

A look at science kits developed by teachers at SIUE in summer 2001

Although the activities in these kits are designed for middle school learners they are a good start for most South African high school students who did not have a chance of being involved in any hands on activities due to the lack of the necessary material or laboratories in their schools. They are also designed to meet the needs of teachers who want to teach activity based science which become impossible in schools where there is lack of resources, lack o time to teach science inquiry, and where the teachers themselves have limited competency to conduct practical work.

The activities encourage independent and discovery learning, they are suitable for use in classrooms where there is no science equipment hence they suggest the use of common material which is readily available and inexpensive in most South African shops.

As the students uncover the world of science, they learn to be better health conscious citizens, which might help them to improve their habits despite the environment in which they live in. They learn about things they interact with on a daily basis and how they can improve the environment in which they live in.

One of the important aspects of the kits is that each activity incorporates many science learning areas e.g. the microbiology kit does not treat its content in isolation, but it also teaches collection and interpretation of data, some aspects of general hygiene and it also includes some basic physics exercises. This will help the learners to broaden they view of thought in a way that they realize whatever is learned in a biology class also applies in physics, chemistry or health education class.

The activities in the kits address the science process skills necessary for students to utilize when learning science. These skills include observation, classifying, taking measurements, predicting, communication, and formulation of hypothesis, experimentation and interpretation of data.

The kits also include performance-based assessment that gives the teachers the opportunity to observe what the students do with the science concepts and skills they have learned. Knowing and being able to apply the science concepts, principles and processes help students to understand what they observe in nature and through scientific experimentation.

Below are some of the activities, which are relevant for use in high school as adopted from the kits, developed by teachers at SIUE in summer.

ACTIVITIES

MICROBIOLOGY THE GOOD, BAD AND THE UGLY

This kit takes the learners through a world of microorganisms. It teaches what they are, their life processes, which ones are helpful, and which ones can be harmful to them. The students are able to participate in and effect in one of the greatest scientific and biological processes, life. As the kit tackles microbiology, it brings in the their behaviors that exposes them to the ugly part of these organisms, thereby not only teach microbiology but also aspects of general hygiene and prevention of illnesses.

Unit 1

The kit first introduces the students to the study of cells. It explains the basic structure responsible for life and its functions. This will enable learners to identify cell structures and then give their functions .A model of a cell will be used to tech this unit.

Standard goals of the unit

- ❖ Know and apply concepts that explain how living things function and adapt to change.
- ❖ Know and apply concepts that describe how living things interact with each other and with their environment
- ❖ Know and apply concepts that describe the interactions between science, technology and society

Now that the students understand the structures of the cell, they will be able to create their own model of the cell. This allow the students to gain confidence of what they have learned through application and use of own ideas.

Unit2

This unit deals with life processes that take place in the cell e.g. mitosis, protein synthesis, why these processes are important and how do they occur. This helps the students to understand what is happening in their bodies while they grow, why do they look like somebody in their families and why are cells often referred to as the basic units of life.

Standard goals of the unit

- ❖ Know and apply how living things function and adapt to change
- ❖ Know and apply concepts that describe the properties of energy and interactions between them

In this unit students will use simple material like different colored beads to illustrate how are proteins formed, in the process they will be learning names of certain amino acids and how these amino acids become building blocks of proteins.

Unit3

This unit deals with communicable diseases. It deals with microscopic organisms which humans interact with on a daily basis and the impact they have on them.

Standard goals of the unit

- ❖ Compare and assess features of organisms for their adaptive, competitive and survival potential.
- ❖ Understand the fundamental concepts, principles and interconnections of life, physical and life sciences.
- ❖ Formulate hypothesis that can be tested by collecting data
- ❖ Collect and record data accurately using consistent measuring and recording techniques and media
- ❖ Interpret and represent results of analyses to produce findings
- ❖ Identify and describe ways to reduce health risks to adolescents
- ❖ Identify how positive health practices and relevant health care can help reduce health risks

Students will learn how scientists classify various diseases causing agents known as pathogens, their transmission and how body defense mechanism deals with these pathogens and how general health behaviors can prevent the spread of these diseases.

The unit also provides some clarity to terms, which students come across and which are often used interchangeably e.g. bacteria, viruses, pathogen

The topic "you're infected, teaches the students how easily some of these diseases can be transmitted and what preventive measures can individuals employ to protect themselves. Included is a survey designed to raise the awareness of the student's hygiene habits and how these habits impact the people around them. By completing the survey, they will be able to calculate the risk of contracting infectious diseases

Unit 4

This unit addresses several topics related to chemistry e.g. monomers, polymers, cross-linking, SI measurement, chemical change and the states of matter.

Standard goals of the unit

- ❖ know and apply concepts that describe properties of matter and energy and the interactions between them

The students will prepare a slime that will be used to explain the concepts monomers and polymers. They will also use paper clips to illustrate the relationship between a polymer and a monomer.

From the knowledge of matter they have gained, they will describe the 3 types of matter and find the density of matter in different phases by doing calculations.

Unit 5

This unit introduces the learners to the fungi, what do they look like the good and the bad things about them.

Standard goals of the unit

- ❖ know and apply concepts principles and processes of scientific inquiry
- ❖ know and apply concepts that explain how living things adapt and change

The students will learn about the yeast as an example of a fungus, they will learn about fermentation and reproduction of yeast.

During the yeast experiments, students will observe the behavior of yeast in different environments and explain what effects do time, moisture temperature and food have on yeast development.

Unit 6

Students realize that sanitary practices they use at home with their families are the smallest unit of the society and can have an effect on the broader society in which they live in. The environmentally good practices they develop at home become the practices that are most likely to cure the environmental problems of their society.

The rationale of the activity is to help students in understanding the reasons behind proper food preparation cleanliness, and maintenance of proper temperature when serving food.

Standard goals of the unit

- ❖ Know and apply concepts that describe how living things interact with each other and with their environment.
- ❖ Know and apply concepts that describe interactions between science, technology, and the society.
- ❖ Explain the basic principles of health promotion, illness prevention and safety.

Students will be introduced to 4 main types of food poisoning or toxins introduced by bacteria which can be prevented with good sanitary habits e.g. botulism, staphylococcal, salmonellosis, perfringens poisoning.

MICROBIOLOGY KIT

ITEM	# IN KIT
Zipper - type plastic sandwich bags	4
Meter long piece of yarn, tied to form a loop	4
Twisties	6
1cm diameter pom-poms	2
15 cm pipe cleaners	4
10cm pipe cleaners	4
5cm pipe cleaners	4
30cm pieces of string	12
Small white envelop	4
Strips of paper bearing DNA codes	4
Charts listing RNA codes for Amino acid	4
Short wide mouthed plastic cups	20
Elastic cord for stringing beads per group (approx. 15cm)	4
Small gold safety pin to keep beads from falling off per cord	4
Chart color listing what bead color to what amino acid for teacher	1
Chart listing correct amino acid sequence in specific proteins for teacher	1
Chart listing the correct bead color sequence for each protein for teacher	1
Paper cups	40
Graduated cylinder	1
500ml of 0.1 NaOH	10
Water	
20 ml phenolphthalein solution	1
Antibacterial soap	1
Towels	3
Liquid and powdered glo germ	2
Small paint brush	2
Plain papers	40
Colored pencils	20
500ml polyvinyl alcohol	1
500ml borax solution	1
Food coloring	3
Wooden stirring sticks	40
Hot plate / microwave	1
Vile with pop top or screw lid	1
Small medicine cups	40
Packages of granulated yeast	7
Package of quick rising yeast	1
Packet salt	1
Packet sugar	1
Potato flakes	
Mixing bowls	8
Mixing spoons	8

WATER WORLD

This kit is designed to explore the physical, biological properties of water. The exploratory topics include density, light, refraction, and reflection, phase changes and the chemical properties of water. Through their tour in the water world, students learn about the importance of water to plant and animal life. The concept water is used to introduce the students to some basic physics and chemistry like, density calculation, acids and bases as well as some basic electricity concepts.

Unit 1

In this unit students learn to determine the density differences between liquid water and frozen water. In order to calculate density using a formula, students first measure the mass and the volume of water, these values are to be used in the formula, and therefore can find the difference in density for liquid and frozen water.

Standard goals of the unit

- ❖ Know and apply concepts principles and processes of scientific inquiry
- ❖ Know and apply concepts that describe properties of matter and energy and the interactions between them

From the understanding of density between the liquid and solid water students will be able to reason why icebergs float.

This activity allows for the development of mathematics skills, substituting values in a given formula.

Unit 2

This activity allows the students to change the subject of the formula in the expression ($D = m/v$) where they are going to research the density of a copper shot and mass is to be the unknown, which will be found without using the balance.

Standard goals of the unit

- ❖ Know and apply concepts, principles and processes of scientific inquiry.
- ❖ Know and apply concepts that describe properties of matter and the energy interactions between them.

Hence now they know how to calculate density using the formula, they may be introduced to finding the density of a substance using the water displacement method.

This activity encourages students to take accurate readings on the measuring cylinder every time a new measurement is taken otherwise they might end up with the wrong answer. Allowing the students to compare the values they have used for the formula with the values obtained in the displacement experiment can do this.

Unit 3

Students always have unanswered questions in their minds like, why do I see somebody who looks exactly like me in the mirror? why does a coin look shallower than it is in a bowl of water? After the rain students always see these beautiful colors hanging in the sky and wonder when do they come from? Is it one of those miracles again?

In this unit, students are introduced to the rectilinear propagation of light. They will observe that white light is composed of seven different frequencies of light which are interpreted as red, orange, yellow, green, blue, indigo and violet. They will also learn that light travels at different speeds when it travels in different media e.g. water, air and how it bends. Because the different colors bend at slightly different angles, they make the ray to separate into the colors of the rainbow.

The activities in this unit may help the learners to develop a positive attitude towards learning science because all the mysteries they are faced with on a daily basis is what science tries to explain.

Standard goals of the unit

- ❖ Know and apply the concepts, principles and processes of scientific inquiry.
- ❖ Know and apply the concepts that describe the properties of matter energy and the interactions between them.

Unit 4

In this unit students investigate the effects that affect the water cycle process e.g. evaporation, condensation and precipitation.

Standard goals of the unit

- ❖ Know and apply the concepts, principles and processes of scientific inquiry.
- ❖ Know and apply the concepts that describe the features and processes of the earth and its resources

In a classroom situation these processes can be observed over a period of time where the students will set up and observe experiments on a daily basis, take measurements and record data which will be used to plot a graph that illustrate the relationship between these concepts.

Unit 5

This unit is intended as a follow up to the previous unit, where the focus will be the investigation of the effects of water on plant life. If plants cannot survive with water can we? This activity can also be used to teach students about water conservation, water is a crucial part of our living without water we cannot live.

Standard goals of the unit

- ❖ Know and apply the concepts, principles and processes of scientific inquiry
- ❖ Know and apply the concepts that describe the features and the processes of earth and its resources.
- ❖ Know and apply concepts that describe how living things interact with each other and their environment

Unit 6

In this unit, students investigate the process of photosynthesis, water as one of the substances needed by plants for photosynthesis to take place and to understand the chemical formula of photosynthesis. The focus of this

activity is the gathering of evidence of oxygen and carbon dioxide exchanges.

Standard goals of the unit

- ❖ Know and apply the concepts, principles and processes of scientific inquiry
- ❖ Know and apply concepts that explain how living things adapt to change

After the students have completed the activity, they should be able to explain the three factors must have to undergo photosynthesis and the products of photosynthesis thereof. They should also be able to explain the evidence that indicates the presence of oxygen and carbon dioxide.

This unit also teaches the students to set up their own experiments and controls which allow them to make predictions, comparisons and also recording observable change in the experiments.

This unit enables the students to explore the important chemical and physical processes which occur in creation, growth and existence of plants as well as principles and processes that make plant life possible.

Unit 7

In this unit, students are introduced to the chemistry of water, which explains the formula of water. They will locate the elements that form water in the periodic table and also construct a molecular model of water using the molecular model kit.

Standard goals of the unit

- ❖ Know and apply the concepts that describe properties of matter and energy and the interaction between them
- ❖ Know and apply the processes of scientific inquiry

Based on the observation of the molecular model, the students will be able to label the electrode in which oxygen or hydrogen is produced during the experiment.

Unit 8

This unit introduces the students to basic electricity concepts e.g. flow of electric current and the electric circuit types. Students are going to be involved in activities that involve building up electric circuits and what make a light bulb in an electric circuit glow.

Standard goals of the unit

- ❖ Know and apply concepts, principles and processes of technological design
- ❖ Know and apply concepts that describe properties of matter and energy and the interactions between them

This unit enables the students to be electricians as they experiment with material to light a bulb in as many ways as possible. From their experience, they may now put it on paper to show how should the material be connected to have a lit bulb and as well draw diagrams illustrating the differences and similarities between a parallel and a series circuit.

As a form of re-enforcement students may be asked to share with the rest of the class which type of circuit they would prefer for their Christmas tree and justify their choice thereof.

Unit 9,10

In these units, students will build their own vegetable batteries that are going to be used as the source of energy in the circuits. They are going to measure the output of the vegetable and investigate the output obtained using different combinations of metals/ non-metals.

Standard goals of the unit

- ❖ Know and apply the concepts, principles and processes of technological design.

These activities will allow the students to gain confidence in building electric circuits. They will use different substances in their circuits in order to classify them as conductors or non-conductors. With the supplied prediction sheet, they are allowed to illustrate their understanding of the concepts, by looking at the set up of each circuit they should predict if the combination is suitable to have the bulb lit.

Unit 11

This unit introduces students to basic chemistry, namely acids, bases and salts. These substances will be identified by means of testing with a universal paper. Distinction should be made between a strong and a weak substance based on the pH scale.

Standard goals of the unit

- ❖ Know and apply concepts that describe properties of matter and energy and the interactions between them.

The knowledge of acids bases and salts that has been gained will now be used to make solutions which will be used to determine the conductivity of the substances. By constructing a circuit with wires connected to 2 copper plates that are dipped in solution, the brightness of the bulb will give an indication of the conductivity of the substance. At the end of this exercise the teacher can then bring in the concept of ionization which will enable the students to understand why are some substances good conductors and some not.

WATER WORLD KIT

ITEM	#IN KIT
5ml pipettes	15
500gm small copper shorts	
Overflow beakers	7
Rock and mineral book	
Flash lights	7
Sheets of block constructing paper	2
Mirrors (24cm x 14cm)	7
Roll of scotch or masking tape	1
Sheets of 9x12 white poster board	7
Pert dishes (65-95mm)	7
Box straws	1
Box plastic teaspoons	1
200cc plastic graduated beakers	10
120cc dish washing soap	1
120cc white corn syrup	1
Plastic clear plastic boxes with sellable lids (30cmx20cmx13.5cm)	7
Aluminum pie pans	7
Box aluminum foil	1
Box plastic wrap	1
Plastic plates	7
Plastic produce bags	7
Tongs	7
Large bag potting soil	1
Thick cotton cords (appr5cm)	
Table lamps	7
#9800 test tubes with stoppers	7
10ml plastic graduated cylinders	7
Photosynthesis funnels	6
Photosynthesis jars around 22cm tall with lid	6
100ml bottles bromothymol blue	3
Box safety razor blades	1
9 volt batteries	10
Hand lenses	9
Molecular model sets	7
Pencils of the same length sharpened at both ends	14
Digital MultiMate (metex3800)	1
2cmx4cm iron or steel strips	30
Iron washers	30
10cm lengths of insulated wire with alligator clips	45
Boxes miniature bulbs with stand	4
Pieces of #22 wire (15cm long)	21
Bulb holders	7
D batteries in holders	7
Rubber bands (approx. 6cm diameter)	7
Paper clips (any size)	7
Wooden dowels (5cm long)	7
Copper wires (6cm long)	7
Pieces of chalk	7
25ml beakers	7
Wax pencil	1
2cmx2cm strips of copper	14
Rolls universal indicator	

A look at native plants and trees.

The major purpose of this kit is for students to develop an appreciation for the area in which they live. Many students around S.A.'s township schools live in areas where native plants and trees are under serious threat. These trees and plants are removed by people who need space to build houses, need wood for fire as for use as building material.

This kit will provide a way for students to make scientific observations of the area they live in and it will make the students realize that nature can be used as a tool to learn. This kit therefore enables the students to explore the important chemical and physical processes that occur in creation growth and existence of plants and how animals as well as human life depend on plant life.

Unit 1

This unit helps the students to understand why seasons occur. This will lead to an understanding what effects do seasonal changes have on plant life and how do plants cope with changes in the environment.

Standard goals of the unit

- ❖ Analyze and explain the large scale, events dynamic forces and processes that affect the earth's land water and atmospheric system.
- ❖ Explain the factors that affect the gravitational forces on objects

Unit 2

This unit introduces the students to the important structures of cross section of the tree and their functions. By using the annual tree ring, they will be able to relate to the environmental conditions that has influenced that tree.

Standard goals of the unit

- ❖ Compare and contrast how different forms and structures reflect different functions.
- ❖ Identify the physical features of plants and animals that help them live in different environments.
- ❖ Identify advantages and disadvantages of natural resource conservation.

By using the exercise growing together, students can research about a particular tree (found in a botanical garden) and compare the growth of that tree with their own lives.

Unit 3

This unit enables the students to determine the types of pigments found in schoolyard vegetation. During the this experiment, students get the chance to engage in science and apply technological design where they compare different substances by controlling and manipulating other variables. E.g. they will learn that when you compare substances the control should be always kept constant while the compared substances are being changed.

Standard goals of the unit

- ❖ Know and apply the concepts, principles of scientific enquiry
- ❖ Know and apply concepts that describe properties of matter and energy and the interactions thereof
- ❖ Know and apply the accepted practices of science

At the end of this unit students will be able to explain why do plants have different colors and the pigments responsible for each color.

Unit 4,5

This unit allows for the exploration and observation of the student's environment, plants and the ecosystem. This exercise will make the students understand the importance of plants in their communities and the life that these plants support.

Standard goals of the unit

- ❖ Know and apply concepts that describe the interactions between science technology and the society
- ❖ Know and apply concepts that explain how living things interact with each other and their environment.