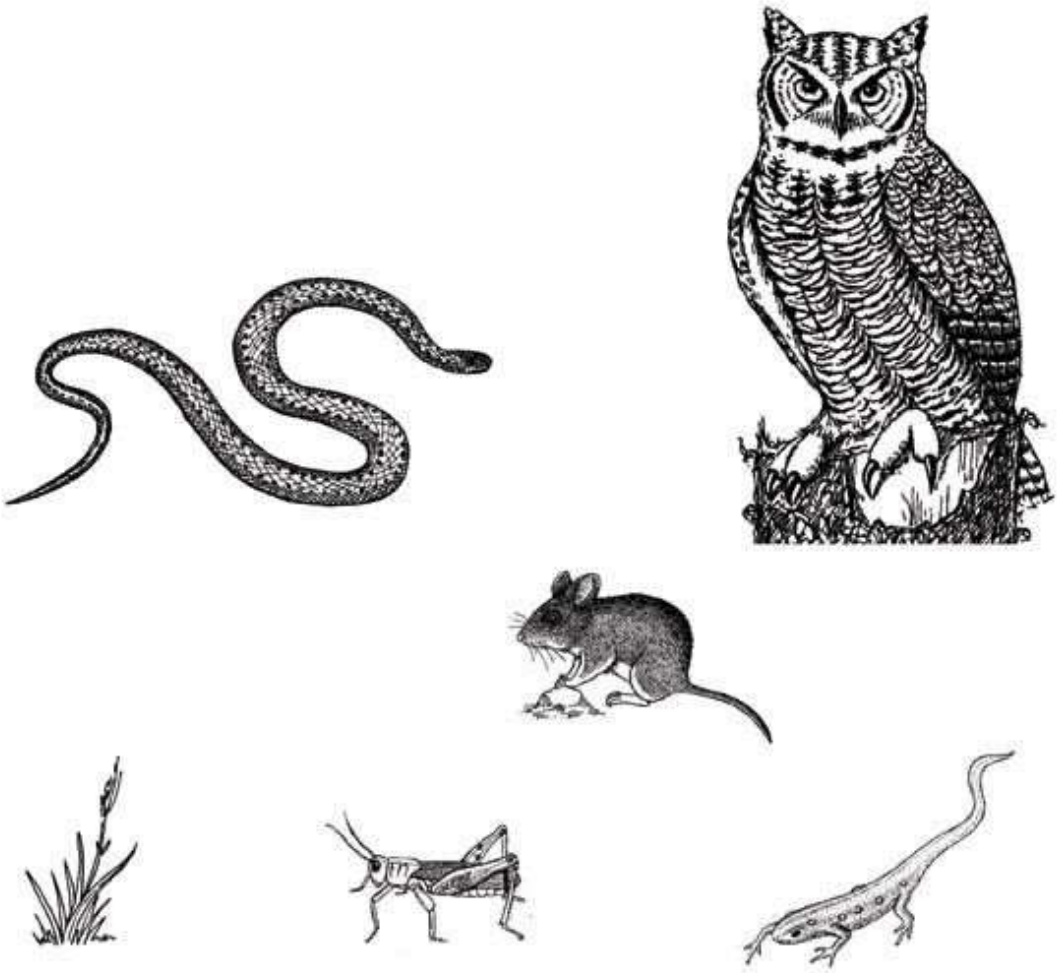

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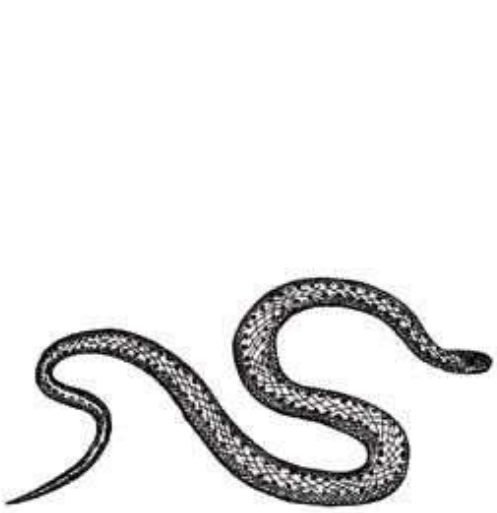

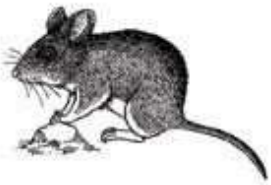

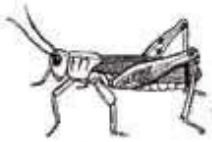

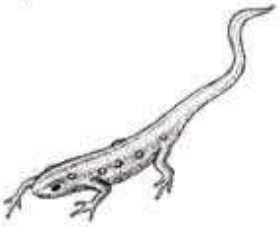

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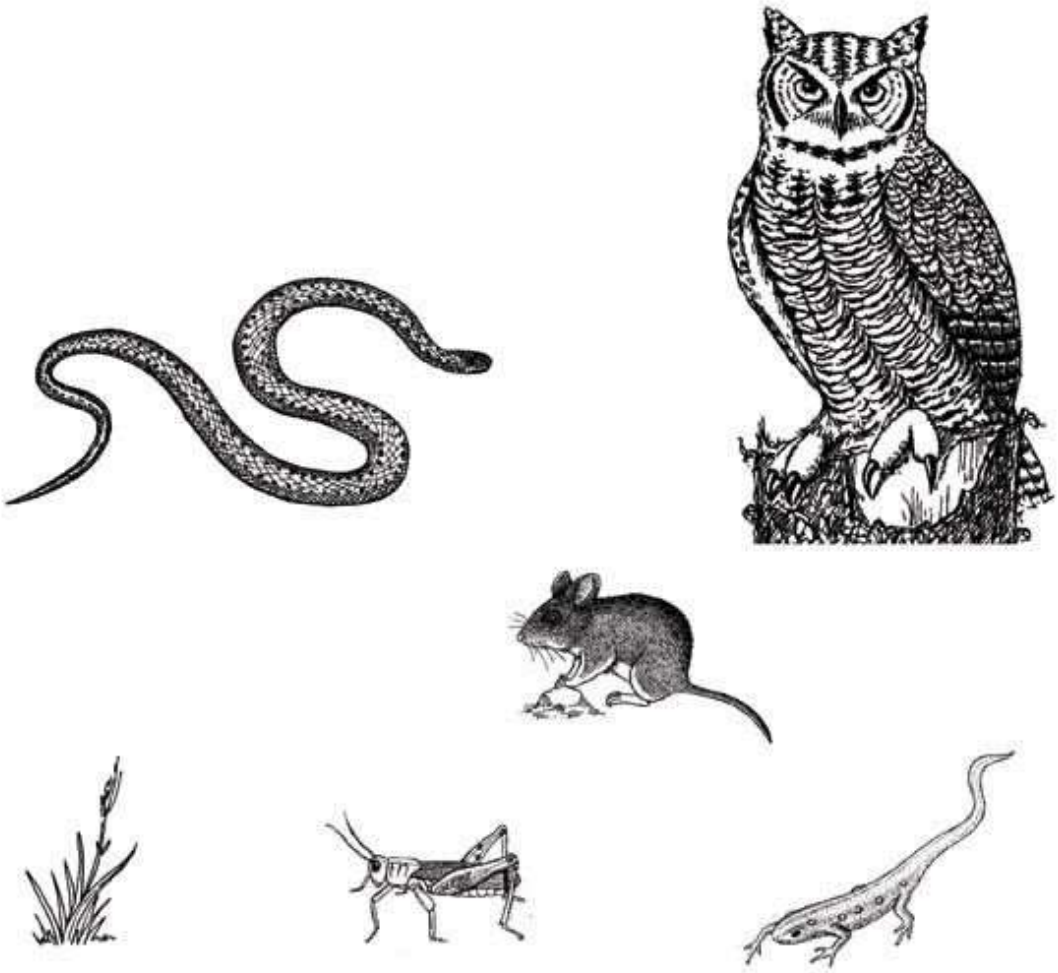
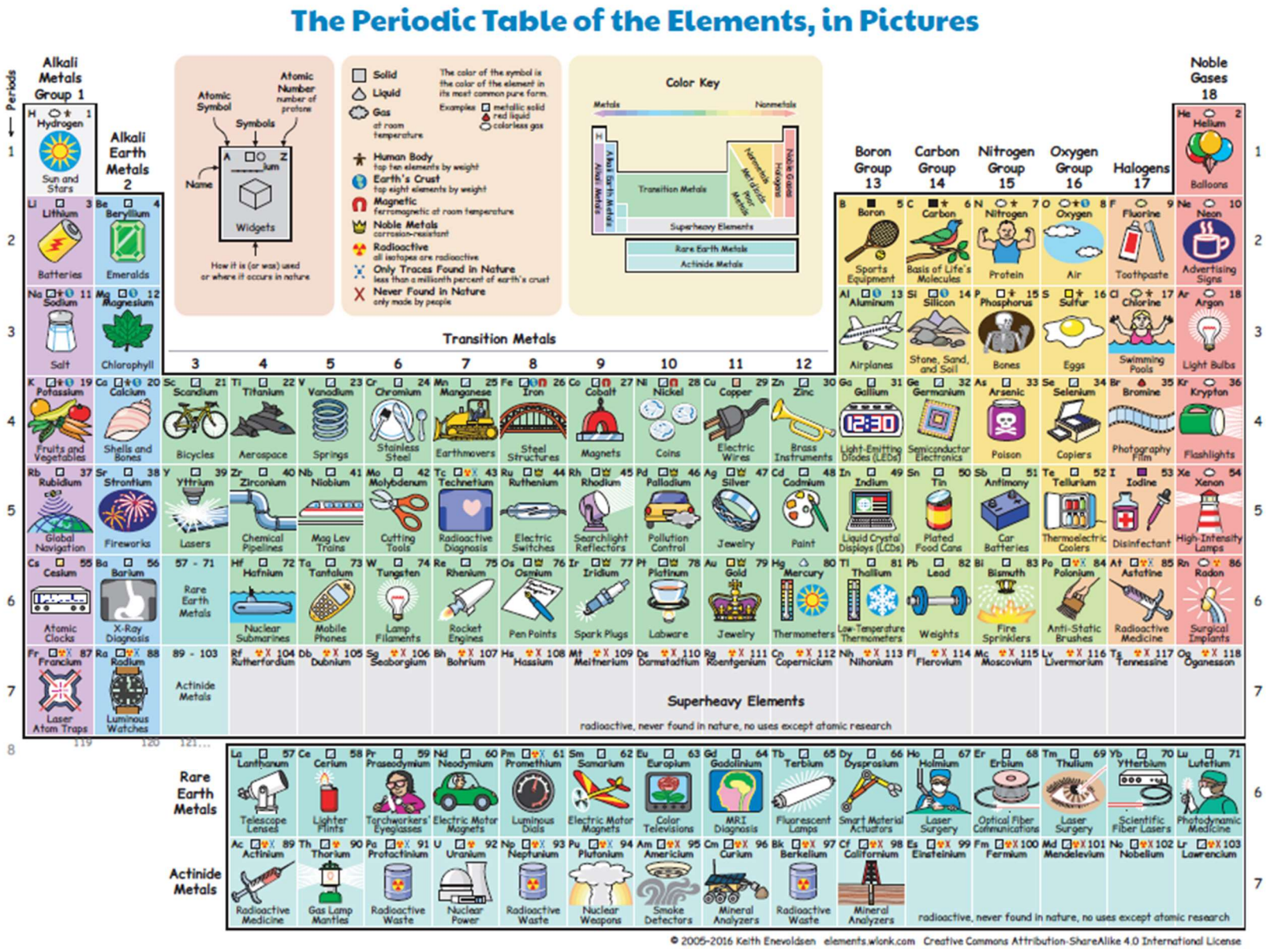
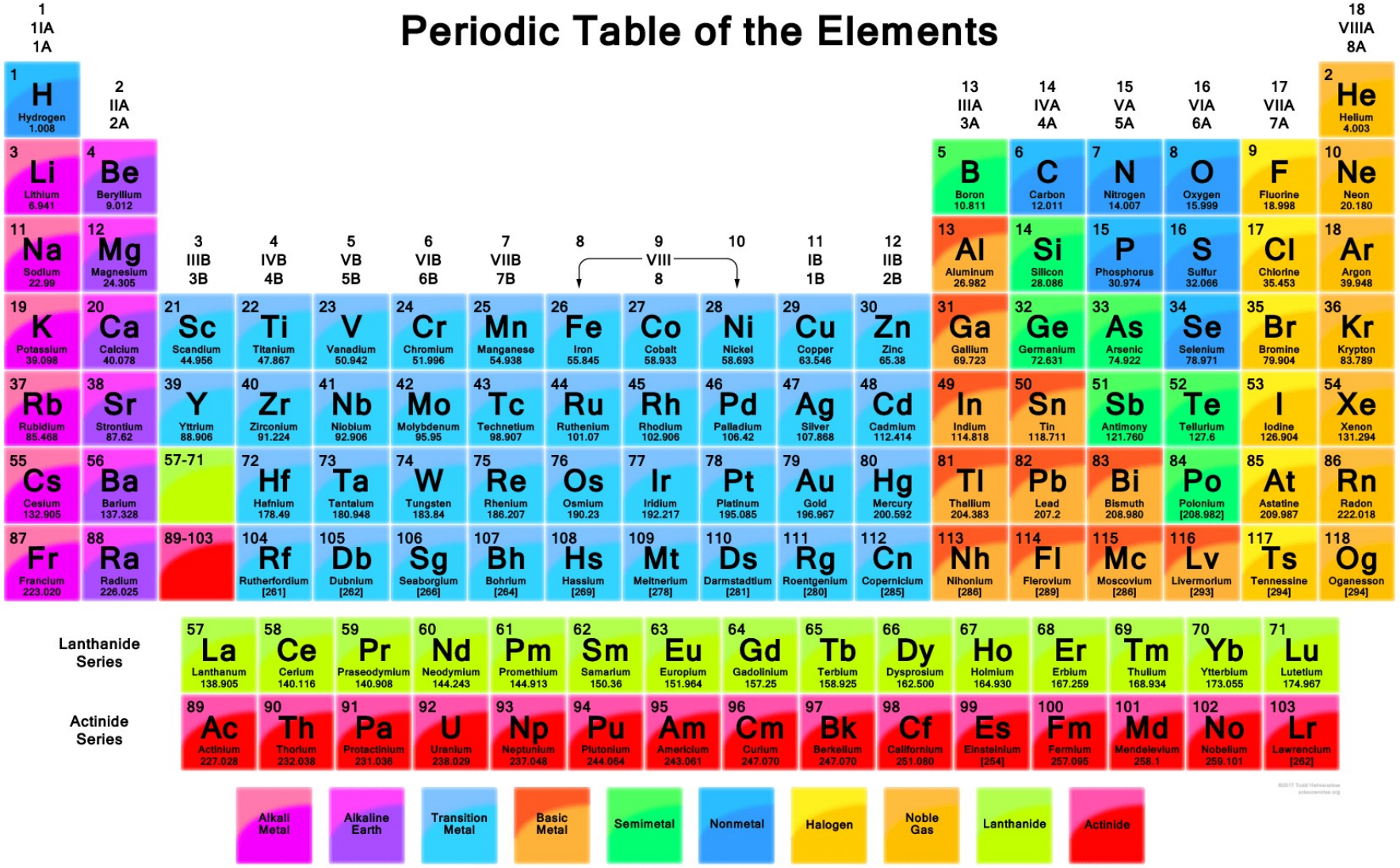


APPENDIX 2: PERIODIC TABLE




Periodic Table of the Elements
1 1IA 1A
2 IIA 2A
3 IIIB 3B
4 IVB 4B
5 VB 5B
6 VIB 6B
7 VIIB 7B
8
9 VIII 8
10
11 IB 1B
12 IIB 2B
13 IIIA 3A
14 IVA 4A
15 VA 5A
16 VIA 6A
17 VIIA 7A
18 VIIIA 8A
1 H Hydrogen 1.008
2 He Helium 4.003
3 Li Lithium 6.941
4 Be Beryllium 9.012
5 B Boron 10.811
6 C Carbon 12.011
7 N Nitrogen 14.007
8 O Oxygen 15.999
9 F Fluorine 18.998
10 Ne Neon 20.180
11 Na Sodium 22.99
12 Mg Magnesium 24.305
13 Al Aluminum 26.982
14 Si Silicon 28.086
15 P Phosphorus 30.974
16 S Sulfur 32.066
17 Cl Chlorine 35.453
18 Ar Argon 39.948
19 K Potassium 39.098
20 Ca Calcium 40.078
21 Sc Scandium 44.956
22 Ti Titanium 47.867
23 V Vanadium 50.942
24 Cr Chromium 51.996
25 Mn Manganese 54.938
26 Fe Iron 55.845
27 Co Cobalt 58.933
28 Ni Nickel 58.693
29 Cu Copper 63.546
30 Zn Zinc 65.38
31 Ga Gallium 69.723
32 Ge Germanium 72.631
33 As Arsenic 74.922
34 Se Selenium 78.971
35 Br Bromine 79.904
36 Kr Krypton 83.789
37 Rb Rubidium 85.468
38 Sr Strontium 87.62
39 Y Yttrium 88.906
40 Zr Zirconium 91.224
41 Nb Niobium 92.906
42 Mo Molybdenum 95.95
43 Tc Technetium 98.907
44 Ru Ruthenium 101.07
45 Rh Rhodium 102.906
46 Pd Palladium 106.42
47 Ag Silver 107.868
48 Cd Cadmium 112.414
49 In Indium 114.818
50 Sn Tin 118.711
51 Sb Antimony 121.760
52 Te Tellurium 127.6
53 I Iodine 126.904
54 Xe Xenon 131.294
55 Cs Cesium 132.905
56 Ba Barium 137.328
57-71
72 Hf Hafnium 178.49
73 Ta Tantalum 180.948
74 W Tungsten 183.84
75 Re Rhenium 186.207
76 Os Osmium 190.23
77 Ir Iridium 192.217
78 Pt Platinum 195.085
79 Au Gold 196.967
80 Hg Mercury 200.592
81 Tl Thallium 204.383
82 Pb Lead 207.2
83 Bi Bismuth 208.980
84 Po Polonium [208.982]
85 At Astatine 209.987
86 Rn Radon 222.018
87 Fr Francium 223.020
88 Ra Radium 226.025
89-103
104 Rf Rutherfordium [261]
105 Db Dubnium [262]
106 Sg Seaborgium [266]
107 Bh Bohrium [264]
108 Hs Hassium [269]
109 Mt Meitnerium [278]
110 Ds Darmstadtium [281]
111 Rg Roentgenium [280]
112 Cn Copernicium [285]
113 Nh Nihonium [286]
114 Fl Flerovium [289]
115 Mc Moscovium [286]
116 Lv Livermorium [293]
117 Ts Tennessine [294]
118 Og Oganesson [294]
Lanthanide Series
57 La Lanthanum 138.905
58 Ce Cerium 140.116
59 Pr Praseodymium 140.908
60 Nd Neodymium 144.243
61 Pm Promethium 144.913
62 Sm Samarium 150.36
63 Eu Europium 151.964
64 Gd Gadolinium 157.25
65 Tb Terbium 158.925
66 Dy Dysprosium 162.500
67 Ho Holmium 164.930
68 Er Erbium 167.259
69 Tm Thulium 168.934
70 Yb Ytterbium 173.055
71 Lu Lutetium 174.967
Actinide Series
89 Ac Actinium 227.028
90 Th Thorium 232.038
91 Pa Protactinium 231.036
92 U Uranium 238.029
93 Np Neptunium 237.048
94 Pu Plutonium 244.064
95 Am Americium 243.061
96 Cm Curium 247.070
97 Bk Berkelium 247.070
98 Cf Californium 251.080
99 Es Einsteinium [254]
100 Fm Fermium 257.095
101 Md Mendelevium 258.1
102 No Nobelium 259.101
103 Lr Lawrencium [262]
Alkali Metal
Alkaline Earth
Transition Metal
Basic Metal
Semimetal
Nonmetal
Halogen
Noble Gas
Lanthanide
Actinide