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FACULTY OF EDUCATION

DEPARTMENT OF APPLIED EDUCATION

**MISCONCEPTION ABOUT PHOTOSYNTHESIS AND RESPIRATION HELD BY
GRADE 11 AND 12 BIOLOGY LEARNERS IN ONATHINGE CIRCUIT IN NAMIBIA.**

BY

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APPROVAL FORM

The undersigned certify that they have read and recommended to the Midlands state University for acceptance, a research project entitled, misconception about photosynthesis and respiration held by Grade 11 and 12 Biology learners in Onathing Circuit in Namibia. Submitted by Uunona Tseline in partial fulfilment of the requirements for the degree of Bachelor of Education Honours Degree in Biology.

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Dedication

This project is dedicated to my lovely late parents.

Abstract

The study sought to investigate the misconception about photosynthesis and respiration held by Grade 11 and 12 Biology learners in Onathing circuit in Namibia.

The research employed the descriptive survey design. Data was gathered through the uses of tests, observations and interviews. The population was made up of 4 secondary schools, 80 learners and 4 Biology teachers. The sample consists of 80 learners 20 from each school and 4 Biology teachers 1 per school. The researcher used random simple sampling in selecting 1 teacher from each school, by the drawing the names of the teachers in a box. The study involved both Grade 11 and 12 students in the secondary school. Stratified random sampling was employed for selecting 20 learners per school each acted as a strata. Simple random sampling was employed whereby names was drawn from a box and 10 was selected from each grade, 10 from Grade 11 and another 10 from Grade 12, make them 20 learners per school and in all 4 secondary school make the 80 (eighty) students. Data were presented in a table form and interpreted. During data analysis, the frequencies of correct responses, incorrect responses because of misconceptions, incorrect responses for lack of evidence of understanding and response items was noted for each item. Percentages of the responds in each category were calculated too. Qualitative data obtained through interviews was summarized and analyses by interpretation. Descriptive statistical analyses quantitative data, it was found that majority of the students had misconceptions about photosynthesis and respiration. The misconception identified was that photosynthesis and respiration are functioning in an opposite and contrasting manner. Learners held misconception that plants photosynthesis during the day, where as they respire at night, another held this misconception that only animals need oxygen for them to survive and more students held misconception that plant photosynthesis, whereas animal respire and many more other misconception. Findings from the study reveal that the terms and explanation used by teachers, presentations of concepts in textbooks and ineffective communication between students and teachers are the cause of students' misconceptions. However it was found that these misconceptions can be minimized or dealt with by use of the conceptual change model when teaching. Recommendations made were that graduating teachers should be well equipped with the various strategies for teaching skills in sciences so as to improve teaching and learning in the subject.

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CHAPTER ONE: THE RESEARCH PROBLEM.

1.1 Introduction

The aim of this study is to look at the misconceptions about photosynthesis and respiration in held by secondary school Grade 11 and 12 students in Onathing circuit in Namibia. This chapter serves to give the background to the study, formulate the statement of the problem, and research questions. The chapter will also outline the significance, delimitation and limitation of the study.

1.2 Background of the study

One of the main barriers that students encounter as they seek to understand science is misconceptions. Teachers are amazed to discover that despite their best efforts, students do not grasp fundamental ideas covered in class. Even when some of the best students give the right answers, they are often only using correctly memorized words, (Mazur, 1997). When probed further, these students reveal their failure to understand the underlying concepts fully.

Thus, in our role as teachers, besides offering students information and helpful examples, we must also guide them on the reasoning processes that leads to algorithms and conceptual generalizations. In many cases students have developed an ability to provide correct solutions to examination problems and questions most of the time, not so much via correct reasoning and conceptual understanding, but rather because they have either come up with generalizations or are familiar with the often-featured questions, (Mazur, 1997). This can have huge Implications when they proceed onward to further learning, as the absences of a fitting understanding or major ideas from the earliest starting of their studies in science subjects. Therefore it is necessary for students to understand the basic concepts in science.

A misconception is an idea that is wrong because it has been based on a failure to understand a situation. According to Fisher, (1998), people form their conceptions of the world and nature, which provide some explanations to commonly observed phenomena. People interpret the world that is received by their sensorial experiences in a way that makes sense for them. These interpretations may vary from person to person and usually they are simplistic and are not in agreement with the accepted scientific theories.

Research finding by Ozmen, (2004) reveal that children bring to science lessons a lot of pre-existing conceptions or misconception which can interfere with students' ability to learn scientific principles or concepts correctly. This understanding has caused science educators to be increasingly concerned about identifying students' difficulties before, during and after instruction in conceptualizing scientific knowledge. However, the in depth of misconception could only be explored if the research focuses on specific topics.

Misconceptions are pervasive they are everywhere: they are on TV, Hollywood films, textbooks and also in other pupils' minds. Even teachers have their misconceptions. There are a plethora of misconceptions students have in regards to science concepts which makes learning much more difficult. These misconceptions make teachers' jobs more challenging because in order for their students to gain a true understanding of science concepts, teachers must address misconceptions first in order to change the way their students think about these science concepts. This is why it is important for teachers to know what misconceptions their students have before instruction, (Mayer, 1987)

Teachers not only need to recognize students' misconceptions, but they also need to know how to address these misconceptions, (McDermott, 1991). If students' thinking and understanding do not change, there is no point in knowing where they struggle. In order for teachers to

address their students' misconceptions, they first need to recognize and address their own misconceptions.

The study seeks to determine if secondary school science teachers accurately identify common misconceptions that students have about photosynthesis and respiration and what they do to address them. According to Larkin (2012), much research has been done on students' misconceptions in science, but most of the research is on concepts in physics and earth science. Research also needs to be done in the other sciences including biology, also known as Living Environment. Photosynthesis and respiration are important concepts Namibian students need to understand. The Namibian senior secondary school (grades 11 & 12) for Living Environment mandate the specific topics and concepts that students need to learn in school.

These performance indicators express what students in middle school should know about photosynthesis and respiration. Unfortunately, students may struggle with these concepts and harbor misconceptions about them. Teachers need to realize this, so they can address their students' misconceptions in order to promote student learning and true understanding. Students learn about photosynthesis and respiration at an early age, but some of them still hold on to their previous ideas and demonstrate their lack of understanding when they reach secondary school even up to university.

1.3 Statement of the problems

Most students come to science classes with a number of misconceptions about the concepts to be learned. These misconceptions act as obstacles to the teaching and learning of science and as such there is a need to identify them and find their sources. The comprehension of these concept has implications regarding understanding the whole processes of photosynthesis and

respiration. Misconceptions have serious consequences on student's learning. The occurrence of these misconception acts as an obstacles to the learning of concepts at more advanced levels. It is important that science, particularly biology teachers find ways of identifying and addressing these misconceptions.

1.4 Research Questions

This research will attempt to answer the following questions:

1. What misconceptions do students have in photosynthesis and respiration?
2. What are the sources of these misconceptions about photosynthesis and respiration?
3. How can these misconceptions be dealt with?

1.5 Significance of the study

This study is an attempt to identify students' misconceptions about photosynthesis and respiration in secondary school, more specifically, the study is to gain a better understanding of the student misconceptions so that teachers can reduce or correct the misconceptions. This study also helps teachers to deal with these student misconceptions. The concepts in photosynthesis and respiration are abstract, so there is great potential for the formation of alternative conceptions as students try to derive meaning from what is said by the teachers or what is written in the textbooks, Thus teachers need to be aware of students misconceptions of photosynthesis and respiration in order to develop teaching strategies to enable their own students to construct ideas of photosynthesis and respiration which are compatible with the scientific concepts in biology.

The study adds value to the current literature on identification and remediation of student's misconceptions. The findings of this study also provide high school teachers with resource

support material based on science education research for the teaching and learning of various aspects of photosynthesis and respiration. The study also enables the researcher to understand the conceptual difficulties held by students in the area of photosynthesis and respiration, the knowledge gained through the study also adds to researcher personal view of conceptual development in this study area. It also helps curriculum developers to improve or work on curriculum development,

1.6 Delimitation of the study

This study was conducted in secondary schools selected in Onathingwe district in Ondangwa town in Oshikoto region, the study focused on identifying student's misconceptions in the topics of photosynthesis and respiration. The respondents were Grade 11 and 12, secondary Biology students and teachers.

1.7 Limitation of the study

The constraints which the researcher encountered include inadequacy of financial resources. The researcher was not able to afford the cost of collecting data from all the schools in the population and therefore she only concentrate on the sample of the population. This study focused on a small number of teachers and biology students; hence it is difficult to generalize the findings to all the students in the country. There is a possibility that respondents to questionnaires and interview might give false information which may lead to the researcher drawing irrelevant conclusions. Hence the research used different instruments to collect the same data.

1.8 Definition of key terms

Misconception – is a conclusion that is wrong because it is based on faulty thinking or facts that are wrong.

Biology – is a natural science concerned with the study of life and living organisms, including their structure, function, growth, evolution, distribution, identification and taxonomy. Sapp (2003)

Photosynthesis – is the process by which plants, some bacteria, and some protist use the energy from sunlight to produce sugar, which cellular respiration converts into ATP, the fuel used by all living things.

Respiration - refers to cellular respiration: the metabolic process by which an organism obtains energy by reacting oxygen with glucose to give water, carbon dioxide and 38ATP (energy).

Concept- It is an explanation of why and how a specific natural phenomenon occurs or a general idea derived or inferred from specific instance occurs.

1.9 Summary

This chapter looked at the background of the study, statement of the problem, research questions, and assumptions of the study and significance of the study. On limitations and delimitation of the study, the researcher stated the factors that constrained the study's findings. Following this unit is chapter two which provides a review of literature related to the research problem

CHAPTER TWO: REVIEW OF RELATED LITERATURE.

2.1 Introduction

This chapter explores the related literature and studies carried out by various authors regarding misconceptions in sciences. The review consists of student's misconceptions about photosynthesis and respiration, as well as misconceptions in other areas in biology. The chapter further looks at sources of misconceptions and how to minimize student misconceptions.

2.2 Conceptual framework.

When students enter a new class, they are not blank slates waiting to be filled with new knowledge. They have many ideas already, and in science, some of these beliefs and ideas do not match up with what is scientifically correct and are therefore considered misconceptions (New York Science Teacher, 2012). Misconceptions can be referred to as a preconceived notion or a conceptual misunderstanding. Many people who have misconceptions do not know their ideas are incorrect and have difficulty changing them (New York Science Teacher, 2012). In order to help students gain a true understanding of concepts in science, teachers need to find out what misconceptions students have and figure out how to address them.

Students harbor several misconceptions in the life sciences including the topics of photosynthesis and respiration. Life science teachers need to understand where students' misconceptions come from so that they will be more knowledgeable on how to dispel them. They also need to be familiar with common misconceptions and make sure that they themselves have sufficient knowledge of the subject matter and do not harbor misconceptions of their own. Life science teachers also need to guide instruction in a way that exposes and addresses these misconceptions in order to overcome them. Research studies have shown that misconceptions

involve conceptual ideas and need to be addressed conceptually (Gooding and Metz, 2011). By using a conceptual change teaching approach, life science teachers can help students identify and overcome their misconceptions in photosynthesis and respiration.

2.3 Students' Misconceptions in photosynthesis and respiration.

Students harbor many misconceptions in the sciences including biology (or life science). The topic of photosynthesis is difficult for students to understand because they have to think conceptually instead of concretely (Marmaroti and Galanopoulou, 2006). This leads to several misconceptions including the autotrophic nature of plants, energy transformations, respiration, and 'inverse respiration' (Canal, 1999; Marmaroti and Galanopoulou, 2006; Ozay and Oztas, 2003).

2.3.1 The autotrophic nature of plants.

Marmaroti and Galanopoulou (2006) administered a questionnaire to 292 Middle students in seven different schools in Greece after the chapter on plant respiration was taught. The results of the questionnaire revealed many student misconceptions. Fifty percent were able to demonstrate their understanding of the autotrophic nature of plants by correctly answering the questions, "Why are plants called autotrophs?" and "Which is the origin of the plant nutrients?" Marmaroti & Galanopoulou, (2006, p. 395).

When students are able to display their knowledge of the autotrophic nature of plants, they demonstrate their ability to conceive that plants are not fed the same way as humans and animals. Students do not have a good understanding of autotrophic feeding according to a study by Ozay and Oztas (2003). They administered a questionnaire to 88 Grade 9 students from a school in Turkey to assess students' misconceptions in photosynthesis and related topics

(Ozay & Oztas, 2003). In this study, they found that students do not realize that plants produce organic materials from carbon dioxide and water (Ozay & Oztas, 2003). Students do not understand why plants are called producers. About half of the ninth grade students questioned in the study by Ozay and Oztas (2003) thought that plants are called producers because they produce fruits or vegetables. Part of the reason why students have difficulty understanding these concepts is because of the multiple meanings of words. Middle school students also have difficulty understanding the chemical reactions involved in energy transformations.

2.3.2 Energy transformations.

Marmaroti and Galanopoulou, (2006) found that only 30% of the middle school students correctly identified where photosynthesis takes place and where chlorophyll is located .This shows that the majority of students do not understand the role chlorophyll has in photosynthesis. Other questions asked students about the role of the sun in photosynthesis. Although 80% of students answered that the sun supplies plants with the energy needed for photosynthesis, 40% answered that the energy is in the form of sunlight and heat (Marmaroti and Galanopoulou, 2006). The ninth grade students also believed the sun keeps plants warm (Ozay and Oztas, 2003). Therefore, students were not able to correctly identify the type of energy needed for photosynthesis.

The students also demonstrated that they do not know how energy is converted during photosynthesis (Marmaroti and Galanopoulou, 2006). The wording of the question may have been misleading, but only 10% of students correctly identified that plants trap light energy to convert it to another form (Marmaroti and Galanopoulou, 2006). Seventy percent of students thought that energy is produced during photosynthesis (Marmaroti and Galanopoulou, 2006). However, one of the fundamental laws of science states that energy cannot be created

(produced) or destroyed. Energy flow is a concept that is important for students to understand because it is broader and encompasses several topics in biology (Ozay and Oztas, 2003). Students also have misconceptions in regards to respiration.

2.3.3. Student misconceptions in respiration

Students often are confused about the reactants and products of photosynthesis (Marmaroti and Galanopoulou, 2006). Sixty-five percent of students were not able to identify the reactants of photosynthesis (Marmaroti and Galanopoulou, 2006). The students who chose the answers that listed oxygen as one of the substances needed for photosynthesis were confusing photosynthesis with respiration (Marmaroti and Galanopoulou, 2006). Sixty-two percent of students accurately identified glucose and oxygen as the products of photosynthesis but when cross-analyzed with the previous question, only 25% of students answered correctly (Marmaroti and Galanopoulou, 2006). Some students have the misconception that green plants only photosynthesize and do not respire (Yenilmez and Tekkaya, 2006). About half of the ninth grade students thought that plant respire only at night (Ozay & Oztas, 2003). They may believe this because photosynthesis only occurs during the day and respiration is sometimes considered to be the inverse of photosynthesis because of their opposite products and reactants.

2.3.4 Inverse respiration.

The concept of inverse respiration is the idea that plant respiration is an inverse gaseous exchange compared to animals (Canal, 1999). This idea causes students to compare plant respiration to that of an animal breathing-taking in and expelling air (Canal, 1999). Inverse respiration also overemphasizes oxygen as a product when the production of glucose is the more important product for plants (Canal, 1999).

The idea of plants breathing like animals relates back to misconceptions from teachers. A teacher's overemphasis on gaseous exchange may lead students to believe this misconception of inverse respiration (Canal, 1999). Teachers need to identify their students' misconceptions as well as their own in order to overcome misconceptions.

2.4 Origin of the students' misconception

Recognizing student misconceptions is an essential component to effectively teaching science. In order to improve science education, educators must recognize how misconceptions are formed and what misconceptions students have for a particular topic. For the purpose of this thesis proposal, the topics of focus will be photosynthesis and respiration. When teachers know the origins of science misconceptions, they are better equipped to address them.

2.4.1 Students' thinking processes

The first step teachers need to take when addressing misconceptions is to understand how they are formed and where they come from. According to Gooding and Metz (2011), misconceptions are formed because of the way our brain stores information. When a person's brain receives new information, it stores this information by making connections to previous information (Gooding & Metz, 2011).

If the new information does not fit with the old, it is reformatted to conform to the existing blueprint (Gooding & Metz, 2011). When this happens, misconceptions are unknowingly created and reinforced as the learner tries to build explanations and solve problems based on faulty reasoning. In other words, sometimes students' current concepts are insufficient in allowing them to successfully understand new observations (Posner, Strike, Hewson, & Gertzog, 1982). When this happens, the students must replace or restructure their current

concepts (Posner et al., 1982). If they do not, they will form misconceptions by trying to force new information to fit into their old concept.

How students process new information and how students think can indicate how successful students will be in understanding respiration concepts (Alparsian, Tekkaya, & Geban, 2003). Formal operational thinkers are more likely to understand difficult science concepts such as respiration because they can reason and process information abstractly and hypothetically (Alparslan et al., 2003). Students who use these process skills are more likely to gain a true understanding of science concepts and less likely to form misconceptions.

Even though misconceptions may be formed unknowingly, they can be fostered and advanced by different experiences. Many factors can foster and advance student misconceptions including the learners themselves (because of the way the brain stores information), media, textbooks, and teachers (Gooding & Metz, 2011).

2.4.2 Misconceptions from media.

Barnett et al. (2006) argue that in order to effectively teach science, teachers need to be cognizant of how popular culture, especially movies, influences students' understanding of science. Hollywood studios try to blend fact with fiction in order to make a movie appear more realistic so the viewer can better relate to it (Frank, 2003). The viewer's perception of reality can become blurred and cause confusion as to what is real and what is not (Frank, 2003). Even though the general public is aware that movies are entertainment and not real, children have difficulty differentiating between the two (Frank, 2003).

Barnett et al. (2006) conducted a study at an urban/suburban middle school to determine what effect watching the movie *The Core* would have on a culturally diverse group of 8th grade

students after completing an Earth Science unit on Earth's interior structure, Earth's magnetic field, earthquakes, and plate tectonics. All 82 students had the same four-week lesson plan. Three of the classes saw *The Core* at the end of the unit in class. The students were interviewed before and after the unit on the Earth with the same questions.

The results showed that students who watched *The Core* were more inclined to think that the inner core was a liquid rather than a solid. All students were unable to give a scientific explanation for the causes of the Earth's magnetic fields. This study found that students who watched *The Core* were influenced by the movie as shown in their responses. They were more inclined to explain their reasoning based on scenes from *The Core* rather than class experiences.

The researchers believed the students' misunderstandings were based on the plausibility of the science in the movie, scientific authority of the main character, and memorable images that outweighed hands-on experiences in class. One of the possible reasons why the proposed scientific explanations in movies are so believable is because they are presented in an intuitive way. Film makers do not want the audience to feel confused which can have a negative impact on their profits. Students could have also thought *The Core* was based on reliable science since they watched it in class. If the teacher sanctions the movie, the students are more likely to accept it as fact. The teacher's thoughts and opinions have a lot of influence on the students' learning, so the teacher needs to make sure that any information presented in the classroom is accurate (Barnett et al., 2006).

2.4.3 Misconceptions from textbooks.

Picture in textbooks can be very misleading and cause students further confusion. I have seen textbooks that contain a diagram portraying the Earth's revolution around the sun shown at an angle which led children to believe that the Earth's upset around the sun appeared at an edge which persuade that the earth's insurgency was extremely curved instead of just marginally circular. That skewed diagram contributes to a widely believed misconception that the reason for seasons is because of the Earth's changing distance from the sun. While that particular diagram is only misleading and not actually wrong, some science textbooks contain incorrect information. John Hubisz performed a study that reviewed science textbooks and he found several errors including pictures of prisms bending light the wrong way, statements about the Statue of Liberty that say it is made of bronze instead of copper, and information about sound that says humans cannot hear below 400 hertz even though there are many piano keys that are below 400 hertz (Walton, 2002).

Some science textbooks have incorrect or misleading information in regard to photosynthesis and respiration. A study by Dikmenli, Cardak, and Oztas (2009) found that there were conceptual problems in 12 out of 15 science and technology textbooks examined that could lead to misconceptions. One textbook stated that living things have developed organs that are used for respiration (Dikmenli et al., 2009). This is not true and this statement also shows that the terminology in textbooks can be confusing. The term respiration is especially confusing because it is sometimes used as a reference to breathing in humans or the exchange of gases on a cellular level. There are textbooks that insinuate that photosynthesis occurs in plants by day and that respiration only occurs at night (Gooding & Metz, 2011). If this were true, plants would die. Plant cells are constantly respiring which is a vital process in all living organisms. This misconception that photosynthesis and respiration cannot occur simultaneously is common

(Yenilmez & Tekkaya, 2006). Many students harbor the misconception that respiration only occurs at night when plants are not able to photosynthesize (Yenilmez & Tekkaya, 2006). Another misconception is that plants do not respire; they only photosynthesize (Yenilmez & Tekkaya, 2006).

Misconceptions can evolve whether or not the information in textbooks is incorrect or deceiving. However, it is challenging for teachers to conquer basic science misinterpretation when science textbooks contain tricky or inaccurate information.

2.4.4 Misconceptions from teachers.

Teachers, without even realizing it, sometimes have misconceptions and teach them to their students (Gooding & Metz, 2011; Stein et al., 2007). When teachers unknowingly pass their misconceptions onto students, these erroneous ideas may never be changed (Gooding & Metz, 2011). The longer students hold on to a misconception, the harder it is to change it.

Several studies have been conducted to determine what misconceptions preservice teachers and classroom teachers have in science and more specifically, photosynthesis and respiration. According to a study by Bursal (2012), at least 40% of the 55 preservice elementary teachers from an American university possessed seven of the 11 common science misconceptions including plants get their food from the soil. Similarly, a study by Cokadar (2012) found that a majority of the 152 prospective elementary teachers who were surveyed did not have a true understanding of photosynthesis and respiration concepts.

Since one of the origins of students' misconceptions in photosynthesis and respiration is teachers, it is important to discover what misconceptions teachers have in this area. Krall, Lott, and Wymer (2008) conducted a study to ascertain conceptions of elementary and middle school

teachers in regards to the role of photosynthesis and respiration in an ecosystem. Participants included 76 in service elementary and middle school teachers from rural school districts. They took a 25 question multiple choice tests to gauge their understanding of life science topics. Responses were analyzed on four different tasks to assess the teachers' understanding of that topic.

In order to obtain a correct answer for the first task, one would need to understand that seed germination and plant growth have different requirements. Plants need water, nutrients from soil, and sunlight while seeds only need water since their nutrients are stored within the seed. Some seeds need a small amount of sunlight to activate germination but not nearly the amount needed for photosynthesis. Forty-seven percent of the teachers answered the question correctly while 42% thought seeds need the same things that plants need i.e. water, nutrients from soil, and sunlight (Krall et al., 2008).

Task two showed that 65% of the participants correctly recognized the cotyledon as the source of food for germinating seeds. The incorrect answers were divided into seeds obtaining food from the soil, seeds making food through photosynthesis, and a young plant not needing food until after it begins to grow (Krall et al., 2008). Task three asked teachers which substance trees use in the largest quantities to develop a large trunk. Only 5% of the teachers correctly identified carbon dioxide as the substance. Thirty-eight percent thought the correct answer was nutrients from the soil and 50% thought it was a combination of carbon dioxide, nutrients from the soil, and sunlight. These results suggest that teachers think other resources are responsible for a plant's biomass instead of gases (Krall et al., 2008).

The fourth task was used to assess the teachers' understanding that plants consume oxygen during respiration (like animals). Only 25% of the participants chose the correct answer which

indicated that plants consume oxygen and release carbon dioxide (Krall et al., 2008). Many students and teachers harbor the misconception that plants only respire at night when actually, they are constantly respiring.

The results on these tasks show that many elementary and middle school teachers have misconceptions about photosynthesis and respiration (Krall et al., 2008). Teachers need to recognize that their students may have the same misconceptions that teachers themselves have and perhaps more or different misconceptions.

2.5 Overcoming Misconceptions

Once teachers have identified the origins of misconceptions and recognized their students' misconceptions as well as their own, they can help students overcome misconceptions and solidify a correct conceptual understanding. The use of a research-based instructional strategy can assist students in overcoming their misconceptions. In order to help correct students' misconceptions teachers can not merely dictate the correct answer (Gooding & Metz, 2011). Effective strategies should give students the opportunity to examine the soundness of their current conceptions as well as discuss and test those beliefs (Cakiroglu, 2006). Misconceptions involve conceptual ideas and need to be addressed conceptually (Gooding & Metz, 2011).

An effective teaching strategy that can be used to challenge students' reasoning is the use of the conceptual change teaching approach (Alparslan et al., 2003; Yenilmez & Tekkaya, 2006). Conceptual change is a theoretical model in which learning is an active process and learners become aware of conceptual relationships and use reason to understand these relationships (Alparslan et al., 2003; Yenilmez & Tekkaya, 2006). This conceptual change theory is based on Piaget's ideas of assimilation, accommodation, and disequilibrium (Alparslan et al., 2003). This

theory focuses on the circumstances needed in order for students' current conceptions to be modified by new conceptions (Alparslan et al., 2003).

According to Posner et al. (1982), this approach proposes that certain conditions must be met in order for a student to have his current concept be replaced by another concept. When a student faces an anomaly with her current conception, she can reject this anomaly as being a fluke or irrelevant, compartmentalize this knowledge to prevent conflict with her current beliefs, try to assimilate the new information into her current conception, or revise her existing conception (Posner et al., 1982). The conceptual change approach proposes two types of conceptual change: assimilation that describes the process where students use existing concepts to deal with new phenomena and accommodation, which describes when students must replace their existing concepts" (Alparslan et al., 2003, p.134). In order for a student to change her way of thinking, she must first become dissatisfied with her existing conception; the new concept needs to provide a better explanation and be understandable (Posner et al., 1982). Then, the new concept must propose solutions to problems and be believable (Posner et al., 1982). Lastly, the new concept must be able to lead to new insights and discoveries (Posner et al., 1982). In this approach, learning involves an interaction between new and previous conceptions (Akpinar, 2007). If these conceptions can be reconciled, learning continues with ease. If they cannot be reconciled, the previous conceptions must be restructured or replaced with the new conceptions (Akpinar, 2007; Kowalski & Taylor, 2004).

Some successful methods for promoting conceptual change in science include inquiry based activities, concept cartoons and conceptual change texts which can be paired with concept mapping or discussion webs. By using these instructional strategies, science teachers are able to identify and address students' misconceptions in photosynthesis and respiration.

2.5.1 Inquiry.

The National Research Council (NRC) (2008) states, “students develop an understanding of the natural world when they are actively engaged in scientific inquiry alone and with others” (p. 29). Thompson (2007) demonstrates an example of scientific inquiry through the “plant-in-a-jar” experiment. The experiment involves planting a small plant in an air-tight jar with moist soil (and a thermometer to monitor the temperature). Each group of students receives their own plant to observe for several months. The students make predictions about the outcome of the plant which usually state that the plant will die in a short period of time. A common misconception is that the plant will use up the water that enters its roots and reduce the total amount of water in the jar which will cause the plant to die. Every couple of days the students make qualitative and quantitative observations and record them in their journals. These observations include the number of leaves on the plant, plant height, the number of flowers, the temperature inside the jar, and descriptions of the plant, soil, and jar. Students also may draw or take a picture. After some time passes they may need to revise their estimates on the plant’s lifespan based on their observations and class discussions. Other inquiry-based activities and discussions can help students better understand transpiration. In this activity, students sometimes think that the plant will use up the air inside the jar and die. The teacher can then lead the students in discussions about photosynthesis and respiration. When they are engaged in inquiry and reflect on this practice, students acquire a better understanding of science (Thompson, 2007). Another tool for helping students overcome misconceptions is the use of concept cartoons (Ekici et al., 2007).

2.5.2 Concept cartoons.

Concept cartoons are cartoons that present the viewer with multiple scientific conceptions about an idea (Keogh & Naylor, 1999). The cartoons contain three to five students whose dialogue contains misconceptions and only one scientifically acceptable answer (Ekici et al., 2007). The concept cartoon helps lead the class into a discussion about which view is considered scientifically acceptable (Keogh & Naylor, 1999). Concept cartoons are successful instructional methods because they are visually appealing and stimulate student involvement in the lesson (Ekici et al., 2007). And more importantly, they identify and eliminate students' misconceptions (Ekici et al., 2007).

In the study performed by Ekici et al. (2007), 24 eighth-grade students were interviewed to determine what misconceptions they had about photosynthesis. Concept cartoons were then developed to help students think about the possible explanations for the specific concept, like food sources for plants as shown in figure 1 (see Appendix A). The class discussions allowed students to hear multiple explanations and challenge their own reasoning. Ekici et al. (2007) found that after the class discussions, all students were able to correctly identify food sources for plants. They also found that most students overcame their misconceptions in the topic of photosynthesis (Ekici et al., 2007).

2.5.3 Conceptual change texts.

One way the conceptual change model can be put into practice is the use of conceptual change texts (Alparslan et al., 2003). In these texts, students are given the identified misconceptions first and then scientific explanations in order to create dissatisfaction (Alparslan et al., 2003). Alparslan et al. (2003) performed a study using conceptual change texts to promote conceptual change in students regarding respiration. The subjects of this study were 68 mixed-gender

students from an urban area high school. The students, ranging in age from 16 to 17 years, were all in eleventh grade. One class was the control group and the other class was randomly assigned to be the experimental group. While the control group was taught with traditional instruction, the experimental group was taught using conceptual change instruction along with conceptual change texts. Results from this study show that students in the experimental group gained a better understanding of respiration concepts compared to students in the control group. All the students were given the Respiration Concepts Test before and after the instructional lessons were taught. The average percentage of correct responses in the pre-test was 48.5% for the experimental group and 41.5% for the control group. The same test was administered as the post-test and 77.4% of the experimental group gave correct responses while only 48.5% of the control group gave correct responses. Alparslan et al. (2003) determined that the scores in the pre-test were not statistically significant, but the scores in the post-test were statistically significant. By using the conceptual change texts, students were confronted with their own misconceptions, causing them to become dissatisfied with their current conceptions and more open to accept scientific explanations. These students participated in activities that helped them revise their current conceptions and allowed them to think and reflect on them (Alparslan et al., 2003). In order to teach using the conceptual change model, teachers need to give students enough time to identify and articulate their current conceptions, scrutinize the soundness of these conceptions and apply new ideas in a familiar context (Alparslan et al., 2003; Tekkaya, 2003). This teaching strategy is based on the theoretical model developed by Posner et al. (1982).

2.5.4 Concept maps.

A slightly different approach to teaching using the conceptual change model is to use conceptual change text along with concept mapping strategy. Tekkaya (2003) performed a study to investigate the effectiveness of using this approach on students' understanding of diffusion and osmosis. The participants in this study included 44 male and female students from two ninth grade classes in an urban area high school. One class was randomly assigned to be the experimental group and the other class was the control group. Both groups received the same amount of instructional time, however, the experimental group was provided with concept maps and conceptual change texts.

All participants took the Diffusion and Osmosis Diagnostic Test as a pre-test and a post-test. There was no significant difference found between the mean scores of the two groups for the pre-test. The experimental group performed significantly better than the control group for the post- test.

The conceptual change method was more successful than the traditional method because the conceptual change approach explicitly addressed students' misconceptions while the other approach did not. This study supports the idea that it is not easy to overcome misconceptions, at least through use of traditional instruction. The important part of the conceptual change method of instruction was "the social interaction provided by teacher guided discussions" (Tekkaya, 2003, p. 13). A discussion web also gives students to opportunity to interact socially.

2.5.5 Discussion webs.

Besides the concept mapping strategy, discussion webs can be paired with conceptual change texts as an instructional method under the conceptual change model (Yenilmez & Tekkaya, 2006). Discussion webs allow students to think individually about their ideas and then discuss

them with others (Yenilmez & Tekkaya, 2006). They use a graphic aid which has a question or statement in the middle and students are asked to agree or disagree and state their reason (Yenilmez & Tekkaya, 2006). Then they discuss their ideas in a small group and reach a general consensus to present to the entire class (Yenilmez & Tekkaya, 2006). In a study by Yenilmez and Tekkaya (2006), 233 students in 8th-grade were split into control and experimental groups to test learning via conceptual change texts and discussion webs. In this urban school, the students were taught by the same teacher using differing methods. The control group received traditional instruction while the experimental group used conceptual change texts and discussion webs. The traditional instruction included lecture/discussion to teach concepts with no thought of students' misconceptions. In the experimental group, the topics were introduced with questions and popular student misconceptions were pointed out explicitly. Students are expected to become dissatisfied with their current conceptions, making way for the scientifically acceptable explanations. The results of this study showed better performance by the experimental group than the control group. The conceptual change approach paired with discussion webs explicitly addressed students' misconceptions, which is needed in order for conceptual change to occur (Yenilmez & Tekkaya, 2006).

2.6. Summary

This chapter was about identifying and addressing students' misconceptions for true understanding in science. Realizing the origins of misconceptions and becoming familiar with common photosynthesis and respiration misconceptions this will help teachers to address their students' misconceptions directly so students can overcome.

CHAPTER THREE: METHODOLOGY

3.1 Introduction

This study was designed to discover what secondary school Grade 11 & 12 science teachers know about the misconceptions their students have about photosynthesis and respiration and what the teachers do to address them. This chapter provides a description of the research methodology adopted for this study, the sampling procedure as well as the research instruments used in the study. Methods of data collection and procedures of data presentation and analysis are also dealt with.

3.2 Research design

In this study the researcher used descriptive survey design because accurate information can be obtained from large number of people with a small sample. The survey as research design leads itself best to answering the research questions asked on this investigation. According to Fraen et al. (1996) the use of descriptive survey is usually associated with feasibility and accuracy. It is a convenient method of data collection and analysis for this study.

The descriptive survey also allows that the information can be collected by means of questionnaires at a relatively low cost. The questionnaire can be distributed to the whole group and collected immediately after completion.

Borg and Gall (1996) argues that the descriptive surveys are useful for exploratory studies and are well suited for producing information about particular characteristics in a population. Descriptive research is a flexible method of research and seeks to find answers to questions through die analysis of various relationships. The researcher gets ideas or information of the

study through making use of interviews, questionnaires, observations or focus group discussions.

Descriptive research is unique in the number of variables employed. Like other types of research, descriptive research can include multiple variables for analysis, yet unlike other methods, it requires only one variable Borg & Gall, 1996). It might also simply report the percentage summary on a single variable, Bany. (1994) Therefore the researcher agrees with Borg and Gall to use descriptive survey as to answer the research questions. The researcher uses descriptive survey as it enables to make use of qualitative and quantitative methods of data collection.

3.3.1 Population

Population group of this study consisted of four secondary schools about 500 ordinary level learners in Grade 11 and 12, and 12 Biology teachers in the circuit.

3.3.2 Sample

According to Rescoe (1975), sample sizes larger than 30 and less than 300 are appropriate for most research. The sample sizes consist of 80 learners, 20 from each school and 4 Biology teachers 1 per schools.

3.3.3 Sampling procedure

The researcher used simple random sampling in selecting 1 teacher per school because the researcher target biology teachers only who are a few in schools, so that each teacher from the school has an equal chance of being selected. This was done by drawing one name of the teachers from the box containing all biology teachers at the school.

The study involves grade 11 and grade 12 students in the secondary school in the district. Stratified random sampling was employed for selection 20 learners per school. Each school acted as strata. Learners were divided into two groups (grade 11 and grade 12) and then simple random was employed where by names was drawn from a box. 10 learners were selected from each grade. Therefore in total was 80 (eighty) learner in all 4 secondary schools.

3.4 Research instruments

An instrument in a research is a tool which the researcher employs to gather information from different sources, such tool include tests, interviews and observations. However in this research study, the researcher selected tests, semi-structured interviews and observation to collect data from students and teachers.

3.4.1 Photosynthesis and respiration misconception test

A test is series of tasks used to obtain systematic observations presumed to be representative of educational attributes.

The test helps the researcher to identify misconceptions of students in the topic of photosynthesis and respiration. The test also helps the researcher to find out if pupils have understood the underlying principles of what they have learnt.

3.4.3 The interview

Interview is a systematic oral technique for obtaining data, directly from an individual. It is a conversation between two or more people, through which information are collected on a particular subject. In order to interact with the teachers and discuss their views of students' alternative answers, interview will be conducted. During the session teachers will be given

opportunities to express their feelings regarding the student misconception toward the issue of photosynthesis and respiration.

Interview is a very effective means to collect information therefore through planned interviews detailed Information can be collected which enables proper analysis of a problem. Interview is a direct method for collecting data in which personal barriers are eliminated; as a result findings from an interview are reliable.

3.4.4 Observation

Observation is recognized as the most direct means of studying people when one is interested in their overt behavior, according to Chiromo (2009). The researcher use observation schedule in order to find out how teachers present photosynthesis and respirations concepts and identifies if there are misconceptions passed to the learners by the biology teachers.

The researcher acted as a complete observer in which the participants were fully aware that they are under investigation. All classes were observed by the researcher for a lesson in a unit and the proceeding of each observation was noted down for the purpose of validation and error collections.

3.5 Data collection procedures

The researcher collected sought of permission from Education Office of Oshikoto region to carry out the research study in the sampled schools. The sampled group of students wrote a test closely monitored so that they do not copy from each other. The researcher then interviewed teachers, the information were summarized for data analysis.

The pupils and teachers involved were informed about the research and assured that they are free to withdraw their consent. The participants were also assured that their responses were treated confidentially. The researcher made sure that no one had access to the data except the researcher. As each student from the sample wrote the test, the researcher ensured that they did not copy from each other to ensure validity of the results.

3.5.1 Validity

Chiromo (2006) says the degree to which research results can be generalized to the population concerns validity of a research. To ensure validity the researcher made sure that the data is collected independently in order to guard against bias. The researcher also made sure that the test had adequate content validity, the questions are spread in such a way that all and issues are covered. The researcher also pilot tested instruments. The researcher also discussed the instruments with the supervisor so that he got necessary assistance; this further ensured the validity and reliability of instruments.

3.5.2 Reliability

In this research the researcher used tests, interview and observation to collect the same information from all respondents in the same condition. This ensures reliability of the instruments. The researcher made sure that the sample is of an acceptable size.

3.5.2 Research Ethics

According to Chiromo (1996) research ethics are the principles of right and wrong that guide researchers when conducting their research. In this study the researcher practiced the following ethical principles in conducting the research: both teachers and students in the sample were informed about the study and the procedure to collect the data were fully explained. Teachers

and students were not allowed to write their names to assure that their responses would be treated in the strictest of confidence.

3.6 Data analysis

The data collected from student test was summarized in a table form and interpreted. During data analysis, the frequencies of correct responses, incorrect responses because of misconceptions, incorrect responses for lack of evidence of understanding and response items was noted for each item. Percentages of the responds in each category were calculated too. Qualitative data obtained through interviews was summarized and analyses by interpretation. Descriptive statistical analyses quantitative data.

3.7 Summary

This chapter covered the research methodology in which the research design used was discussed. The research adopted the descriptive survey design. The target population consists of 500 and only 80 learners who took part in the research. The chapter also explained the data analysis procedures adapted in the study. Photosynthesis and respirations' test, interview and observation were used as data's gathering instruments for this study. The next chapter focuses on data presentation, analysis and discussion.

CHAPTER FOUR: DATA PRESENTATION, ANALYSIS AND DISCUSSION.

4.1 Introduction

This chapter serves to represent, analyze and discuss the findings gathered from the Grade 11 & 12 learners and teachers in Onathing Circuit Namibian. Students' misconceptions have been presented in a tabular form against the corresponding numbers of learners with such misconception. Analysis and discussion of research findings follow after the table. The findings were based upon the students' test, interview for teachers and observation content analysis of written materials. The data was presented according to the research questions as follows:

4.2.1 Research Question 1: Student's misconceptions in photosynthesis and respiration?

Table 4.1 Learners misconception in photosynthesis and respiration misconception.

Items	No. of learners with misconception	No. of learners without misconception
Item 1. Plant's biomass	42	38
Item 2. What happen at midday in a plant	46	34
Item 3. What happen at midnight in a plant	67	13
Item 4. Organisms where photosynthesis happen.	0	80
Item 5. Whether plants and animals needs oxygen for survival.	78	2
Item 6. Ends products of photosynthesis in plants	34	46
Item 7. Comparing photosynthesis and respiration	74	6
Item 8. Difference between respiration and photosynthesis.	68	12
Item 9. Light and dark reaction.	62	18

Item 10. Chemical equation for respiration	0	80
Item 11. Difference between breathing and respiration	78	2
Item 12. Comparison of respiration in plants and animals	49	31

Result presented in the table above shows that in most cases there is a higher numbers of students with misconceptions compared to those without misconception. Item 1 investigated where most plant's biomass come from, this findings reveal that most 52.5 % of the students hold misconception that plants ingest all of their food from the soil, where as 47.5% of this students knows that most of the plant's biomass come from carbon dioxide from the air and water from the soil. This goes hand in hand with a research which was carried out at Arboye Secondary School (ASS) and Dera Secondary School (DSS) in Eastern Arsi Zone, Oromia, by Amente (2012), found out that more than half of the students from each school 54.3% of ASS students and 57.5% of DSS students thought that the mass of the plants mainly comes from the water, not carbon dioxide. This belief of the students may be tied with their chemistry knowledge about the physical properties of carbon dioxide gases. It is very difficult for them to believe that the solid and massive wood of the tree developed due to the chemical reaction of colorless gases (carbon dioxide). However, it is described in their textbook after the work of Van Helmont's experiment biologists found that most of the mass of the tree comes from carbon dioxide which was incorporated into organic compound during photosynthesis, according to Bell (1985).

Item 2 and 3 sought to find out if students know what time of the day photosynthesis and respiration take place, the study shows that 57.5% to 83.8% of the learners held misconception that plants photosynthesis during the day, where as they respire at night, It was also found in

another study, Köse and Uşak (2006), that most of the learners had misconceptions that green plants respire only in nights when there is no light, respiration occurs only in the leaf of plants. But few students 42.5% and 16.2 % are without this misconception, they are aware that at midday mainly photosynthesis and some respiration take place and respiration take place at midnight in the absence of light. From the observation it is concluded that all 4 teachers gives the examples that photosynthesis can only happen during the day when sunlight is available and respiration does not require light and can happen at night.

In item 5, whether plants and animals need oxygen for survival, majority 97.5% of students held this misconception that only animals need oxygen for them to survive. This indicates that the students had conceptual difficulty about the roles of oxygen and carbon dioxide in plants. This may be due to the students' knowledge that gases can only originate from other gases, just as solids originate from other solids. Besides, they also considered oxygen released as a byproduct during light dependent reaction of photosynthesis originated from carbon dioxide. But the origin of oxygen in the process of photosynthesis is from water molecule.

In item 6, products of photosynthesis, here only 42.5% students have a misconception that the major photosynthetic products from photosynthesis is oxygen and glucose and half 57.5% students don't carry this misconception, this result is also consistent with the study of Köse, (2008), whereby the same misconception whereby students do not understand that glucose is stored in plants in a form of starch and sucrose is a simple starch.

Item 7, comparing photosynthesis and respiration the results indicate that 92.5% more students held misconception that plant photosynthesis, whereas animal respire, while 7.5% do not hold this misconception. The research by Riffard and Wan of Gdersee (2001) and Seymour and Longden (1991) revealed that pre-service teachers have misconceptions of the difference of

plant and animal respiration. They even have wrong information, like plants do not respire. This misconception is due to the wrong information that they have. They are educated mostly on animal and human respiration. As a consequence of this study, group work and demonstrative experiments based on the conceptual change approach are more effective than traditional approaches in the elimination of misconceptions in photosynthesis and respiration in plants topic in science education.

The students were required to compare the process of photosynthesis and respiration in plants. In this item, the misconception identified was that photosynthesis and respiration are functioning in an opposite and contrasting manner. This may be due to the oversimplified equations of photosynthesis and respiration that are given in their biology textbook. According to Amente (2012), this misconception was held by 32.8% of ASS students and 33.8% of DSS students. Responses of many students show that as if there is a persistent belief that respiration and photosynthesis are mutually exclusive processes that do not occur at the same time in plants. They thought that plants respire only at night because plants make photosynthesis in the sunlight. In general this finding provides useful indicators that students had conceptual difficulties about the relationship between photosynthesis and respiration in plants.

In item 8, students were asked to differentiate between photosynthesis and respiration. The majority of the student (85%), think that photosynthesis and respiration are the same processes which is not true, and some students held misconception that photosynthesis is the opposite of respiration, but these two are different terms and respiration take place in both plants and animals. Marmaroti and Galanopoulou (2006) presented similar assertions which were evaluated misconceptions about photosynthesis and respiration by thirteen year old Greek students. Authors say that students often think photosynthesis is one of the possible ways how a

plant might respire. Photosynthesis is the process by which plants convert carbon dioxide and water into sugar and oxygen. Photosynthesis requires energy, and a plant's chloroplasts absorb solar energy to fuel these reactions. Photosynthesis can only happen during the day when sunlight is available. While respiration, on the other hand, is the breaking down of sugars and oxygen to provide energy for plant growth. Respiration also produces carbon dioxide and water, essentially the opposite of photosynthesis. Respiration does not require light and can happen also at night, according to Barman et al (2006).

Item 9 light and dark reaction, more than 77.5% students held a misconception that light reactions took place during the day and dark reaction took place in the dark during the night this is the same as in item 12. The students indicated that they had misconceptions about the dark and light reactions of photosynthesis. According To Amente (2012), about 45.7% of ASS students and 43.8% of DSS students believed that plants carry out light reaction of photosynthesis during a day, whereas the dark reaction takes place at night. This misconception probably arose from their biology textbook. The author of Grade 10 biology textbook explained that the mechanism of photosynthesis divided into light and dark reactions of photosynthesis. This makes the students to have misconception on the concept of dark reaction. It is better to use the Calvin cycle or light independent reaction of photosynthesis instead of dark reaction. Barras (1984) suggested that sometimes textbook authors use misleading words that lead students to have misconceptions. In addition to this, textbooks also contain errors and misleading or conflicting illustrations and statements which give rise to misconceptions. Hence, textbooks should not be regarded as a document which is free of error and a document that explain and illustrate concepts perfectly. Thus, periodic revision of the textbooks by publishing

company is necessary. Furthermore, teachers must consult other books, refine their understanding and convey to students present understanding on a subject matter.

In item 10 and 11 students asked about the differences between respiration and breathing. The majority (97.5%) of the students held the misconception that breathing is the same as respiration and 2.5% do not hold this misconception. The misconception held by students was the meaning of respiration; students thought that respiration in plants is the process of breathing. Probably the reason for their misconceptions may be the difference between the scientific and daily language. For example, it is seen that the students use the respiration concept as the same meaning with breathing the act of taking oxygen and giving off carbon dioxide. However, the two events are different from one another; respiration is a chemical event and breathing is a physical event, according to Schmidt (1991).

Item12, most students have a misconception that respiration in plants and animals take place at the same rate, but the rate of respiration in plants is slow and the rate of respiration in animal is fast, because respiration is the process that provides energy for the to use. Animals use more energy overall than plants, and it is not all for movement. It takes an enormous amount of energy to send messages along our nerves, and all animals have nerves except sponges.

4.2.2 Research Question 2; Source of misconceptions about photosynthesis and respiration?

Findings from the study have identified the following sources of these misconceptions; can be misinterpreting of concepts by teachers, it identified the potential sources that generated students' misconceptions such as the terms and explanation used and given by the teacher as well as the textbooks. Ausubel(1963), presents a scientist's view, claiming that the way textbooks and teachers present photosynthesis and respiration, is as if everything is very

simple and clear, but is deluding and misleading. In addition the way the syllabus is structured, topics are not inter-linked might mislead student in understanding the key concepts and also due to simple simple explanation or wrong examples given by teacher.

It also revealed that all teachers agreed that ineffective communication between students and teachers might cause students misconceptions. According to Ozay and Ostas (2003), a lack of effective communication between students and teachers can lead to a mismatch between what is taught and what is learned. However learning in science requires more than just adding new concepts to the knowledge. It often requires realignment in thinking and construction of new ideas that may be in conflict with earlier ideas.

According to the findings of the study, information from the internet, student background and student prior knowledge might cause student misconception. Students come to the classroom with various backgrounds that might help or hinder their correct understanding of scientific concepts. Research has consistently shown that students do not come to the classroom with, blank slates, rather they come with a well-established understanding about how and why everyday things behave as they do, Posner et al (1982), argues that there are a variety of sources of misconceptions, such as experiences encountered in daily life, traditional instruction language and students' knowledge of science. Now day's students read much of information from the internet which they might benefit or they might read wrong information and develop misconceptions.

4.2.3 Research Question 3, how can these misconceptions be dealt with?

Findings reveal that qualified and competent science teachers to teach the subject might eliminate student's misconceptions. Teachers who are competent will understand student's view of science concepts and therefore impact new knowledge. According to the constructivist view of learning, learners' existing ideas are important to make source of new experience and new information, Dufly et al. (1991).

The study identified the use of conceptual change model as ways of minimizing student's misconceptions. Although much research has focused on investigating student misconceptions and developing teaching strategies for conceptual change, few researchers have accused on exploring the cause behind the misconceptions. Boo (1998) showed that conceptual change approach provides a better acquisition of scientific conceptions and removing misconceptions.

However, the findings of the study suggest the use of e-learning as way of minimizing student's misconceptions. For example Cyber School which makes teaching and learning environment more visual rather than conceptual so that students can better relates. Ausubel, (2001) argues that after teaching should begin with children's experience, each new experience made by children in a classroom is organized with the aid of existing concepts. The methods and strategies used in such an environment should guide students towards science, Naiz (1995). To promote meaningful learning, learning process should involve all students' senses. This makes students to conceptualize concepts and find learning fruitful.

4.3 Summary

This chapter presented the findings of the study. The findings revealed that students had misconceptions in the topic of photosynthesis and respiration. From the analysis made it was established that student's background, terms and explanation by teachers and textbooks might

cause students' misconceptions. Lastly ways of eliminating student misconceptions were discussed. Following this unit is chapter five which gives a summary and recommendation.

CHAPTER FIVE: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

4.1 Introduction

This chapter summarizes the research. It gives a summary of the research study and its findings. It also draw conclusion on the findings of the study. The conclusion will be to make recommendations on the possible ways for effective ways of teaching and learning biology in general.

4.2 Summary

The main purpose of this research was to ascertain, identify and address common misconceptions that students have about photosynthesis and respiration, in Biology by the Grade 11 and 12, secondary school leaners, Ontananga circuit, Namibia. The researcher was motivated to the fact that during her teaching practice she found out that most students have misconception when it comes to the topic of photosynthesis and respiration which driver her to carry out the research.

In literature review, it was reported students often bring to science lesson a lot of pre-existing conception or misconception which can interfere their ability to learn scientific concepts correctly. Major sources of students which have been identified in literature are everyday languages, textbook, teachers and poor method of instruction and everyday experiences. The results showed that teachers not only do not know what misconceptions their students have in these topics, but they do not even have a true understanding of what misconceptions are.

They also do not know how to teach in a way that would help students overcome their misconceptions in photosynthesis and respiration. These findings support the prior research

performed in this field. According to Gooding and Mertz (2011), when teacher pass on their misconception onto students, these erroneous ideas may never be changed.

The literature indicates several external factors that might cause learning impediments regarding the concepts of photosynthesis and respiration. Stinner (1995) and Sutton (1996) for example, claim that the analysis of current textbooks is of a pivotal importance because they constitute the most widely and frequency used teaching aids at all educational levels. However, to promote meaningful learning, ways must be found to eliminate or prevent misconceptions. Several research studies suggested that instructional strategies leading to conceptual change could be employed to eliminate students' misconceptions.

The descriptive survey research design was adopted in this study, in which test, interviews and observation were used as data gathering instruments. The study was carried out in 4 (four) selected secondary schools in Onathing circuit. 80 (eighty) students and 4 (four) teachers participated in the study. The researcher used random simple sampling in selecting 1 teacher from each school, biology teachers only by choosing a name of a teacher from the box which was prepared. Stratified random sampling was employed for selecting 20 learners per school, students were divided into Grade 11 and 12 whereby 10 learners from each Grade. Findings from students was presented in a table form, analysis and discussion of research findings were based upon the students' test, interview for teacher and observation was presented according to the research questions.

The research findings revealed that students had misconceptions on the photosynthesis and respiration thinking that they are the same things, that plants gets their foods from the soil to feed them instead of knowing that plants make their own foods. And a believe that plants do not respire and also that respiration and breathing is the same thing.

Findings from the study have identified that terms and explanations used by teachers, presentation of concepts in textbooks and ineffective communication between students and teachers might be sources of student's misconceptions. Teachers proposed that the way the syllabus is structured; topics are not inter-linked and lack of competent sciences teachers are also sources of students' misconceptions. In addition student backgrounds, student prior knowledge and student negative attitude towards the subject might cause student misconceptions.

The study identified the following strategies as ways of minimizing student misconceptions: use of conceptual change model, use of e-learning to make teaching and learning environment become more visual than conceptual so that they can better relate and qualified and competent science teachers to teach the subject.

5.3 Conclusion

From the research findings of the study, students have misconception about photosynthesis and respiration. These misconceptions are the plants biomass, different between respiration and photosynthesis. The findings show that terms and explanations used by teachers, presentation of concepts in textbooks and ineffective communication between students and teachers might contribute to student's misconceptions. The external factors that might mislead students understanding the key concepts are the students' background, negative attitude of students towards the subject and students' prior knowledge. The study identified the following strategies as ways of minimizing students misconceptions; use of conceptual change model, use of e-learning for example cyber school which makes teaching and learning environment more visual than conceptual so that student can better relate.

5.4 Recommendations

The researcher made the following recommendations

- 1) Science teacher education should be improved. Thus graduating teachers should be equipped with the various strategies for teaching skills so as to improve teaching and learning in science.
- 2) Science teacher should be motivated and supported by school administration, parents and community at large.
- 3) Current biology textbooks should be revised to include the element of conceptual change.
- 4) Relevant research results about student misconceptions should be communicated to curriculum developers to inform improvement in the practice.

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APPENDIX 1

TEST

My name is Uunona Tseline, a student at Midlands State University in the department of Applied Education, doing a Bachelor of Education Degree in Biology. I am carrying a research on the misconception about photosynthesis and respiration held by Grade 11 & 12, in Namibian Secondary Schools and effects it might have in the teaching and learning of Science. The information I am gathering is purely for academic purposes and will be treated as confidential. I therefore kindly ask you to answer the following question, Thank you in advance.

DO NOT WRITE YOUR NAME ON THIS SCRIPT.

This consists of questions to test your knowledge of photosynthesis and respiration. Circle the most appropriate answer for each question.

1. Where does most of a plant's biomass come from?
 - a) from the soil
 - b) from carbon dioxide from the air and water from the soil
 - c) from nutrients in the soil
 - d) from water

2. At midday, what is happening in the leaf of a plant?
 - a) Respiration
 - b) Photosynthesis
 - c) Mainly photosynthesis and some respiration
 - d) None of the above

3. At midnight, what is happening in the leaf of a plant?

- a) Respiration
- b) Photosynthesis
- c) Photosynthesis and respiration
- d) None of the above

4. In which organisms does photosynthesis happen?

- a) Plants
- b) Animals
- c) Plants and animals
- d) None of the above

5. Which of the following need oxygen to survive?

- a) Plants
- b) Animals
- c) Plants and animals
- d) None of the above

6. The end product(s) of photosynthesis in plants are oxygen plus:

- a) Glucose
- b) Starch
- c) Starch and Sucrose
- d) Water

7. Thinking about photosynthesis and respiration in plants, which statement is correct:

- a) Photosynthesis is the opposite of respiration
- b) Photosynthesis and respiration both occur in plants
- c) Only photosynthesis occurs in plants
- d) Respiration for maintenance and growth only occurs in the dark

8. Which of the following items comparing the processes of respiration and photosynthesis in plants is true?

Photosynthesis	Respiration
a) Occurs only in green plants.	Occurs only in animals.
b) Occurs in all the plants.	Occurs only in all animals.
c) Occur in green plants if light energy is available.	Occurs in all plants and animals at all times.

9. Photosynthesis takes place in two separate but dependant series of steps, the light reactions and the photosynthetic carbon reduction cycle; this second cycle (also known as the dark reaction / light independent stage / or the Calvin-(Benson-Bassham)* cycle) of photosynthesis occurs:

- a) Only in the dark in intact plants
- b) In the light and dark in intact plants
- c) Only in the light in intact plants, although will work in the dark in a test-tube
- d) None of the above

10. Which of the following choices is the general equation of photosynthesis?

- a) $\text{CO}_2 + \text{energy} \longrightarrow \text{Glucose} + \text{H}_2\text{O}$
- b) $\text{C}_6\text{H}_{12}\text{O}_6 + \text{O}_2 \longrightarrow \text{CO}_2 + \text{H}_2\text{O} + \text{energy}$
- c) $6\text{CO}_2 + 6\text{H}_2\text{O} \longrightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$

11. What is true about breathing and respiration?

- a) Breathing is the exchange of gases and respiration is the formation of chemical energy
- b) They are the same process
- c) They both take place in the mitochondria
- d) None of the above.

12. Which of the following choices about the respiration in plants and animals is true?

- a) Respiration in plants is photosynthesis.
- b) Plants make respiration only nights, animals makes all the time.
- c) There is no difference between respiration in plants and animals, both are similar.

APPENDIX 2

Interview Guide Teachers

Introduction

- Presentation: about the interview and research project.
- Permission to use a tape recorder.
- Question from interviewer regarding interview.

- 1.) What grade level do you currently teach?
- 2.) How long have you been teaching this grade level?
- 3.) Have you had any experience teaching at another grade level?
- 4.) Are you science certified (if so, which science and at what grade levels)?
- 5.) What can you tell me about what a misconception is?
- 6.) How do people/students get science misconceptions? Where do they come from?
- 7.) What are some common biology misconceptions your students have had?
- 8.) As students advance in school, what happens to their science misconceptions?
- 9.) How does a student's misconception affect the success of your science teaching?
- 10.) How much do you think about misconceptions while you are planning a science lesson/before you teach a science lesson?
- 11.) What misconceptions do students have in regard to photosynthesis and respiration, if any?

12.) What have you done to help a student correct a misconception in photosynthesis and respiration?

13.) Has that been effective in dispelling students' misconceptions?

14.) How do you know a student has successfully overcome a science misconception?

APPENDIX 3

OBSERVATION GUIDE FOR THE RESEARCHER

This guide is designed to help the research in observing how the Biology teachers present in photosynthesis and respiration concept during the teaching of Biology

DATE

PERIOD

TOPIC

CLASS

Areas of Observation

a) Teaching and Learning aids used

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b) Definition of Photosynthesis and respiration.

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c) Number of example on Photosynthesis and respiration given

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d) Relation of photosynthesis and respiration to everyday life

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