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Differentiated Teaching Strategies of Selected Topics in Biology

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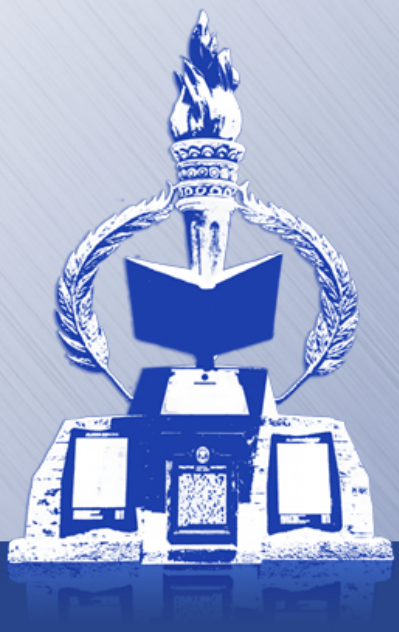

Philippine Normal University
National Center for Teacher Education

Differentiated Teaching Strategies

of Selected Topics in Biology

Presented to

The College of the Graduate Studies and Teacher

Education Research

Philippine Normal University, Manila

In Partial Fulfillment

of the Requirements for the Degree of

Master of Arts in Science Education with Specialization in Biology

Riza Mae O. Salinas

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Philippine Normal University
National Center for Teacher Education

APPROVAL SHEET

This thesis entitled "**DIFFERENTIATED TEACHING STRATEGIES OF SELECTED TOPICS IN BIOLOGY"** prepared and submitted by **RIZA MAE O. SALINAS** in partial fulfillment of the requirements for the degree of Master of Arts in Science Education with specialization in Biology, is hereby recommended for approval and acceptance.

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DEDICATION

This work is dedicated to my family, my Nana and Tata, who raised us well, my siblings, Rikki and Aiza. My loving husband Alvin, and to my one and only daughter Gabbie. This is the least that I can do for all their love and support.

I also dedicate my work to my students who always trust and

love me as their teacher.

To the One and Only God, Source of all goodness and blessings,

to Him be all the Glory.

Philippine Normal University
National Center for Teacher Education

Abstract

Name: Riza Mae O. Salinas

Title: Differentiated Teaching Strategies of Selected Topics in Biology

Key Concepts: Auditory, Differentiated Teaching Strategies, Kinesthetic, Learning Styles, Visual

Degree: Master of Arts in Science Education

Specialization: Biology

Advisers: Prof. Genelita S. Garcia
Prof. Josephine E. Tondo

The present study was designed to compare the effects of differentiated teaching strategies and traditional method in teaching least mastered topics in Biology. More specifically, it answered the following research questions; 1) What are the dominant learning styles of the students in the differentiated group? 2) What are the least mastered topics in Biology? 3) Is there a significant difference between post and pre-test achievement scores of the differentiated and traditional groups? 4) Is there a significant difference between the differentiated and traditional groups in terms of their post achievement scores? 5) Are there significant differences among the post achievement scores of students in the differentiated groups when they are categorized according to their learning styles? And, 6) Are there significant differences among the

changed scores of the subject when they are categorized according to their learning styles?

Sixty Grade 8 participants were used in the study, 30 respondents for the control and 30 participants for the experimental group. A Learning Style Inventory adapted from Clark (2005) was administered to the experimental group. The achievement test was administered to Grade 9 students which revealed the 3 least mastered topics in Biology, and these were Cell Division, Genetics and Digestive System. Both groups were given a pretest before the treatment. The experimental group was taught using the differentiated teaching strategies such as Learning Centers, Cooperative Learning, Anchoring Activity, Tiered Assignment and Role, Audience, Format, Topic while the control group was taught using the traditional method such as lectures and discussion. After the treatment, they were given a parallel set of posttest and the data were analyzed. The results revealed that the dominant learning style was visual (60.0%), Auditory (16.7%) and Kinesthetic (23.3%). The least mastered topics in Biology were also identified and these were; Cell Division, Genetics and Digestive System. It was also revealed that there was a significant difference between the posttest and pretest scores of the two groups.

Another, it was found out that there was a significant difference between the posttest scores of the differentiated and traditional groups.

Results suggested that there was no significant difference in the post achievement scores of the differentiated group when categorized according to their learning styles.

Lastly, it showed that there was a significant difference among the change scores of the subject when categorized according to their learning styles. With these results the researcher came up with the following conclusions; using differentiated teaching strategies were found to be effective in terms of increasing the achievement level of students in Biology, in creating differentiated activities, it is an important consideration to make sure that the learning input is congruent in the learning styles of the students. Their learning styles can be used either to initiate or to accomplish a certain task. It was also revealed in the study that, those students who have auditory learning styles have the highest improvement in terms of their scores.

Finally, the following recommendations are offered by the researcher; differentiated teaching strategies may be used to investigate its effect on the achievement of students in other subject areas such as Social Studies, Physical Education and Filipino, before choosing strategies that will be used in the classroom, learning styles of the students may be considered. Another is, the teaching modalities can be enhanced using differentiated activities tailored to the learning styles of the students, a comparison of the effectiveness of the various

differentiated teaching strategies from one another and before differentiating instruction, a readiness test must be given to the experimental group.

Keywords: Auditory, Differentiated Teaching Strategies, Kinesthetic, Learning Styles, Visual

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CHAPTER I

THE PROBLEM AND ITS BACKGROUND

Introduction

Education in the 21st century is far different from other centuries, it is dominated by technologies and bringing these technologies in the field of teaching and learning process. Though many centuries had passed, and these centuries were far behind from each other, still the role of the teacher remains unchanged, and that is to foster change. Teaching is not simply giving instructions or narrating the lesson, but it is more of using pedagogies of learning that will allow the students to maximize their full potentials in acquiring the knowledge and skills.

Aside from imparting changes in the lives of the students, teachers must also learn to adopt and adapt with the changes in the education; such as changes in the curriculum through continuous learning and discovering.

In 2012, the biggest leap and major changes in our education system was marked and that was the implementation of K to 12 curriculum in the Philippines. Since Philippines is among the three remaining countries in the world that still uses a 10 year basic education cycle, it was believed that there is a need to improve the quality of our education system and the implementation of K to 12 curriculum serves the purpose (Velasco,2012) . The major shift in the curriculum is strongly felt mostly by science teachers who have been teaching their specialization for so many years, and these are the Biology, Chemistry and

Physics teachers who are now facing a greater challenge, and that challenge as an educator is to, make sure that meaningful learning will transpire despite changes in the content and curriculum as well. Accepting the challenge means having deeper understanding of the topics and discovering strategies that will fit not only on the topic, not because it is the strategy mastered by the teacher, but it should be a strategy that will meet the needs of the diverse learners of the new curriculum (Tomlinson, 2014).

As the curriculum changes, it is expected that it will change achievement of students by increasing it. According to Owiti (2011), Biology is considered as a powerful tool for social and economic changes. It is also considered as one of the easiest subject, but then different researches revealed that students fail to attain a scientific foundation in Biology (Ross, 2012). Different studies have shown the poor performance of students in Biology.

A study conducted by Lebata (2014), revealed that the performance of high school students in Biology at Lesotho, Africa was really a big disappointment. According to Benito (2007), the poor performance of students in Biology was also evident in the Philippines, based on the results of the National Achievement Test for the school year 2006-2007; it was revealed that more than half of high school students who took the exam achieved low mastery in learning competencies in each subject areas.

Results showed that one out of five students seldom showed mastery in science. In terms of the percentage of students who gained mastery, science has lowest percentage of improvement. It was discovered in the study that an average high school student can answer 5 out of 10 questions correctly in English, Mathematics and Araling Panlipunan while 4 out of 10 in science.

Based on their scores, it was also evident that science is the most difficult subject among high school students. In connection with this, the Division of Bohol issued a memorandum number 41 series of 2009, which puts an emphasis on the least mastered skills in science. As seen from the results of the National Achievement Test for the school year 2005-2006, the following were the least mastered topics in Biology, this include, Genetics which focus on the different chromosomal aberrations, traits which follow the Mendelian principles and traits which do not follow the Mendelian patterns of inheritance. Organ System was also included which focused on the Parts and Functions of the different Organ Systems in plants and animals and Ecosystem with emphasis on Natural and Human Made Ecosystem, and last was Cell Structure and Functions which focused on identifying the different types of cells and its functions (Jala, 2009).Similar with the findings of Cimer (2012), he mentioned that cell division and genetics were perceived by students as two of the most difficult topics to learn. On a study conducted by Owiti (2011), he mentioned different

factors which contribute to student's poor performance. One of them is failure of using appropriate teaching strategies in Biology. When teachers failed to choose the strategies suited for the learner and with the topic, poor achievement becomes evident. One of the suggestions given was to incorporate practical activities that will be used in class.

According to Wood as cited by Lebata (2014), normally most Biology teachers use the traditional way of teaching wherein it involves long lectures, with these learners were given little knowledge on concepts. It also leaves an impression to the learner, that Biology does not require critical thinking but simply memorization of bulk of concepts. Since different technical terms were encountered by the students in their Biology subject, they have no choice but to remember these terms, in order to pass the subject. According to Cimer (2012), one of the factors that caused learning difficulties is the teacher's style of teaching and student's attitude towards the topic. It was mentioned by Benito (2007), that those students who got high scores in the National Achievement Test in science were taught by their science teachers using strategies, which allow students to give various responses and were able to use the deductive method wherein big information were broken into smaller ones. This scenario inside the classroom, stirred the mind of educators and researchers to discover and explore different avenues and strategies for learning suited for the K to 12 curriculum which will increase the achievement level of students.

Nevertheless, teachers are also facing problems posed by the existing individual differences among students and it affects the teaching learning process. Teachers should always make and innovate activities which challenge the curiosity of learners in the areas of cognitive, affective and psychomotor as stated by Aspacio cited by Leonardo (2011). But in a traditional classroom, wherein a teacher uses one strategy for all learners, they failed in accommodating the individual differences that exist among them such as their learning profile, interests, readiness and needs.

This failure results in the low achievement of students. Now, how can a traditional teacher solve this problem? The researcher sees the solution in this problem, through differentiation.

Differentiation is a perspective and philosophy that molds the curriculum, planning, instruction, assessment and classroom management (Arends and Kilcher,2010). Differentiation stems from beliefs about differences among learners, how they learn, learning preferences and individual interests mentioned by Anderson cited by Leonardo (2011). A classroom is filled with various learners, struggling learners, fast, average and those learners who will fit themselves somewhere in between. Within these various categories, they learn in different and unique ways.

In a differentiated classroom, teachers use two or more strategies in order to accomplish a lesson for every topic. These lessons are tailored

around their needs, interests and learning profiles. Teachers aspire to have all their students to learn. To engage students of diverse learning styles in our classrooms, teachers must reach beyond the ways of teaching that worked well for learners. Discovering different strategies suited for the needs of the learners is not an easy task, but as teachers it is their job to make a difference.

CONCEPTUAL FRAMEWORK

A classroom is a place where different individualities exist. These are the different learners with various levels of readiness and learning styles. Aside from existing individual differences, teachers are also facing the present status of science; specifically in Biology which are; low achievement level, failure to attain a scientific foundation in Biology and failure to use appropriate teaching strategies. The low achievement level of students was evident in their poor performance in the National Achievement Test for the school year 2005-2006. It showed that one out of five students seldom showed mastery in science (Benito, 2007).

Second is the failure to attain a scientific foundation in Biology, it happens when students were taught using the traditional method of teaching which focuses more on long discussion rather than hands on experience (Lebata, 2014). Last is when teachers failed to use appropriate teaching strategies; teacher's style of teaching is one of the factors that caused difficulties among the students to learn the concept (Cimer, 2012). When teachers failed to use the appropriate teaching strategies, students failed to

learn and attain a scientific foundation in Biology which eventually results to low achievement. This is the classroom situation and the type of learners that teachers must accommodate at all means.

One of the mistakes of the teachers is when they failed to consider the variances among learners, and it happens when one strategy is being used for all learners inside the classroom which were not tailored to their readiness and learning styles. This is one of the reasons why students failed in class and mastery of the lesson is not achieved, which eventually results to low achievement. Given this scenario, the researcher sees the solution through differentiating instruction.

Differentiation is a practice of modifying the curriculum and teaching strategies to meet the needs of the students. Awareness about the needs of the learners and creating ways to accommodate the various learners are the important goals of differentiating instruction (Arends and Kilcher, 2010). There are three ways to differentiate; through content, process and product.

In differentiating content, it deals with the topic, skills and knowledge related to the subject areas. Another is process, these are the different instructional activities and strategies utilized in the class. Strategies that can be used in differentiating instruction are anchoring activities, learning centers, cooperative learning, tiered assignment and Role, Audience, Format, Topic (RAFT). Last is product, which can be differentiated by allowing the

students to choose the project they want to work with or varying the levels of difficulty of their task.

Differentiated instruction is supported by two key elements and these are; readiness and learning styles. Lev Vygostky's zone of proximal development is one of the most influential theory of differentiated instruction. It supports one of the key elements of differentiated instruction which is readiness. Zone of proximal development is the difference between what a child can do independently and what he/she is capable of doing with targeted assistance. It is proved that individual learned best when they were being taught based on their readiness. Vygotsky used the term "sweet spot" to describe the zone of proximal development, when teaching strategies and activities are designed based on the child's zone of proximal development, students will perform better.

Psychologists revealed that when students are given a task which is not too difficult, and they worked on it with little effort, students are not learning but rather rehearsing (Lui, 2012). Furthermore if the tasks given to students are too challenging, beyond their abilities, it may lead to frustration. Zone of proximal development recommends that teachers should have awareness of the skills in which the child needs guidance and assistance thus, encouragement should be provided so that students will perform better in a given task. In connection with this, the researcher used the principles of zone of proximal development, in designing the activities or tasks that were used

in class. The activities created by the researcher were challenging enough to help them develop new skills around their knowledge and skills that have already been established. Also, the activities and strategies used by the researcher allowed the students, either to work independently and with guided assistance by utilizing cooperative learning strategies which allow them to work collaboratively and freedom to choose the task they want to work on their own.

The second key element of differentiated instruction is learning style. Fleming's model of learning styles known as VAK model cited by Bonk (2008) which are visual, auditory and kinesthetic supports the second key element of differentiated instruction. According to this model, most people possess a dominant or preferred learning style or an evenly balanced blend of the three styles which are visual, auditory and kinesthetic. It was stated in the study of Baykan and Nacar (2007), that the learning styles of every individuals vary, a learner can learn best through one learning style while others learn using two or more learning styles.

Guided with this theory, the teacher identified the dominant learning style of the students, through an inventory test adapted from (Clark, 2005). After identifying the learning styles of the students, they were grouped according to their dominant learning styles. In creating differentiated activities, the learning styles of the students were being considered.

The learning styles of the students were used to accomplish the task in each activity.

For visual learners, activities and strategies which demand for visualization skills such as storytelling, discussion and verbal lectures. For kinesthetic learners, they learn best through body movement, these activities include hands on experimentation and using body language. Guided with these theories, the researcher considered differentiated teaching strategies has something to offer and can bring significant changes in teaching selected topics in Biology under K to 12 curriculum. This study compared differentiated instruction and traditional instruction in providing solutions to the present status of Biology and increasing the achievement level of students.

Similarly, it was revealed in the study that differentiated teaching strategies had a significant difference compared with the traditional method of teaching. This was supported by the study conducted by Tambong (2012), wherein it was found out that students that were taught using differentiated instruction had greater achievement in Geometry in terms of their scores compared to students taught using traditional instruction. In terms of their posttest scores of the differentiated and traditional groups, there was a significant difference, which means that when students were taught under differentiated instruction, they performed at their best. It is supported by the study of (Simpkins (2009), wherein he found out that when fifth grade

students were exposed to differentiated instruction they attained a higher scores in their tests in science.

Moreover, Leonor (2014), found out that using differentiated instruction, encourage students to develop and use different problem solving skills such as decision making and reasoning. Also it was found out that there was no significant difference among the performance of visual, auditory and kinesthetic learners in terms of their posttest scores, as long as the learning input is congruent on their learning styles. When the learning styles of the students were tapped, they performed at their best. It is supported by Beecher and Sweeny (2008) when they found out that differentiated instruction was chosen as one of the methods in bridging the achievement gap. It was observed that dedication in learning was evident among students when the activities were matched on the learning styles of the students. It was mentioned by Koeze (2007), that before a teacher can differentiate, an assessment of student's learning styles must be accomplished and the results of the inventory serves as the guide of the teacher in differentiating instruction.

On the other hand, in terms of their changed scores, there was a significant difference among the change scores of the students when they were categorized according to their learning styles, and auditory got the highest change scores. This was supported by O'Meara (2010), when she mentioned that in differentiating instruction; teachers must identify the learning styles of the students and group them accordingly to their learning

styles. When teachers consider the learning styles of the students, they were given freedom to choose the activities they want to work with it, thus students perform at their best, and yields greater achievement.

These hypotheses were drawn from the present status of Biology which are the; decline in the achievement level, failure to attain a scientific foundation and failure to use appropriate teaching strategies. Identifying the significant difference of the achievement level between those students who were taught using traditional method and differentiated instruction, allowed the researcher to discover appropriate teaching strategies suited on the students, that can be used in classroom instruction, which eventually help the students to attain a scientific foundation in Biology and may lead to an increase in the achievement level in Biology.

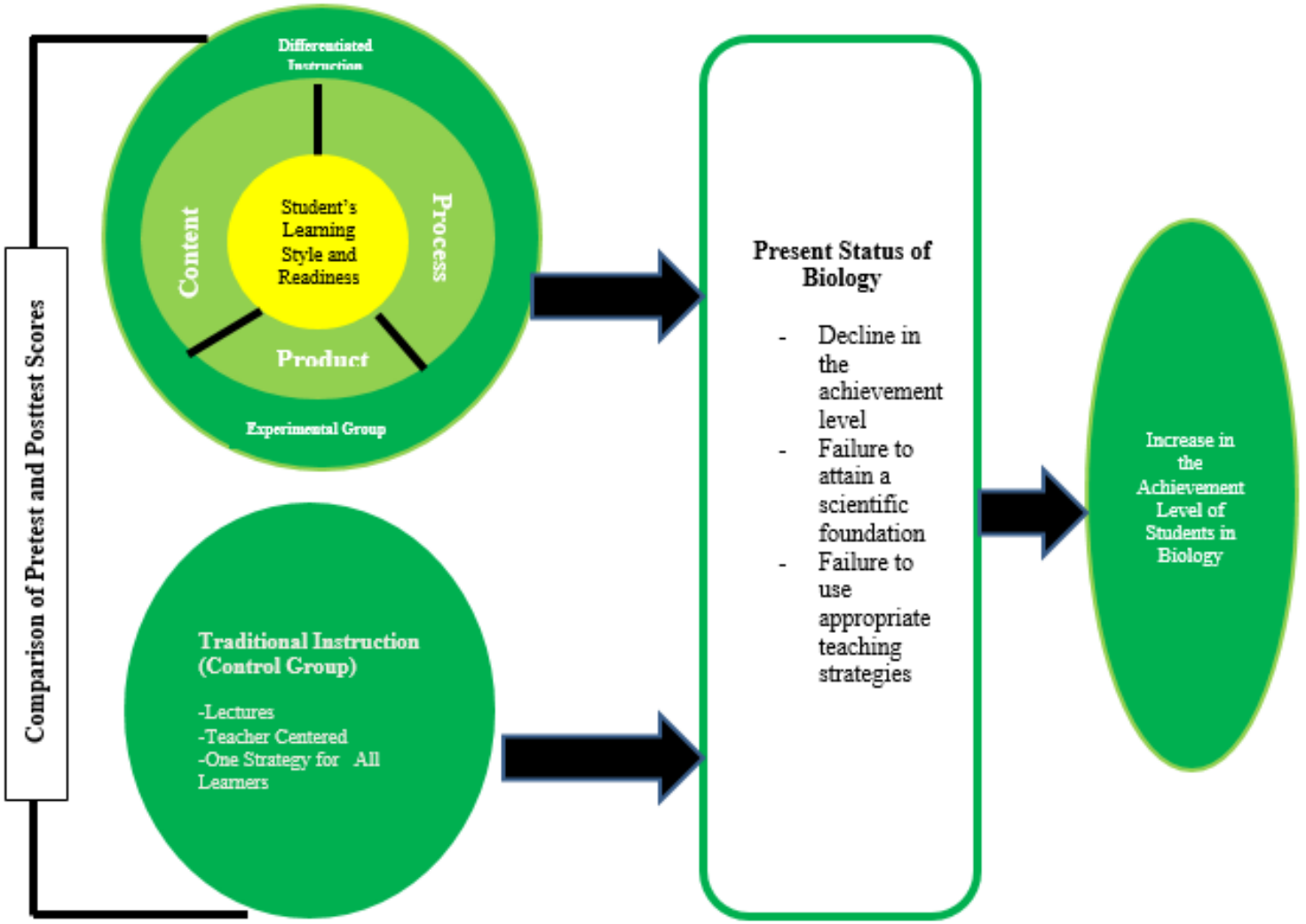


Figure 1. Research Paradigm of the Study

Statement of the Problem

The study in general attempted to examine the effects of differentiated instruction in teaching selected topics in Biology in terms of achievement level of grade eight students of Gen. Emilio Aguinaldo National High School for the school year 2015-2016 using a developed achievement test as an instrument.

Specifically the study sought answers to the following questions;

1. What are the dominant learning styles of the students in the differentiated group?;

2. What are the least mastered topics in Biology of grade 8 students?;

3. Is there a significant difference between post and pre-test achievement scores of the differentiated and traditional groups?;

4. Is there a significant difference between the differentiated and traditional groups in terms of their post achievement scores**?;**

5. Is there a significant difference among the post achievement scores of students in the differentiated groups when they are categorized according to their learning styles?; and

6. Is there a significant difference among the change scores of the subject when they are categorized according to their learning styles?

Research Hypotheses

The study was guided by the following hypotheses;

1. There is no significant difference between the post and pretest achievement scores of the differentiated and traditional groups in terms of their post achievement scores;

2. There is no significant difference between the post achievement scores of the differentiated and traditional groups;

3. There is no significant difference among the post achievement scores of students in the differentiated groups when they are categorized according to their learning styles.

4. There is no significant difference among the change scores of the subject when they are categorized according to their learning styles; and

Significance of the Study

This study aimed to investigate the differentiated teaching strategies that would be used in teaching selected topics in Biology using the researcher's developed achievement test benefits specifically the following;

Learners

Differentiated teaching strategies to be employed inside the classroom would be tailored based on student's learning profile, interests

and readiness. It offers a new approach to teaching and learning wherein both fast and struggling learners would be accommodated and no learners will be left behind. Each learner would be given an equal opportunity to learn and express their ideas, work independently or work collaboratively wherein the teacher would serve as facilitator of learning. Hence students would become responsible of their own learning. Moreover, learners would develop an awareness about the strengths and weaknesses which allowed them to use their potentials in enhancing their academic performance and to improve their weaknesses that may serve as a hindrance for them in optimum learning. After the treatment, both experimental and control groups were taught under differentiated instruction.

Parents

Having awareness in the learning styles of their children would become grounds for them to support and understand their children. It would become easy for the parents to encourage their children to pursue their interests, and provide opportunities for them to develop and maximize their full potentials.

Teachers

The teacher would be given another teaching strategy. This study would reveal the significance of recognizing individual differences inside

the classroom and finding ways to accommodate these differences to elevate student's learning.

It would also inspire teachers to create and modify their lesson plans, strategies, projects and activities based on the learning profile of their students. When teachers were equipped with the knowledge about teaching using differentiated strategies, students will find learning as an enjoyable process, they will perform at their best, which may lead to an increase in their achievement level.

School Administrators

This study may provide a background if there is a need to redesign, strengthen or modify the science curriculum to provide a lifelong learning. School administrators could also provide seminars and trainings on different teaching strategies.

Furthermore, this study would inculcate the research culture among teachers; understand students, and exploring new frontiers on raising student's academic performance in Biology.

Scope and Limitation of the Study

The study focused on using differentiated teaching strategies in selected topics in Biology and increasing the achievement level of students. The topics were Digestive System, Biodiversity, Cell Cycle,

Mitosis, Meiosis and Mendelian Genetics. The research was conducted to two sections of Grade 8 students of Gen. Emilio Aguinaldo National High School, for the school year 2015-2016. The researcher used 60 participants for the study that served as the representative of the population of Grade 8 students. One of the limitations of the study, was the researcher was not able to secure a consent form. However, both the control and experimental groups were informed that they will be used as the respondents of the study. They were given freedom to choose if they will not involve themselves in the study. The researcher used the following differentiated teaching strategies which were; Role, Audience, Format and Topic (RAFT), tiered assignment, anchoring activities, cooperative learning and learning centers.

Definition of Terms

The following terms were defined operationally in accordance to the study.

Anchoring Activities. This refers to the different tasks and activities related to the topic which can be done independently or collaboratively.

Differentiated Teaching Strategies. This refers to the instruction used by the teacher in the experimental group which was based on their learning styles.

Learning Center. This refers to a strategy wherein it uses various "stations" or sets of materials which will be manipulated or used by the students.

Learning Profile. This refers to the individual record of students' dominant learning style

Learning Style. This pertains to the preferred mode of learning. The learning styles used in the study were visual, auditory and kinesthetic. Visual learning styles, focuses on manipulating images, auditory learning styles is more on the listening skills and kinesthetic learning styles puts emphasis on hands on experimentation.

Process. This refers to the approaches, strategies, and learning activities used by the teacher.

Product. This refers to the tasks chosen by the students to work with and it can be a project or performance based.

Readiness. This refers to the least mastered topics in Biology which the treatments were applied.

Role, Audience, Format, Topic (RAFT). This pertains to a strategy wherein students choose a particular topic, format and role.

Tiered Assignment. This refers to the different types of learning activities at different levels of difficulty and complexity but of the same topic.

Zone of Proximal Development. This pertains to the developmental and readiness level of a child wherein they can work independently or collaboratively.

CHAPTER II

REVIEW OF RELATED LITERATURE

The following paragraphs discuss the current literature on K to 12 Curriculum in Science, K to 12 Curriculum in Biology, Difficulties/ Challenges in Teaching Biology, Differentiated Instruction, Instructional Strategies that Support Differentiation, Congruent Strategies, Differentiated Instruction Similar Researches, and Synthesis of Literature.

K to 12 Curriculum in Science

According to Villamero (2014), the Department of Education had already policies regarding differentiated instruction, and these can be seen in Department of Education Order Number 72, which emphasize the significance of differentiated instruction in increasing the school participation rate of students. It emphasizes the curriculum modifications through adaptation by considering individual's needs and potential. With the implementation of the K to 12 curriculum, it promotes differentiated instruction which can be seen in its principle and that is, creating a curriculum which focus on the learner, comprehensive education and effective teaching and assessment. One of the impacts of Aquino's administration in our country is the major transformation of the curriculum, from Basic Education Curriculum (BEC), it was changed to K to 12 curriculum."K-12" means kindergarten and the 12 years of elementary and secondary education, which was later changed into K to 12. Under K to 12 curriculum, there are four levels of education that a learner must undertake these are; kindergarten, elementary education, junior high school and senior high school. A five year old child is

expected to be in the kindergarten, followed by six years of elementary education, four years of junior high school or secondary education and additional two years for senior high school. The K to 12 curriculum aims to produce "holistically developed learners with 21st century skills". Furthermore, K to 12 curriculum is learner-centered which promotes a lifelong learning while meeting the basic learning needs.

Activities which encompass meaningful and authentic learning experiences which entail critical thinking are being incorporated in the lesson. In terms of science it will be reflected in practical use (Velasco,2012).

The main feature of the K to 12 curriculum is the uplifting of the basic education curriculum, that will produce learners that will have skills they will used and have a contribution in the society. Through the collaborative effort of Commission on Higher Education and the Technical Education and Skills Development Authority, the program will offer professionally designed classes, apprenticeships in sports, arts, middle level skills, entrepreneurship and applied math and science. K to 12 program aims to prepare every learner who graduates after senior high school (grade 12) an opportunity for a better employment and entrepreneurship while the high school graduates have the skills to pursue college degree (Luistro, 2012). It is supported by Quismundo of Philippine Daily Inquirer, wherein it is believed that K-12 curriculum will create a more significant education to Filipino students. It will craft a more learner centered curriculum. New curriculum is being planned and prepared by top officials from academe. Unlike the old curriculum which is more "teacher-centered" and relies heavily on

memorization, K to 12 curriculum is "learner-centered" which aims to develop critical thinkers (Quismundo,2012).

Implementation of K to 12 curriculum is based on the agenda which are the principles of lifelong learning, child centered learning and experiential learning in the Philippine schools. K to 12 is a combination of new and old curriculum (competencies). An interview done to DepEd Undersecretary and for Programs and Projects, Yolanda Quijano emphasized that the approach used in the development of K to 12 is spiral progression especially in Mathematics and Science. The difficulty of the subject matter increases, making connections on concepts and ideas previously learned or what they called as prior knowledge. The concepts and skills they've learned in their previous grade will be pre -requisite in order for them to acquire and learn new skills and concepts. It is believed that this will help the students to achieve mastery in the subject matter (Teves ,2012).

Basic science concepts were included in the grades 1 and 2 subjects, languages, mathematics, and health (under music, arts, physical education and health). Emphasis will be given in the communication skills in the early grades, science concepts will be included in the discussion of other subjects such as reading class. The medium of instruction that will be used is mother tongue (Quismundo, 2012). The shift is strongly felt in the Secondary level, especially in Science, wherein Biology, Chemistry and Physics will no longer be taught as separate subjects, unlike before wherein Biology is taken up by second year students, Chemistry in third year and Physics in fourth year. A vertical articulation or seamless program of completeness is being observed. The role of teachers and their

approach in teaching will be entirely different from the old curriculum. The teacher serves as facilitator of learning, guiding the students on how to become critical thinkers, solve problems and develop higher order thinking skills (Teves, 2012).

Science in the K to 12 curriculum placed an emphasis on the rudimentary concepts in Biology, Chemistry, Physics, and Earth/ Space Science. The degree of complexity across grade levels increases. It is being centered on the development of awareness and understanding about daily problems which learners encounter. In terms of learning time, it should not only be limited in school, it also includes off school learning experiences at home or in community for transfer of learning to take place. Two to four hours may be allotted to allow them to learn independently with others. In terms of assessment, there are four levels which include knowledge, process/skills, understanding, and product/ performance. Knowledge refers to the content and skills that learners should master. Process refers to the intellectual operations for the purpose of constructing meaning and understanding. Understanding refers to the long lasting big ideas, principles and generalization. Product/ Performance refer to the creation evidences which may show the application of their understanding in the concepts in real life situations. The expectations are expressed in specific terms of content and performance standards. Content Standard serves as the criterion of knowledge and skills, it explains what the students are expected to know, how they will demonstrate what they know. Performance standard is the criterion for transfer of learning which is expressed in two ways; students should apply their learning in real life situations, and they must do it independently. The evidence of transfer of learning will be based on the

products or performance created. Students are expected to produce products/ performance as evidence that they can transfer or use their learning in real life situations (Velasco, 2012).

K to 12 Curriculum in Biology

The impact of K to 12 spiral progression is mostly felt in science subjects, wherein grade 8 students will have a dose of four areas of science in every quarter, which are Physics for the First Quarter, Earth Science for the Second Quarter, Chemistry for the Third Quarter and Biology for the Fourth Quarter. In Grade 8 Biology, under Structure and Functions: Focus on Digestive System, learners will gain understanding about the functions of Digestive System and its interaction with circulatory, respiratory and excretory systems in providing the body with nutrients for energy. They will also learn the different diseases due to nutrient deficiency and ingestion of harmful substances as well as their prevention and treatment. For Heredity: Inheritance and Variation of Traits, learners can compare mitosis and meiosis and their role in the cell division cycle. They will have an understanding about the significance of meiosis in maintaining the chromosome number and they are able to predict phenotypic expressions of traits following the Mendelian Pattern of Inheritance. Under Biodiversity, they will have knowledge about the concept of a species and can classify organisms using hierarchical taxonomic system. And the last topic, which is Ecosystem, learners can describe the transfer of energy through the trophic levels, can analyze the roles of organisms in the cycling of materials, can explain the materials cycle in an ecosystem and can suggest ways to minimize human impact on the environment. (K to 12 Science Curriculum Guide, 2013).

Difficulties/ Challenges in Teaching Biology

Biology is being considered as an easy subject, but some researches revealed the poor performance of students in Biology. According to Lebata (2014), the performance of high school students in Biology at Lesotho, Africa was really a big disappointment. It was revealed that, in 2010, there was an increase of 55.48% of failed students in Biology and 27.92% for the passers. The same trend was also observed in 2011, the percentage of passers declined by .73% while the percentage of students who did not pass is about 59.98%. An increase in the performance in Biology became evident in 2012, when the percentage of passers climbed to 33.55% and those who failed lowered down to 44.14%. Most of the learners obtained a passing score. But then their passing scores were not enough to allow them to pursue courses in science. With these the performance of students in Lesotho, Africa was considered worst. It was also identified in the study that one of the factors that play a significant effect in the student's poor performance is the , use of English as a medium of instruction Darling-Hammond;Orleans; Strenberg & Wagner; Yong and Wankoshi cited by Lebata (2014). In terms of using English as a medium of instruction, it was revealed that when students have difficulties in understanding and communicating in English, it becomes difficult for them to learn Biology, which is considered as the most descriptive in nature in all of the sciences (Lebata, 2014). These learners who have weak foundation in English cannot comprehend with the teacher's discussion. Students find it hard also to comprehend, since Biology textbooks are written in a descriptive manner, containing long sentences which demand more for a strong foundation in English vocabularies. It

was emphasized by Lock and Richardson cited by Lebata (2014) that Biology uses a collection of technical terms in presenting various principles, thus students experienced more difficulty in reading.

It was also mentioned by Ross (2012) the weak foundation of students in Biology are brought by these difficulties they encountered in their Biology subjects, which are the following; the first one is content, Biology subject is always associated with numerous contents and terminologies that need memorization, and as our frontiers of knowledge continue to expand, more terminologies and content are being added to Biology textbooks. It is indeed a big challenge for the teacher to capture the interest and let the students master and remember the different terms associated in Biology subject. It was mentioned by Cimer (2012) that there are five topics in Biology which students find it difficult, and these are matter cycles, endocrine system and hormones, respiration, cell division, genes and chromosomes. It was supported by Dikmenli, (2010), when he mentioned that students do not have a conceptual understanding in cell cycle- cell division, mitosis-meiosis, haploid-diploid cells, sister chromatids homologous- chromosomes, and centromere-centrioles. Another difficulty that is being encountered is process, in teaching Biology concepts such as mitosis and meiosis, some teachers simply utter the names and cite the steps in mitosis and meiosis, but then students are not being taught about the science process skills, or to train them on how to think like a scientist. Teachers should give daily examples to which students can easily relate their knowledge. The third difficulty is the terminology, Biology subjects contain the lists of different technical terms, that students must have a mastery, but we need to

ensure that mastery is properly scaffold. It also includes the correct pronunciation and spellings. And the last one is assessment, in giving assessment to the students, the teacher should encourage deep conceptual and contextual thinking not shallow ones, sometimes teachers give too much assessment which does not give opportunity for deep thinking.

Differentiated Instruction

Differentiated instruction has been gaining popularity in American education for many years, but the documents which support the practice of differentiated instruction was created in 1990's**.** Differentiation is a technique and a philosophy that shapes the curriculum, planning, instruction, assessment and classroom management. It is also a practice of modifying the curriculum, teaching strategies and the classroom environment to meet the needs of all students. In order to differentiate, teachers should be aware about the needs of the diverse learners and find ways to provide opportunities to accommodate the various learners in the classrooms (Arends and Kilcher, 2010).

Another definition of differentiated instruction was given by Universal Design for Learning cited in Nevin, Thousand and Villa (2015), wherein it is defined as giving emphasis on the student and accommodating a variety of learners inside the classroom which can be achieved through modification and adjusting of teaching strategies, tasks and products depending on the needs and interest of the students. On the other hand, O'Meara (2010), mentioned that differentiated instruction was used to define as providing individualized instruction. With this definition, it created a lot of misconceptions among teachers, wherein they believed

that they have to prepare different sets of lessons for every learners inside the class, but actually it is a big mistake, teachers identify the needs of the learners, and group them accordingly based on their needs.

As teachers differentiate; students are given opportunity to learn the content and acquire the needed skills. When teachers consider learning styles and intelligences, it become easy for students to choose the activities they want to work with. A differentiated environment promotes a climate of security for all types of students gifted or struggling wherein they are not afraid to take risks and express what they've learned. It was mentioned by Sanchez (2016), the need to be successful, is the motivation of both struggling and gifted learners. Failure to meet this will create an emotional problem among students. Struggling learners who were not supported by their parents will not have enough courage to at least try a certain task but rather lose the interest to learn.

On the other hand, the gifted learners, who were given high expectations, would be afraid to seek help and tend to make excuses about their failures. According to Bellanca, Esparza and Rodriguez (2016), when learners are given encouragement

and support from their parents and teachers, they tend to perform better in school. Allen (2007), mentioned that the teacher's ability to lead the student's towards learning is very crucial in achieving learning. Similarly Garnes and Stronge cited in Langa and Yost (2007), mentioned that one of the qualities of effective teachers is the ability of the teacher to make the students feel that they have an important role to play inside the classroom and their shared ideas are significant. The learning

process that students had in order to obtain knowledge and the knowledge they gained, are what matters most inside a differentiated class (Chapman and Gregory 2012). According to Huebner (2010), teachers are expected to do adaptations in the curriculum tailored on the needs of the learners but students are not expected to adjust and adapt themselves to fit for the curriculum.

Tomlinson as cited in Arends and Kilcher (2010), described a six- part framework for differentiation. It begins with the student and proposes the student's academic readiness, their interests, and their learner's profiles should guide the planning of learning activities. According to Burden and Byrd, (2007), students vary in terms of readiness to work with a particular idea or skill at a given time, topics that they find interesting, and their learning profiles that may be shaped by gender, culture, learning styles or intelligence profile.

Tomlinson as cited in Arends and Kilcher (2010), explained that, differentiation by readiness means broadening student knowledge, moving out from the comfort zone a little bit beyond what they can do independently. Readiness is a student's prior knowledge regarding the particular content or skill (Burden and Byrd 2007).

Knowledge about the prior knowledge of the students plays an important role in differentiating instruction; this is the key point where the teacher should begin in differentiating instruction and later on extending the readiness continuums from basic to more complex that the child can work independently.

The second framework which is differentiation by interest, which means connecting school work related to the student's interests. As defined by Burden and

Byrd (2007), interests refer to a student's affinity, curiosity or passion for a particular topic or skill. Activities and learning tasks should be tailored based on student's interests. When student's interests are capture, they will demonstrate the best learning they will have using their strengths and skills. Differentiating by learning preference means giving a variety of choices of learning tasks/ activities that students can easily relate and use their strengths to accomplish the task.

There are different ways on how curriculum can be differentiated; it includes content, process and product Burden and Byrd (2007).

Content refers to the curriculum, materials and approaches used for students to learn the content. In differentiating content, it deals with the topic, skills, and knowledge related to the subject and materials, on how learning will be accomplished. Since curriculum guide are provided containing the objectives and topics are provided, little differentiation may take place in the content area. There are some ways that a teacher might differentiate access to the content. The teacher may use texts or novels at more than one reading level, may present instruction through both whole to part and part to whole approaches, may use varied text and resource materials, and may provide various types of support for learning, such as using highlighted printed materials mentioned by Tomlinson and Allan cited by Burden and Byrd (2007).

Second is process, which includes the instructional activities or approaches used to help students to learn the curriculum (Burden and Byrd 2007). In differentiating process, it deals with the various and appropriate approaches that a teacher may use in order for the students to have an understanding of the lesson, a

teacher may vary the activity and strategies as long as the learning goal will be attained.

As stated by Tomlinson and Wormelli cited by Burden and Byrd (2007), suggested ways on how process might be differentiated; the teacher may provide options at differing levels of difficulty or options based on differing student's interests, give student's choices about how they express what they learned in a project and differ the amount of teacher and student support for a task.

In differentiating products, the students may choose the projects they want to work with, it can be in the form of portfolio, reports, diagrams or they can make a power point presentation regarding the topics. There are different ways on how products can be differentiated, (Burden and Byrd, 2007).

Teacher may allow students to design products around essential learning goals, may provide product assignments of varying degrees of difficulty to match student readiness, and use a wide variety of assessments. Differentiating instruction demands a lot of time and effort on the part of the teacher, especially in terms of managing student work. They proposed that teachers should develop task cards, student opinion journals, learning logs, note taking formats and student portfolio. Using task cards will serve as a guide for different learning activities and assessments. Learning logs function as a communication between the teacher and student, especially for those who are working on different tasks. Portfolio serves as a monitoring guide where the teacher and students can monitor the progress of their work. Product criteria cards are also helpful tool for teacher, where expectations or

desired outcomes for the work of the student are presented by the teacher (Dodge as cited by Arends and Kilcher 2010).

Instructional Strategies that Support Differentiation

Researchers laid down a number of practices that will offer the basis for differentiation and these are effective classroom management, promoting student engagement and motivation, responding to learning styles, considering student's readiness and zone of proximal development and grouping student for instruction as mentioned by Allan Tomlinson, Hall, and Anderson cited by Huebner, (2014).

Differentiating instruction demands a lot of time and effort on the part of the teacher. In order to differentiate successfully, there are different instructional strategies that support differentiation (Arends and Kilcher, 2010). Chapman and King (2014), mentioned that differentiated instructional strategies are anchored on the philosophy of differentiation wherein the teachers are expected to modify the learning opportunities that will meet the student's needs and achieve the target goals of learning. There are factors to be considered before differentiation takes place and these are the following: First is to develop learner profiles, a learner's profile is an important tool in differentiating instruction, it contains files for student's readiness, interests and abilities that may vary every year and different in every subject area. Learner's profile will be the guide or basis of the teacher as she prepares her activities and task for the learner. Second is, content must be presented in various formats with different levels of difficulty. Content may contain the following materials or activities that are simple and lower than the grade level, average which is within the grade level, complex which higher than the grade level

and professional which is under expert level. Content and materials should be made available up to the expert level.

Aside from these, activities should contain different cognitive processes such as knowledge dimension which includes knowledge, factual, conceptual and procedural. It should also have the processing dimension which allow the students to remember, understand, apply, analyze, and create (Arends and Kilcher,2010). The teacher can also provide choice and learning activities which depend on their interests and capabilities. Choice opportunities may contain different reading selections, research topics, activities, reporting and assessment strategies. Tic-Tac-Toe Strategy is being used in giving choices of learning among students. In this strategy, there are nine options to master a common goal. A student will choose three learning activities in different directions either across diagonally or horizontally. The students will learn about a certain topic after completing all the activities, stated by Coil cited by Arends and Kilcher (2010). The teacher can also consider flexible grouping in a differentiated classroom wherein groupings are not always permanent, students have an opportunity to work alone, with partner or to work in small groups. The different grouping arrangements or flexible grouping give them an opportunity to use their preferred learning styles and explore new ways of learning. Half class strategy is being used as one of the strategy under flexible grouping. In this strategy, the class is divided into halves.

On the first group, the teacher will teach the lesson while the other group performs other task or activities such as working on a graphic organizer or writing.

Then after 10 to 15 minutes, the teacher will move to the second group where she teaches the lesson (Dodge cited in Arends and Kilcher,2010).Learning contracts can also be utilized by the teacher and student. Both the teacher and student agree on the activities and strategies on how the student is going to accomplish what is written in the learning contracts which are based on the student's interests.

Peer tutoring and having mentors /experts inside the classroom can means a lot. Students can work with other students such as preparing for a test or working on an assignment. Advanced students can work on with a mixed group wherein they can tutor the less advanced learner. At the same time advanced learners can work with intellectual peers where they can gain knowledge. Inviting mentors can also provide assistance to less experienced learners, asking assistance from teachers who are from different grade levels to teach a certain topic that they have mastery is a big help. Having experts from different fields such as medicine or engineers that will share their expertise and knowledge in a group of students who like anatomy and math will provide a meaningful experience.

Considering student's multiple intelligences and accommodating these intelligences is another factor to be consider in differentiation (Arends and Kilcher, 2010). Designing learning activities and assignments that focus on the different intelligences and have students choose those that play to their strengths is one way to begin using the ideas of multiple intelligences. Another one is considering learning styles and preferences, students differ in their learning styles and preferences. They vary on how they process the information, and the learning

environments where they want to learn. In terms of learning preferences, some students are verbal learners, others are auditory learners, some students learn visually. Teachers in differentiated instruction, accommodate the different styles and preferences by providing learning activities which are more structured while providing discovery oriented activities. It was mentioned by Brown cited in Huebner, (2010), that a teacher who wants to differentiate can use manipulative, visual aids, charts, audiotapes, stating the clear goals and providing an enriched curriculum.

The teacher can utilize another strategy which is cubing, mentioned by Cowan and Cowan cited by Arends and Kilcher, (2010) which let the students experience the different views and ways of thinking about a topic. Each side of the cubes will include different tasks, assignments and questions which may ask students to remember, understand, analyze, evaluate or create. Students can work in cubing by simply seating together either in groups or pair where they will roll the cube, and tackle the task that rolls up. Students can work alone or help one another. Cubing promotes differentiation, practice student's cognitive processes and helps them link ideas.

Arends and Kilcher (2010), suggested interest centers or learning stations as another strategy that can be used in differentiating instruction. Interest centers can be created in different manner. It can be crafted in different subject areas or a particular topic of a subject. In organizing a learning center, the vital point is that it should be created based on the learning preferences and interests of the students.

Learning centers can be created through using sets of boxes with different activities that are tailored on the student's preferences and interests.

Arends and Kilcher (2010) mentioned that cooperative and problem based learning provide avenue for differentiation. Cooperative learning allows students to work with their group mates and share their ideas with one another. One strategy which uses cooperative learning approach is the Jigsaw. Similar to a Jigsaw the topics are being distributed to the students. They will discover and learn the topic, and they will discuss it with their group mates.

Problem based learning was also suggested by Arends and Kilcher (2010) that can be used in differentiating instruction. It gives opportunity for students to think critically, investigate and solve problems either individually or wit their group mates.

Tiered assignment can be considered by the teacher which is consist of series of activities which are tailored on varying levels of complexity but related to the same essential question or standard (Arends & Kilcher, 2010). RAFT (Role, Audience, Format, Topic) is another strategy that can be utilized in differentiation. In RAFT, the teacher will give opportunity for students to assume different roles and create different products to demonstrate their learning. They are given freedom to assume different roles and responsibilities (Leonardo,2011). According to Doubet and Hockett (2015), establishing a good relationship with their students and peer relationship must be on top of the list.

To become successful in differentiating instruction, teachers must build an ambiance, wherein student's differences are given importance. It also entails proper

planning of activities, techniques and providing opportunities for students to learn and identifying the needs of the learner. It was mentioned by Petty (2009), that the student preference in the teaching methods that will be used in the classroom is also an important consideration. Students will pay more attention if the teaching methods are suited on their needs. Chapman and Gregory (2013), emphasized that as a teacher, it is vital to become aware on the learners "sweet spot" which is the point where there will be a connection with the new learning which yield to effective learning outcomes. According to Gregory and Kaufeldt cited in Chapman and Gregory (2013), to identify student's sweet spot teachers must find ways and create activities that will capture student's interest, providing chances for success and meaningful experiences. Moore (2012), also mentioned that the role of the teacher is to create various avenues in which students can interact. Learning is also enhanced when there is an interaction with their parents, teachers and peers.

Congruent Strategies

The following paragraphs discuss some of the strategies which are suited in discussing the topics in Biology.

A study conducted by Dikmenli ,(2010) which aims to identify the misconception of biology student teachers on cell division through drawings and interviews revealed various problems regarding the concept of cell division. These problems were mostly closely related to meiosis rather than mitosis. Students had difficulties in gaining a conceptual understanding of cell division concepts such as; cell cycle-cell division, mitosis-meiosis, diploid-haploid cells, sister chromatids-homologous chromosomes, centromeres-centrioles and spindle fibers-chromosomes.

As mentioned by Bakar cited by Dikmenli,(2010) emphasized that these misconceptions cannot be eliminated through conventional teaching strategies. It was also suggested to use new teaching strategies such as conceptual maps, conceptual networks, semantic feature analysis and conceptual change tests as mentioned by Tekkaya, Novak and Canas, cited by Dikmenli,(2010). As stated by Kiemeter et.al., cited by Dikmenli, (2010) incorporating student centered learning activities in teaching cell division was also recommended. Utilization of educational materials such as computers can also eliminate misconceptions as mentioned by Cepni et.al., cited by Dikmenli, (2010). Using of models in teaching cell division was also mentioned by Clark et., al cited by Dikmenli (2010).

It was also mentioned in the study of Chinnici, et.al., cited by Dikmenli,(2010) that role playing is an effective strategy in discussing mitosis and meiosis wherein students will act as human chromosomes. In another study conducted by Baccay (2012), she mentioned three strategies that can be used in order to sustain student's interest in genetics and these were the following; using many examples as possible in which students can easily relate to such as the inheritance of their characteristics which can be observed easily . Another strategy was including activities which can capture the interest of the students, and last was incorporating group activities which permit collaborative work.

On the other hand, Rurinda (2014) examined the effectiveness of teaching and learning the topic in biodiversity in Zimbabwe and it was revealed that the strategies used were not student centered, that is why students are not performing well. In terms of teaching the content of biodiversity, it must use examples and

applications that students can easily relate to, activities must be student centered which demands for the active involvement of the students.

It was supported by the study conducted by Okur (2011), wherein it was found out that teachers most often used lecturing, questions and answers and problem solving as a strategy in teaching Biodiversity. It was suggested in the study, that teachers should use strategies which entail active involvement of the students, and develop activities which are student centered. Fieldtrips and cooperative learning were also mentioned as a strategy.

Another strategy was, cooperative learning wherein it was found out that it was more effective compare to traditional teaching in terms of teaching Biology as mentioned by Neri cited by Noble, (2011). In terms of achievement, cooperative learning promotes greater achievement across all age levels, subject areas and almost all tasks as stated by Kagan, cited by Noble,(2011). It was mentioned by Cooper (2010), that there were three important features of cooperative learning and these were; objectives of the group must be well understood by the members, responsibility of each member of the group, and giving the same chances for every members to succeed. It was supported by Harbaugh and White-Cornelius (2010), when they mentioned that building a spirit of cooperation is vital in a learning environment, with these learners are not afraid to perform a task. The National Institute of Health; Sousa and Tomlinson cited in Carbaugh and Doubet (2016) also emphasized that learning experiences were most effective when students were provided with a safe, adjustable and organized environment while the spirit of cooperation was evident.

It was explained by Stahl cited by Noble, (2011) wherein he mentioned that cooperative learning allows the students to use their rational reasoning based on inquiry, scientific method and to solve problems and evaluate science information.

It was also mentioned in the study that to achieve a conceptual understanding of genetics, integration of mitosis and meiosis should be included in the discussion of genetics, specifically law of segregation (Baccay,2012).

In other fields of science such as Chemistry, as mentioned by Zich, cited by Noble (2011), revealed that cooperative learning resulted to greater achievement.

On the other hand, in terms of motivating students, it was mentioned in the study of McCurdy cited by Noble (2011), unmotivated students become active and motivated learners when cooperative learning strategies were employed.

Cooperative learning was considered as one of the strategies used in differentiating instruction. It promotes collaboration, support and lessen academic competition among members (Bradley, 2011). Based from the study of Flaherty and Hackler (2010), it was revealed that differentiated instruction and cooperative learning activities were effective teaching strategies that increase student's intrinsic motivation levels. As seen from their study, that a combination of differentiated instruction and cooperative learning, reinforces the teacher and student, student and student relationship. It was also mentioned that students become more responsible for their own learning and with their group. Also the importance of leadership and teambuilding in accomplishing tasks were realized.

It was supported by Bradley (2011), when she mentioned that differentiated instruction and cooperative learning are perfect combination. As the

teacher differentiates her lessons, the teacher uses the cooperative learning in grouping these students based on their learning needs and learning styles.

Based on the study of Gambari et.al, (2013), it was suggested that computer applications should be encouraged for teaching and learning biology specifically Digestive System. It was also revealed in his study that the use of computer simulations was more effective compare to conventional method of teaching. It was also suggested in her study to use computer simulation in teaching the concept of digestive system. Computer simulation is one of the modes of Computer Assisted Instruction or CAI which gives student opportunity to observe real life phenomenon.

It was also emphasized by Mc Kinney cited by Gambari,2013, wherein he said that one of the most promising computer application is the use of simulation.

As mentioned by Rey, cited by Gambari, (2013), computer simulations improved learners retention. Another strategy that can be utilized is using of interest centers, which provide opportunity for students to choose the learning tasks of their interests and preferences. Interest centers can be used in different topics and subjects. In Biology class, interest center or learning stations can be used in differentiating instruction. In a classroom, a teacher can have a computer station, laboratory station, small group station, a teaching station and assessment station. Various tasks and activities are being completed on each station. It provides individual, pair and small group learning opportunities for students (Arends and Kilcher,2010). It was mentioned by Cox (2011), that learning centers are very helpful in implementing differentiated instruction. Through learning centers, students were given an opportunity to experience various strategies and activities suited on their learner's needs.

The advancement of technology can be used in teaching various topics in Biology. Cheng, Cheng, & Chen, (2012) compared the effects of multimedia computer with the traditional method on the student's learning achievement on selected topics in Biology which is "molecules that dominate secret of life". It was revealed in the study that students who were taught under computer assisted instruction have a higher performance compared to those students who were taught under traditional method. It was also mentioned in the study that, through the use of multimedia computer assisted instruction, teachers can easily discuss those topics that are abstract and phenomenon that required actual observation but impossible to do in real-life situations (Cheng, Cheng & Chen,2012).

Olalere (2010) examined and compared the effects of computer assisted instruction in teaching Biology with the traditional method. 120 first year senior secondary students from three private schools in Oyo States, Nigeria were used as the samples of the study. It was revealed in the study that students performed better when they are being taught with computer assisted instruction regardless if they are being taught individually or cooperatively compared with the conventional method.

It was also recommended in the study to use and develop computer assisted instruction in teaching biology in Nigerian Secondary Schools (Olalere,2010).

Differentiated Instruction Similar Researches

There were various foreign and local studies which support differentiated instruction in motivating students and increasing student's achievement in different areas of discipline. Many studies revealed that differentiated instruction has significant effect to teaching and learning (Nicolae, 2014). It was supported in one of the researches conducted by Buese and Valli (2007), when they mentioned that

one of the solutions in adapting to the changing roles of teachers is the use of differentiated instruction as one of the policy doctrines. Most of the researches about differentiated instruction were in the area of reading and one of them is the study conducted by Schlag cited by Scott (2010) concluded that students improved in terms of instructional reading levels and they've learned different comprehension strategies, mastery of phonemic and decoding skills and attitudes towards reading was also improved.

A similar study about using differentiated instruction in teaching phonics among first grade students was conducted and progress among students became evident (Dahl, Gregor, Lauren, and Scharer,2011).

Another study about reading program which showed that differentiated instruction bring significant changes among Grade five students in terms of fluency in reading and comprehension (Kaniskan, Little, Mccoach, Muller,& Reis,2010).

Differentiated instruction was integrated with a reading software and it yields a positive result among elementary, middle and high school students (Cobb, 2010).

In the field of language arts differentiated instruction can be used as a powerful organizing framework as revealed by McInnes and Tobin (2008). It also showed on how teachers in grade 2 and 3 differentiate instruction in different ways. They used scaffolding by providing a variety of tiered assignments and projects, expert tutoring and guidance.

In terms of improving test scores and sustaining student's interest differentiated instruction become successful and one of these is the study conducted by McAdamis and Subban cited by Scott (2012) found out an improvement in test scores in Missouri. It was also revealed that students become more interested in lesson under differentiated instruction.

It was also evident in the study of Beecher & Sweeny (2008) that in terms of providing meaningful experiences and capturing student's interest, it was revealed in the study that it can be successfully achieved through the utilization of various techniques in teaching such as differentiating content and process, use of learning centers and incorporating different reading materials. It was also mentioned in their study that enrichment and differentiated instruction were selected as methods in bridging the achievement gap. Dedication in learning can be seen among students when the activities are matched on the interests and learning styles of the students.

The effectiveness of differentiated instruction was being tested in mixed ability classroom in 24 elementary classes. It was revealed that the use of

differentiated instruction increases the achievement level of students (Kyriades, Koutseline and Valinde, 2011).

A similar study was conducted by Koutseline and Valinde (2009), wherein teachers were trained on how to differentiate in teaching language in a mixed ability classroom, and the after using the approach a significant increase in the academic achievement was revealed.

The use of differentiated instruction has been gaining popularity in the field of mathematics, different researches support the positive effect of differentiated instruction in mathematics. One of these studies was done by Chamberlin (2010) which uses differentiated instruction in an undergraduate mathematics course. It was revealed that students who were exposed to differentiated instruction attained positive gains in their mathematical understanding which was measured through interviews and analysis of student's output. It was also mentioned in her study that differentiated instruction brought a significant improvement in learning of students under K-12 curriculum.

Another study conducted by Tieso cited by Scott (2012) supported the significant effect of differentiated instruction in terms of improving mathematics achievement. It was revealed that a combination of flexible grouping and differentiated instruction had a positive effect in the achievement of gifted students. It was suggested in the study that the curriculum and activities should capture student's interests and promotes critical thinking that will promote learning which were long lasting. It was also mentioned in the study that flexible grouping combined

with a differentiated or revised curriculum positively impacted achievement for gifted students It was also supported by Ellis et al., as cited by Tambong, (2012), wherein they used differentiated instruction and modified the curriculum, strategies and student work in order to increase the achievement of students in Mathematics. The results of the study revealed a significant increase in student's academic performance

In the field of science, differentiated instruction also played a significant role in increasing the achievement level of students. It was revealed in the study conducted by Simpkins, (2009) which showed the significant effect of differentiated curriculum among fifth grade students in their science subjects. It was also stated that students who received differentiated curriculum enhancements attained a higher scores in their tests.

The use of differentiated science inquiry activities were able to understand the concepts in Chemistry and were able to relate the concepts they've learned in other subject areas. Students were encouraged to demonstrate different skills such decision making, reasoning and planning that can be used in problem solving (Leonor, 2014).

In the Philippines, the effectiveness of differentiated had also been proven effective. One of them was the study conducted by Leonardo (2011) wherein she used differentiated instruction as an approach in improving student's achievement

in Trigonometry in tertiary level and it brought significant improvement in their performance in Trigonometry in the subject.

Tambong (2012) compared differentiated instruction and traditional method in teaching lessons in geometry. It was revealed in the study that differentiated instruction increases the achievement of students in geometry which is measured by their posttest. It was concluded in the study that differentiated instruction is more effective in teaching geometry compared to traditional teaching.

The utilization of differentiated instruction was found out to be more effective than the traditional approach in terms of increasing the achievement level of students. It was also revealed in a study conducted by Salomon & Kansas as cited by Tambong, (2012) wherein they used differentiated instruction in teaching students from Educational Department of University of Mindanao.

Differentiating instruction cannot happen overnight it needs meticulous and careful planning, it requires the teacher to know their student's strengths and weaknesses. Before a teacher can differentiate an assessment must be done, and assessment goes hand in hand with differentiation.

It was supported by Koeze (2007), wherein she suggested that teachers who will differentiate instruction should use different strategies which are tailored based on student's choice and interest. It was also mentioned that before a teacher can differentiate, an assessment of student's learning style must be accomplished and this can be done through learning style inventory. The results of the learning inventory will be the basis and guide of the teacher in differentiating choice and interest. This was

also supported by Hall, Strongman, Meyer, (2009) wherein they pointed out that conducting a pretest and continuous assessment of student readiness and growth is necessary for differentiated instruction.

In terms of providing meaningful experiences and capturing student's interest it was revealed in the study of Beecher & Sweeny (2008) that it can be successfully achieved through the utilization of various techniques in teaching such as differentiating content and process, use of learning centers and incorporating different reading materials.

Synthesis of Literature

Differentiated instruction has been gaining its popularity in the field of teaching and learning. Similar researches conducted by Nicolae (2014), Buese and Valli (2007) revealed that the utilization of differentiated instruction have brought positive effect on the teaching and learning process. It was recommended that differentiated should be included in the policy of doctrines of their school. Different subject areas utilized differentiated instruction and one of them is in terms of improving reading skills.

The same results were also seen in the study of Scott (2012), Dahl, Gregor, Lauren, Scharer (2011) Cobb (2010), Dahl, Kaniskan, Little, Mccoach, Muller and Reis (2010) McInnes, and Tobin (2008) that there were improvements in reading,

comprehension skills, phonemic skills and language fluency when students were exposed to differentiated instruction.

In other field such as Mathematics, differentiated instruction was also found to be effective in terms of improving test scores. These were seen in the study of Scott (2012), Tambong (2012), Leonardo (2011) and Chamberlin (2010), wherein it was found out that differentiated instruction has improved the performance of students in the different areas of Mathematics such as Geometry and Trigonometry.

In terms of comparing traditional and differentiated groups, it was shown in the study of Tambong (2012) that students had a greater achievement under differentiated instruction than traditional instruction.

In other areas such as science, differentiated instruction had brought an increase in the achievement level of students. The same kind of findings were seen in the study of Leonor (2014) and Simpkins (2009),wherein students were able to understand the concepts better under differentiated instruction.

Similar findings were seen in the study of Scott (2012), Beecher and Sweeny (2008), wherein the use of differentiated instruction in providing meaningful experiences among students was successful. The same kind of findings were revealed in the study of Koustidine, Kyriades and Valinde (2011) and Koutseline and Valinde (2009) wherein the utilization of differentiated instruction in a mixed ability classroom was successful.

Today's classroom is filled with different learners each with different needs and capabilities. It is the role of the teacher to find ways to accommodate these differences. As the teachers differentiate her lesson, the existing individual differences were accommodated, an atmosphere of acceptance and belongingness were created.

Through differentiated instruction, the teacher was able to motivate the students to perform at their best while maximizing their full potentials.

Differentiated instruction provides opportunity to discover different avenues for creativity and learning. It has been proven by various researches, in the different academic areas such as Mathematics, Reading and Chemistry. These positive results of differentiated instruction stirred the mind of many researchers to continuously discover the impact of differentiated instruction in fostering changes in the teaching and learning process.

CHAPTER III

RESEARCH METHODOLOGY

This chapter includes the discussion of the research design, the participants of the study, the research instrument, the data gathering procedure and statistical treatment.

Research Design

In this study, the researcher utilized the true-experimental design particularly the pretest and posttest equivalent group design. It is an effective design which shows the cause and effect. The pretest and posttest equivalent group design gives for both control groups and use pretest to measure any difference among the two groups before the treatment (Heffner,2014).

The arithmetic mean was used to describe the scores in the pretest and posttest, and changed scores of both groups before and after the treatments were employed. Then the F test and Randomized Block Design using One Way Anova was used to determine if there is a significant difference in their change scores for the differentiated and traditional groups.

Lastly, various statistical treatments were used to determine the effects of the treatments.

Participants of the Study

The participants in the study included two groups of grade eight students from General Emilio Aguinaldo National High School for the school year 2015-2016.

The control and experimental group had thirty students each. The teacher matched the Third Quarter grades in Science 8(see Appendix A) of the control and experimental. The fishbowl method was used to determine which among the two classes will be the control and experimental. In this method, two boxes were prepared, the first box which contained two kinds of paper. The word "control group" was written on the first paper and the word "experimental group" was written on the second paper. Both papers were folded. The second box contained another 2 sets of paper where the names of the sections were written. The teacher drew a paper from the first box, and another paper from the second box. And as the teacher revealed the results, it shows the experimental group on the first strip of paper and VIII-Ruby on the second paper, which means that VIII- Ruby was the experimental group, and the remaining four sections were the control group.

Threats to Internal Validity

The following were the threats to internal validity which were controlled by the researcher;

History – One of the threats to internal validity in the study was history, and that was when the respondents had already encountered the topics in Biology that will be addressed during the treatment. The researcher was able to address this threat by, including the regular students for both control and experimental groups. Repeaters, Dropped –out and Balik Aral students were not included in the study.

Maturation- Another threat was maturation, it happens when the duration of the treatment was very long, such as it took for almost a year. The researcher was

able to control this by, making sure that the duration of the study covers only the Fourth Quarter Period.

Regression- The third threat was, regression it happens when the researcher purposely select the students for a particular group, wherein the bright students or the slow students will be placed in the experimental group. The researcher was able to address this by matching the grades of the respondents for both groups.

Selection- This threat involved, "people factors", such as the respondents who were more intelligent or be placed in the experimental group. The researcher was able to address this through random selection specifically the fishbowl method, in terms of assigning the section for the control and experimental group.

Testing- Last potential threat was testing, it happens when students became familiar with the test item. In order to control this, the researcher administered a parallel set of posttest.

Threats to External Validity

The following were the threats to external validity which were controlled by the researcher;

Interaction of Selection and Treatment- This threat involved the inability to make conclusions beyond the group. The researcher was able to address this, by making sure that the participation of the respondents in the study is convenient as possible.

Interaction of Setting and Treatment- This came from inability to generalize from the setting where the experiment occurred to another setting. This was address by the researcher by including the scope and limitation of the study,

that the research was administered to Grade 8 students of Gen. Emilio Aguinaldo national High School.

Research Instruments

The following instruments were used by the researcher in the conduct of the study.

A. Learning Style Inventory

To determine the various learning styles of the students, the researcher administered a Learning Styles Self- Assessment Questionnaires (see Appendix B) which was adapted from Clark (2005).The inventory consisted of thirty items which described specific learning styles. The three learning styles included in the inventory visual, auditory and kinesthetic. The results of the inventory were used by the researcher as a guide in creating activities that were used in the study.

B. The Achievement Test

The researcher constructed a 100 item test (see Appendix C) in Biology. The topics that were included in the achievement test were Digestive System, Interactions, Biodiversity, Cell Division and Mendelian Genetics. It served as an item pool to determine the items which will be included in the final draft of the achievement test. The researcher was guided by the following steps in the development and validation of the test.

Stage I - Planning the Test

Stage II - Validation

Stage III - First Trial Run

Stage IV - Item Analysis

Stage V - Evaluation of the Test

Stage I. Planning the Test

A table of specifications was made by the researcher (see Appendix D). The main goal of using a Table of Specifications was to make sure that the test would contain the learning objectives and the items were properly distributed based on the number of days it was taught. The topics included in the 100 item achievement test were Digestive System, Interactions, Biodiversity, Cell Division and Genetics.

Stage II. Face Validation

The achievement test was subjected to validation by three experts using Science Achievement Test by Gronlund (2003) (see Appendix E).The recommendations and suggestions were incorporated in the achievement test.

Stage III. First Trial Run

To determine the language appropriateness of the items, the clarity of test instructions from the point of view of examinee's the second draft of the achievement test was given to grade 9 students.

Stage IV. Item Analysis

The items in the second draft of the achievement test were subjected to item analysis. The Kuder Richardson Formula 21 was used to identify the index of difficulty and index of discrimination (see Appendix F). The following values were used to determine the index of difficulty and index of discrimination.

Difficulty Index	Interpretation
0.8 and above	Easy item
0.2 and below	Difficult
0.21 to 0.79	Average

Discrimination Index	Interpretation
.3 and above	Good, Closer to one is Very good
0.22 to 0.29	Moderate
0.20 and below	Poor

Based on the interpretation, those items which obtained an average difficulty and moderate value in their discrimination index were retained. Therefore, those items with a difficulty index of .21 to .79 and discrimination index of .22 to .29 were retained..

Stage V. Second Trial Run and Evaluation of the Test

Revisions were made in the second draft of the achievement test based on the results of item analysis. The third draft of the achievement test was composed of 50 multiple choice items (see Appendix G).The Table of Specifications (see Appendix H) and 50 Achievement Test (see Appendix H) were subjected to validation by three Biology experts and four Biology teachers. Their suggestions were all included in the final draft of the achievement test. The final draft of the achievement test was presented to her thesis advisers.

C. 30 Item Pretest and Posttest

A thirty item pretest was prepared by the teacher, which was used to determine the readiness level of the students. The pretest questions came from the

fifty item achievement test. A parallel set of posttest was prepared by the teacher which was used to measure if the students gained mastery after the treatment.

D. Differentiated Lesson Plans and Activities

Based on the results of achievement test which revealed the three least mastered topics, the researcher made differentiated lesson plans and activities (see Appendix I) and differentiated lesson plans matrix (see Appendix W) suited on the learning styles of the learner. These were validated by three experts. The researcher adapted two instruments which were used in validating the differentiated lesson plans and activities and these were Lesson Plan Evaluation Hadley (2012) (see Appendix J) and Teacher's Checklist Performance Standard 4: Differentiating Instruction Barge (2012) (see Appendix K).

E. Differentiated Lesson Plans Matrix

The researcher prepared nine differentiated lessons plans for the three least mastered topics in Biology, and these were; Parts and Functions of the Digestive System, Mechanical and Chemical Digestion, Proper Caring of the Digestive System, Cell Cycle, Mitosis, Meiosis, Comparison of Mitosis and Meiosis, Law of Segregation/Independent Assortment and Law of Dominance. The experimental group was taught using the differentiated lesson plans and activities. The activities for each lesson were based on the dominant learning styles of the students, activities were classified into visual, auditory and kinesthetic. The dominant learning styles of the students were used to initiate the tasks on the activities or their dominant learning styles were used in accomplishing the tasks. Also each activity was able to utilize other learning styles in combination with the dominant learning styles of the

students. For example, the kinesthetic activity for mitosis, the students were asked to make models of the different stages of mitosis and in order for them to accomplish the task, they will be guided by the article which describe each stages of mitosis.

In this activity, the auditory learning style was tapped and their dominant learning style was used in accomplishing the task. The students were grouped and seated according to their dominant learning styles during the entire treatment. The researcher used the following strategies and these were; cooperative learning, learning centers, anchoring activities, tiered assignment and RAFT (Role, Audience, Format, Topic). Learning centers, cooperative learning, and anchoring activities were the strategies mostly used during the entire treatment. According to Bradley, (2011), cooperative learning was considered as one of the strategies used in differentiating instruction. It promotes collaboration, support and lessens academic competition among members. Based from the study of Flaherty and Hackler (2010), it was revealed that differentiated instruction and cooperative learning activities were effective teaching strategies that increase student's intrinsic motivation levels.

F. Traditional Lesson Plans and Activities

The researcher prepared nine traditional lessons plans and lesson plans matrix (see Appendix X) for the three least mastered topics in Biology, and these were; Parts and Functions of the Digestive System, Mechanical and Chemical Digestion, Proper Caring of the Digestive System, Cell Cycle, Mitosis, Meiosis, Comparison of Mitosis and Meiosis, Law of Segregation/Independent Assortment

and Law of Dominance. The lesson plans and activities were validated by three experts using the Lesson Plan Evaluation which was adapted from Hadley (2012) (see Appendix J). The following values were used by the researcher to determine acceptability and agreement. The control group was taught using the traditional lesson plans and activities. In a typical traditional classroom, the teacher has the full authority to deliver the information and sole source of knowledge. Traditional lesson plans and activities were not tailored to student's learning styles. Only one strategy and one type of activity were used for all learners inside a traditional classroom.

Acceptability	Interpretation
3.50 - 4.00	Excellent
2.50 - 3.49	Highly Satisfactory
1.50 - 2.49	Satisfactory
1.00 - 1.49	Below Satisfactory

Most of the time, the instructions were delivered through long lectures. It was mentioned by Wood cited by Lebata (2014), usually most Biology teachers used the traditional way of teaching wherein it involves long discussion. According to Wood (2009), he mentioned that traditional teaching strategies failed in accommodating the learning needs of many students. With this failure, it serves as the ground for designing and enhancing strategy. The acceptability and agreement of the differentiated lesson plans were both measured.

Agreement	Interpretation
100	Perfect
90.1 – 99.0	Very High

80.1 – 90.0	High
60.1 – 80.0	Marked Substantial
40.1 – 60.0	Moderate
20.1 – 40.0	Low Negligible
0.01 – 20.0	Negligible
0.00	No Agreement

Table 1. Arithmetic Mean, Acceptability and Agreement for Differentiated Lesson Plan: (Traditional Tool)

Topic	Acceptability[b] Mean	SD	Remarks	Agreement[a] Index	Remarks
1. Cell Cycle	3.1	0.57	Highly Satisfactory	72.95	Marked Substantial
2. Mitosis	3.35	0.55	Highly Satisfactory	75.14	Marked Substantial
3. Meiosis	3.09	0.88	Highly Satisfactory	62.15	Marked Substantial
4. Comparison of Mitosis and Meiosis	3.16	0.54	Highly Satisfactory	2.43	Marked Substantial
5. Digestive System	3.14	0.72	Highly Satisfactory	69.86	Marked Substantial
6. Law of Dominance	2.96	0.8	Highly Satisfactory	60.14	Marked Substantial
7. Law of Segregation	2.98	0.61	Highly Satisfactory	63.99	Marked Substantial
8. Law of Independent Assortment	2.63	0.51	Highly Satisfactory	76.66	Marked Substantial

a. Percentage agreement using linear weights
b. based on Mean

Table 1 exhibits the summary of validation of differentiated lesson plan using the traditional tool based on acceptability and agreement. In terms of acceptability, all eight differentiated lesson plans got a remark of highly satisfactory while in terms of agreement all differentiated lesson plans got a remark of marked substantial. Differentiated lesson plan for Mitosis got the highest mean score of 3.35 while the lesson plan for Law of Independent Assortment got lowest mean score of 2.6.

Table 2. Arithmetic Mean, Acceptability and Agreement for Traditional Lesson Plan (Traditional Tool)

	Acceptability[b]			Agreement[a]	
Topic	**Mean**	**SD**	**Remarks**	**Index**	**Remarks**
1. Cell Cycle	3.1	0.59	Highly Satisfactory	63.68	Marked Substantial
2. Mitosis	3.35	0.55	Highly Satisfactory	75.14	Marked Substantial
3. Meiosis	3.09	0.78	Highly Satisfactory	66.21	Marked Substantial
4. Comparison of Mitosis and Meiosis	3.16	0.58	Highly Satisfactory	73.11	Marked Substantial
5. Digestive System	3.14	0.72	Highly Satisfactory	58.82	Moderate
6. Law of Dominance	2.96	0.82	Highly Satisfactory	59.17	Moderate
7. Law of Segregation	3.38	0.75	Highly Satisfactory	69.84	Marked Substantial
8. Law of Independent Assortment	2.63	0.55	Highly Satisfactory	78.33	Marked Substantial

a. Percentage Agreement using linear weights
b. based on Mean

Table 2 displays the summary of validation of traditional lesson plan using the traditional tool in terms of acceptability and agreement. Based on acceptability, all the lessons plans had a remark of highly satisfactory while in terms of agreement the traditional lesson plans for digestive system and law of dominance received a remark of moderate while the remaining six lesson plans got a remark of marked substantial. In terms of their means scores, the lesson plan for Law of Segregation got a highest mean score of 3.38 while the lesson plan for Law of Independent Assortment got the lowest means score of 2.63. Both lesson plans for Law of Independent Assortment had the same means score.

Table 3. Arithmetic Mean, Acceptability and Agreement for Differentiated Lesson Plan: (Differentiated Tool)

	Acceptability[b]			Agreement[a]	
Topic	**Mean**	**SD**	**Remarks**	**Index**	**Remarks**
1. Cell Cycle	3.42	0.57	Highly Satisfactory	88.33	High
2. Mitosis	3.31	0.61	Highly Satisfactory	71.87	Marked Substantial
3. Meiosis	3.25	0.44	Highly Satisfactory	79.99	Marked Substantial
4. Comparison of Mitosis and Meiosis	3.38	0.46	Highly Satisfactory	78.54	Marked Substantial
5. Digestive System	3.61	0.65	Excellent	70.83	Marked Substantial
6. Law of Dominance	3.19	0.53	Highly Satisfactory	74.65	Marked Substantial
7. Law of Segregation	3.45	0.8	Highly Satisfactory	60.9	Marked Substantial
8. Law of Independent Assortment	3.13	0.42	Highly Satisfactory	75.62	Marked Substantial

a. Percentage Agreement using linear weights
b. based on Mean

Table 3 shows the summary of validation of differentiated lesson plans using differentiated instrument. It was validated based on acceptability and agreement. The differentiated lesson plan for digestive system got a remark of excellent while the remaining seven lesson plans received a remark of highly satisfactory while in terms of agreement, the differentiated lesson plan for cell cycle received a remark of high, while the remaining seven lesson plans received a remarks of marked substantial. In terms of their mean score, the differentiated lesson plan for digestive system received the highest means score of 3.61 while the differentiated lesson plan for Law of Independent Assortment received the lowest mean score of 3.13

Data Gathering Procedures

The study encompassed three phases and these were; the pre- experimental phase, experimental phase and post experimental phase.

The Pre- Experimental Phase

During the pre-experimental phase, the preparation of activities and lesson plans, and the selection of participants were accomplished. The basis in the selection of the participants for the study was their year level and their grades in Science during the Third Quarter.

The Experimental Phase

A Learning Style Self-Assessment Questionnaire was administered to the experimental group for the purpose of identifying the learning styles of the student (**see Appendix M).** Based from the results of the inventory, students were grouped according to their three learning styles (visual, auditory and kinesthetic). The 50-item achievement test was administered to Grade nine students to determine the three least mastered topics in Biology which were be differentiated. Then the teacher administered a 30- item pretest for both control and experimental groups to identify the three least mastered topics in Biology **(see Appendix N).**

Table 4. Anova for Pretest Achievement Scores: Differentiated Group vs. Traditional Group

Treatment	f	Mean	SD	Mean Difference	F-value	Fcrt	df	p level	Remarks
Differentiated	30	9.07	2.33	0.47	0.5	0.482	1,55	<.001	Not Significant
Traditional	30	8.60	2.76						

Table 4 exhibits the pretest achievement scores of control and experimental groups. Based from the following data, the differentiated group had a mean of 9.07 while the traditional group had a mean of 8.60. In terms of their standard deviation during the pretest, the performance of both groups was heterogeneous, with a standard deviation of 2.33 for the differentiated group, while 2.76 for the traditional group. The table also revealed, the computed value of F is .500 with a critical value of 4.02 (1,55). It showed that there was no significant difference between the pretest and posttest scores of the control and experimental group. The two groups were comparable in terms of their pretest.

Statistical Treatment of Data

Based on the nature of problem and data that were gathered, the researcher used the following statistical treatments and these were;

1. Percentage Frequency Distribution and Ranking were used to present the learning styles of the respondents in the experimental group and the least mastered topics in Biology.

2. Arithmetic Mean was used to describe the scores in the pretest, posttest and change scores of the differentiated and traditional groups. It was also used to analyze the results of the expert's validation of the instruments that were used in the study such as lesson plans, activities and achievement test.

3. Coefficient Variation was used to present the summary of change scores of pretest and posttest of the differentiated and traditional

groups as well as the pretest and posttest scores of the auditory, kinesthetic and visual learners of the differentiated group.

4. Standard Deviation was used to examine the variability of the pretest and posttest scores of the control and differentiated groups. It was also used to interpret the result of expert's validation of lesson plans and activities.

5. F test and Randomized Block Design using One Way Anova was used to determine if there is a significant difference between the differentiated and traditional groups in terms of their post achievement scores and to examine if there is a significant difference in the post achievement scores of the students when they were categorized according to their learning styles. Repeated Measures Anova was used to identify if there is a significant difference between the posttest and pretest achievement scores of the differentiated and traditional groups.

Before the treatment, both the control and experimental groups were informed that they will be used as the respondents of the study. They were not obliged to participate rather they were given freedom if they choose not to be involve in the study. During the treatment, both the control and experimental groups were provided will all the necessary activities and materials and enough attention by their teacher to help them learn the concepts well.

Both the control and experimental groups were treated fairly by the teacher, especially during the discussion wherein all the queries and clarifications of the concepts were addressed, they were also guided by the teacher. In the study, the control group was treated fairly as with the experimental group. In terms of the acceptability and agreement, the activities given to control and experimental groups got a similar rank. This implies that the kind and level of difficulty of the activity for both group were the same. The control group was provided by the materials that they used in their activity and guidance was given. After the entire treatment of the study, all classes handled by the researcher including the control and experimental groups were taught using differentiated instruction.

Chapter IV

RESULTS AND DISCUSSION

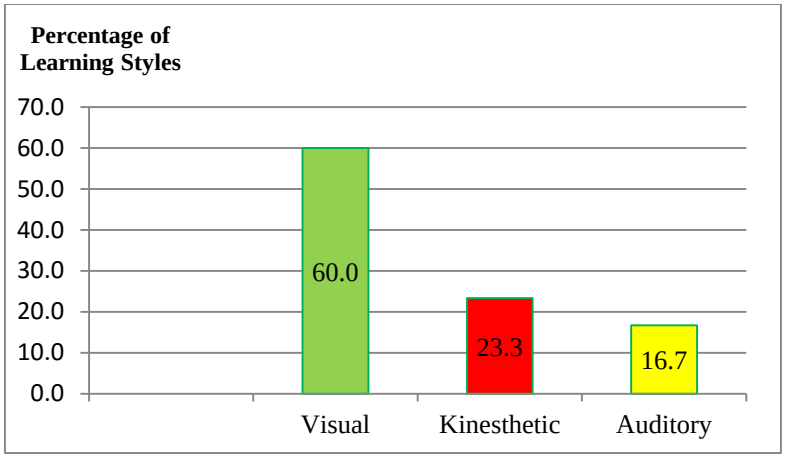
This chapter presents the findings of the study. The presentation of findings and analysis of data were guided by the problem statements presented in Chapter I. It also discusses the results and interpretation of data that were attained during the entire study.

Problem 1: What are the dominant learning styles of the students in the differentiated group?

Table 5. Number of Learning Styles in the Experimental Group

Learning Styles	Frequency	%
Visual	18	60
Kinesthetic	7	23.3
Auditory	5	16.7
Overall	**30**	**100**

Figure 2. Learning Styles in the Experimental Group



Based on the results of the Learning Styles Self- Assessment Questionnaires (see Appendix B) which was adapted from Clark (2005), Table 5 and Figure 2 show the number of learning styles which existed among the subjects in the experimental group. It shows that 18 among the subjects in the experimental group were visual learners which about 60%, 7 among the subjects in the experimental group were kinesthetic learners, which about 23.3% and 5 were auditory learners which about 16.7%. Visual learners had the highest percentage which means that their preferred learning style was through the use of pictures, maps, charts, diagrams and visual organizers. It was followed by kinesthetic which means that these subjects acquire knowledge through demonstration and hands on activities and last was auditory learners, these learners depend on listening activities such as discussions and sharing, and. The results of the learning style inventory was similar to the statement made by Dunn and Dunn as cited in Landrum and Mcduffie (2010), when they mentioned that normally the least preferred learning style was auditory which is 20 to 30 percent of the students while the most preferred learning style is visual which is about 40 percent

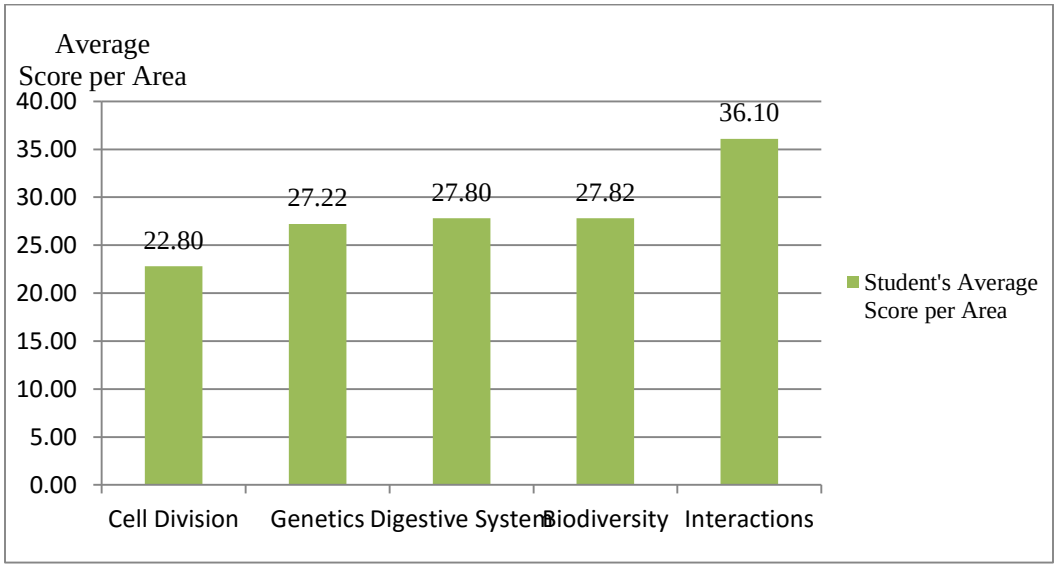
The remaining 30 percent to 40 percent are either kinesthetic or a combination of each learning styles.

Problem 2: What are the least mastered topics in Biology?

Table 6. Least Mastered Topics in Biology

Topics	Total Number of Items (50)	Student's Average Score per Area (Based on Correct Answers)	Rank
Cell Division	10	22.80	1
Genetics	9	27.22	2
Digestive System	10	27.80	3
Biodiversity	11	27.82	4
Interactions	10	36.10	5

Figure 3. Least Mastered Topics in Biology



After administering the achievement test that was validated by three Biology experts using the Science Achievement Test which was adapted from Baccay (2012) (see Appendix E) among grade nine students, Table 6 and Figure 3 provide

information about the least mastered topics in Biology, the total number of items for each topic and the corresponding percentage of incorrect responses. The total number of items per topic was based on the number of days the topics were taught. The table also displays the student's average score per area; Cell Division at rank 1 which is 22.80, followed by Genetics which is 27.22, Digestive System at rank 3 which is 27.80, Biodiversity at rank 4 which is 27.82 and Interactions at rank 5 which is 39.10. The three least mastered topics which were Cell Division, Genetics and Digestive System were taught by the teacher using the traditional strategy for the control and differentiated strategies for the experimental. The findings were supported by Cimer, (2012) when he mentioned that cell division, genes and chromosomes were considered as two of the most difficult topics in Biology. Bannet & Ayuso cited in Baccay (2012), also pointed out that students were not always interested in studying genetics.

Problem 3:

Is there a significant difference between pre and post-test achievement scores of the differentiated and traditional groups?

Table 7. Repeated Measures ANOVA: Posttest vs. Pre-test Differentiated Group

Phase	f	Mean	SD	Mean Difference	F-value	Fcrt	df	p level	Remarks
Post	30	25.03	2.86	15.96	635.57	4.18	1,29	<.001	Significant
Pre	30	9.07	2.33						

Table 7 reveals the mean of the differentiated group during the pretest which was 9.07 and 25.03 during the posttest with a mean difference of 15.96. The performance of the group was heterogeneous during the pretest, as shown by its standard deviation with a value of 2.33. On the other hand, after the posttest, their performance was still heterogeneous as indicated by its standard deviation which is 2.86. It also displays the computed F value which was 635.57, and the tabular value at df (1,29)= 4.18. With these values, the null hypothesis was rejected, it means that there was a significant difference between the posttest and pre–test of the differentiated group.

Table 8. Repeated Measures ANOVA: Posttest vs. Pre-test: Traditional Group

Phase	f	Mean	SD	Mean Difference	F-value	Fcrt	df	p level	Remarks
Post	30	18.4	4.63	9.80	112.49	4.18	1,29	<.001	Significant
Pre	30	8.6	2.76						

On the other hand, Table 8 reflects the mean of the traditional group during the pretest which was 8.6 and 18.4 in the posttest, with a mean difference of 9.80. The standard deviation during the pretest was heterogeneous with a value of 2.76 and still heterogeneous during the posttest as indicated by their standard deviation which is 4.63.

It also displays the computed value of F which was 112.49 with a tabular value at df (1,29)= 4.18. With these values, the null hypothesis was rejected which means that there was a significant difference between the posttest and pre-test of the traditional groups.

Both groups displayed a significant increase in their post and pretest scores, but the differentiated group had a greater increase, with the computed value of F which was 635.57. This shows that, differentiated teaching strategies were more effective in increasing the achievement level of the students in Biology. The findings of the study, were supported by Leonor (2014), when she pointed out that the use of differentiated science inquiry in teaching concepts in Chemistry had improved the understanding and mastery of the concepts in Chemistry. On the other hand, Beecher & Sweeny (2008), stressed in their study that differentiated instruction and enrichment were chosen as a strategy in increasing the achievement level of students.

It was also observed that learners in the differentiated group find enjoyment and excitement in every activity. Learners were not hesitant to ask questions and clarifications. It was supported by Beecher and Sweeny (2008), when they mentioned that commitment in learning is being shown by the learners, when their interests, choices

and learning experiences were tailored on the lesson. As a teacher differentiates, she is promoting a climate of security and acceptance for all types of learners, wherein

learners are given chances to learn the content and express what they've learned without any doubts or fear (Chapman & Gregory, 2012).

Problem 4: Is there a significant difference between the differentiated and traditional groups in terms of their post achievement scores?

Table 9. Anova for Posttest Achievement Scores: Differentiated vs. Traditional

Treatment	f	Mean	SD	Mean Difference	F-value	Fcrt	df	p level	Remarks
Differentiated	30	25.03	2.86	6.63	44.608	4.02	1,55	<.001	Significant
Traditional	30	18.4	4.63						

Based on the results of the 30 item achievement test (see Appendix P) which was administered to the differentiated and traditional groups, Table 9 answers problem number 4, which shows the mean of the differentiated group which was 25.03 was higher as compared to the traditional group with a mean of 18.4. A mean difference of 6.63 was obtained. The performance of the two groups during the posttest was both heterogeneous, based on the results of their standard deviation which were 2.86 for the differentiated and 4.63 for the traditional group. The computed F value which was 44.608 was higher as compared to the critical value of (1,55)= 4.02 p <.001. With these values, the null hypothesis was rejected, which means that, there was a significant difference between the posttest of the differentiated and traditional groups.

The performances of the two groups differ significantly, in favor of the differentiated group. And in terms of their gain scores in the posttest and pretest that was administered by the researcher, the experimental group gained an average of

15.97% while the control group gained an average of 9.80, with a difference of 6.17%. It implies that the treatment used in terms of increasing the achievement level of students in the experimental group was effective, which caused an increase in the posttest scores of the experimental group.

Problem 5: Is there significant differences among the post achievement scores of students in the differentiated groups when they are categorized according to their learning styles?

Table 10. One Way Analysis of Variance Posttest of the Differentiated Group

Treatment	f	Mean	SD	F-value	Fcrt	df	p level	Remarks
Differentiated	30	25.03	2.86	0.265	5.49	2,27	<.001	Not Significant

Table 10 answers question number 5, it shows on the data, that the mean of the differentiated group during the posttest is 25.03, with a standard deviation of 2.86, which reveals that the performance of the differentiated group when they were categorized according to their learning styles was heterogeneous. In terms of their computed F value which is 0.265 as compared with the tabular value df= (2, 27), 5.49 was not significant. It means that there was no significant difference in terms of their achievement scores, when they were categorized according to their learning styles. Achievement in the differentiated instruction was independent with the learning styles, which means that whether the students were visual, auditory and kinesthetic, they

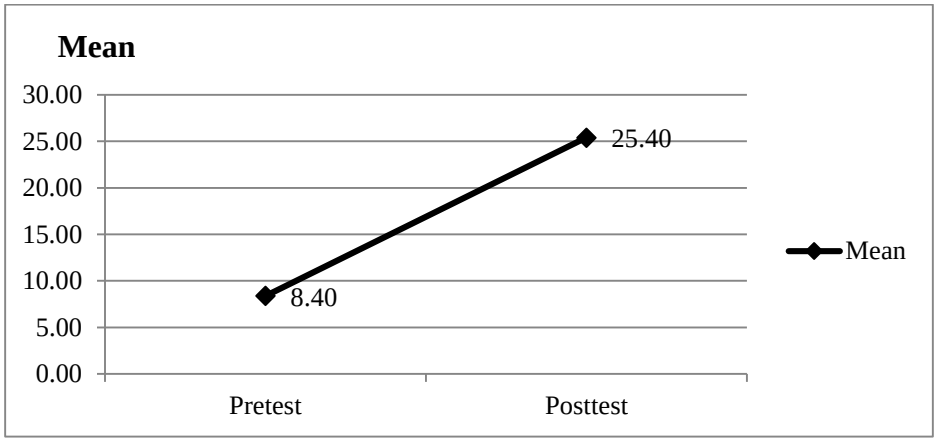
performed well under differentiated \instruction and also implies that learning styles can be used with other teaching strategies.

Problem 6: Is there significant differences among the change scores of the subject when they are categorized according to their learning styles?

Table 11. Summary of Change Scores: Posttest vs. Pretest Auditory Learners

Test	N	Lowest Value	Highest Value	Mean	SD	Coefficient of Variation %
Pre-test	5	6	10	8.40	1.82	0.22
Posttest	5	23	28	25.40	2.07	8.16
Change		17	18	17.00	0.25	7.94

Figure 4. Summary of Mean Change Scores: Posttest vs. Pre-test Auditory Learners

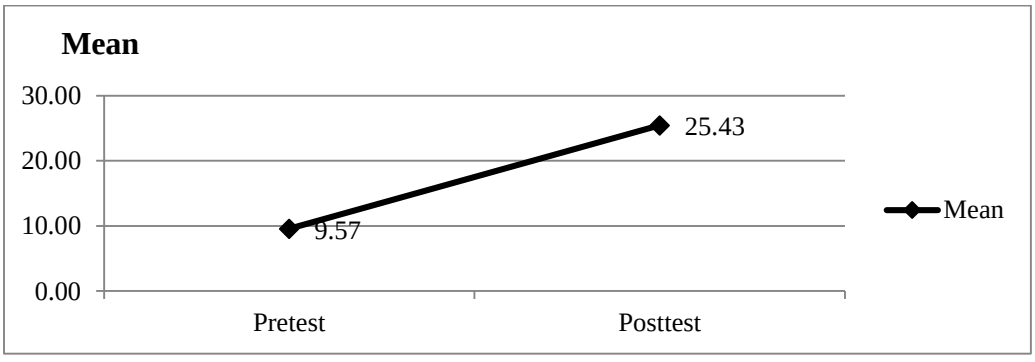


The mean gain among the three groups of learners in the experimental group were gathered, Table 11 and Figure 4 present the summary of mean change scores from posttest to pretest of the auditory learners which shows a mean gain of (17) from posttest (25.40) to pretest (8.40). The value of SD was more homogeneous during the pretest (1.82) as compared with the posttest (2.07) which shows that their performance was almost the same before they were exposed to differentiated teaching strategies, then there was a change in their performance after the treatment, which can be seen in the increase in the standard deviation (0.25).

Table 12.Summary of Change Scores: Posttest vs. Pretest Kinesthetic Learners

Test	N	Lowest Value	Highest Value	Mean	SD	Coefficient of Variation %
Pre-test	7	7	11	9.57	1.62	16.91
Posttest	7	21	29	25.43	2.7	10.61
Change		14	18	15.85	1.08	-6.3

Figure 5. Summary of Mean Change Scores: Posttest vs. Pre-test Kinesthetic Learners

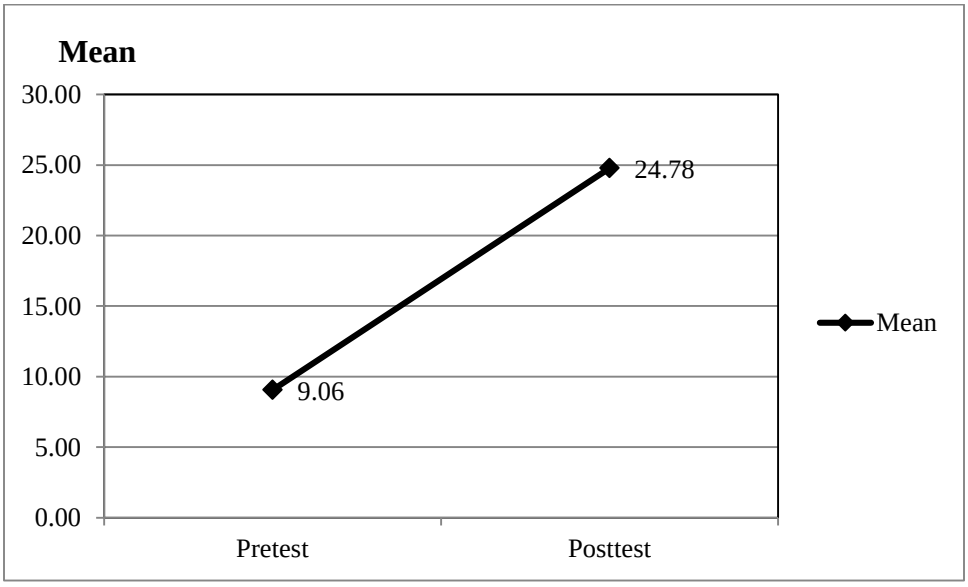


The mean gain among the kinesthetic learners was being calculated, Table 12 and Figure 5 exhibit the summary of mean change scores of kinesthetic learners of their pretest and posttest which is (15.85) from posttest which is (25.42) to pretest (9.57). The SD during the pretest is (1.62) which means that their performance during the pretest was homogeneous and during the posttest (2.70) there was a slight increase of 1.08, and their performance became heterogeneous.

Table 13.Summary of Change Scores: Posttest vs. Pretest Visual Learners

Test	N	Lowest Value	Highest Value	Mean	SD	Coefficient of Variation %
Pre-test	18	4	13	9.06	2.71	29.94
Posttest	18	19	29	24.78	3.19	12.88
Change		15	16	15.72	0.48	-17.06

Figure 6. Summary of Mean Change Scores: Posttest vs. Pre-test Visual Learners



Lastly Table 13 and Figure 6 display the summary of mean change of the visual learners of their pretest and posttest which shows a mean gain of (15.72) from posttest of (24.78) to pretest of (9.06). In terms of the standard deviation, during the pretest the performance of the group was homogeneous with a standard deviation of (2.71), their scores were closer, then after they were exposed to treatment, and their performance became heterogeneous, with a standard deviation of (3.19).

Among the three groups of learners, (auditory, visual, kinesthetic) the auditory learners has the highest mean gain which is (17), compared to kinesthetic which was (15.85) and visual which was (15.72).

With the following data, these rejected the null hypothesis, which means to say that there was a significant difference between the change scores of the subject when they were categorized according to their learning styles. It implies that, after being exposed to differentiated teaching strategies, they were able to learn the concepts well as shown by the increase in their mean scores and standard deviation.

As seen from the results of the study, it was evident that the use of differentiated teaching strategies can increase the achievement level of students in Biology. As a teacher differentiates her instruction, she can consider the learning styles of the students. In a way that all the activities and tasks were aligned in their learning styles, their learning styles can be used to initiate or can be used to accomplish the tasks of a particular topic. Based from the results of the study, when the learning styles of the students were tapped, they performed well in terms of their achievement scores.

And in terms of the level of difficulty of a particular activity or tasks, teacher can consider the zone of proximal development, wherein the activities that will be created should not too difficult because this may lead to frustration or too easy because it may lead to boredom, but it should be a little bit beyond the student's zone of proximal development, which implies that challenging enough at their level.

CHAPTER V

SUMMARY OF FINDINGS, CONCLUSIONS, RECOMMENDATIONS

This chapter presents the summary of findings, conclusions and recommendations.

Summary of Findings:

After conducting the study, the following findings were drawn**;**

1. The highest percentage of learning styles of the students in the differentiated group was visual which is 60.0 % followed by kinesthetic which was 23.3 % and auditory which was 16.7 %.

2. The three least mastered topics in Biology were Cell Division with a percentage of 60.2 %, followed by Genetics 56.8% and Digestive System which is 56.4%.

3. There was a significant difference between the post and pretest achievement scores of the differentiated and traditional groups. Both strategies were effective in terms of increasing the achievement level of students in Biology. But then, the differentiated group had a higher computed F value of 635.57 than the traditional group with a computed F value of 112.49 which implies that differentiated teaching strategies were more effective than the traditional method.

4. There was a significant difference between the post achievement scores of the differentiated and traditional groups.

5. There was no significant difference among the post achievement scores of students in the differentiated instruction when they were categorized according to their learning styles. It implies that achievement in the differentiated instruction is independent with learning styles and learning styles can be incorporated with other strategies.

6. There was a significant difference between the change scores of the subject when they were categorized according to their learning styles. The auditory group had a higher change scores, followed by kinesthetic and visual learners.

Conclusions:

On the basis of the foregoing results, the following conclusions were drawn; as seen in the outcome of the study, differentiated teaching strategies had significant difference compared with traditional method of teaching which was evident in the results of their posttest, however there was no significant difference in the posttest scores of the differentiated group when they were categorized according to their learning styles. This implies that when students were taught using differentiated teaching strategies, they performed at their best which may lead to an increase in the achievement level of the students.

It was revealed that in differentiated instruction, as long as the learning input was congruent in their learning styles there was no significant difference in the performance of auditory, visual and kinesthetic learners. This denotes that students will perform well as long as their learning styles were tapped in the activities or tasks created by their teacher. On the other hand, in terms of their change scores, auditory has the highest change scores compared to visual, auditory and kinesthetic. In this study, it indicates that all learners had an improvement in terms of their change scores, but auditory learners had a greater improvement as compared with the other learner.

Recommendations

In light of the findings of the study, the following recommendations are offered for considerations.

1. Differentiated teaching strategies may be used to investigate its effect on the achievement of students in other subject areas such as Social Studies, Physical Education and Filipino.

2. Before deciding and applying teaching strategies, learning styles of the students may be considered.

3. Enhance teaching modalities using differentiated activities with the various learning styles needed by the learners.

4. For future study, a comparison of the effectiveness of various differentiated teaching strategies from one another.

5. Administered a readiness test among the experimental group before differentiating instruction.

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APPENDIX A

THIRD QUARTER GRADES IN SCIENCE 8

THIRD QUARTER GRADES IN SCIENCE 8			
. EXPERIMENTAL 1	89	CONTROL 1	89
EXPERIMENTAL 2	89	CONTROL 2	89
EXPERIMENTAL 3	88	CONTROL 3	88
EXPERIMENTAL 4	88	CONTROL 4	88
EXPERIEMENTAL 5	88	CONTROL 5	88
EXPERIMENTAL 6	87	CONTROL 6	87
EXPERIMENTAL 7	87	CONTROL 7	87
EXPERIMENTAL 8	87	CONTROL 8	87
EXPERIMENTAL 9	87	CONTROL 9	87
EXPERIMENTAL 10	87	CONTROL 10	87
EXPERIMENTAL. 11	87	CONTROL 11	87
EXPERIMENTAL 12	87	CONTROL 12	87
EXPERIMENTAL 13	87	CONTROL 13	87
EXPERIMENTAL 14	86	CONTROL 14	86
EXPERIMENTAL 15	86	CONTROL 15	86
EXPERIMENTAL. 16	86	CONTROL 16	86
EXPERIMENTAL 17	86	CONTROL 17	86
EXPERIMENTAL 18	86	CONTROL 18	86
EXPERIMENTAL 19	86	CONTROL 19	86
EXPERIMENTAL 20	86	CONTROL 20	86
EXPERIMENTAL 21	85	CONTROL 21	85
EXPERIMENTAL. 22	85	CONTROL 22	85
EXPERIMENTAL. 23	85	CONTROL 23	85
EXPERIMENTAL 24	85	CONTROL 24	85
EXPERIMENTAL 25	84	CONTROL 25	84
EXPERIMENTAL 26	84	CONTROL 26	84
EXPERIMENTAL. 27	81	CONTROL 27	81
EXPERIMENTAL 28	80	CONTROL 28	80
EXPERIMENTAL 29	78	CONTROL. 29	78
EXPERIMENTAL 30	71	CONTROL 30	71

APPENDIX B

Learning Style Inventory (Adapted from Clark)

Name : _____ Learning Style: _____
Directions: Put a (/) on the space provided.

SECTION 1- VISUAL

_____ 1. I take written notes and/or draw mind maps.
_____ 2. When talking to someone else I have a difficult time understanding those who do not maintain a good eye contact with me.
_____ 3. I make lists and notes because I remember things better if I write them down.
_____ 4. When reading a novel, I pay a lot of attention to passages that help me to picture the clothing, description, scenery, settings, etc.
_____ 5. I need to write down directions so that I can remember them.
_____ 6. I need to see the person I am talking to in order to keep my attention focused on the subject.
_____ 7. When meeting a person for the first time, I notice the style of dress, visual characteristics, and neatness first.
_____ 8. When I am at a party, one of the things I love to do is to stand back and observe the people.
_____ 9. When recalling information I can see it in my mind and remember where I saw it.
_____ 10. If I had to explain a new procedure or technique, I would prefer to write it out.
_____ 11. In my free time I am most likely to watch television or read.
_____ 12. If my leader/boss has a message for me, I am most comfortable when she sends a memo.
Total for Visual _____

SECTION 2- AUDITORY

_____ 1. I read out loud or move my lips to hear the words in my head.
_____ 2. When talking to someone, I have a difficult time understanding those who do not talk or respond with me.
_____ 3. I do not take a lot of notes, but still remember what was said. Taking notes often distracts me from the speaker.
_____ 4. When reading a novel, I pay a lot of attention to passages involving conversations, talking, speaking, dialogues, etc.
_____ 5. I like to talk to myself when solving a problem or writing.

_____ 6. I can understand what a speaker says, even if I am not focused on the speaker.
_____ 7. I remember things easier by repeating them over and over.
_____ 8. When I am at a party, one of the things I love to do is talk in depth about a subject that is important to me with a good conversationalist.
_____ 9. I would rather receive information from the radio, rather than read a newspaper.
_____ 10. If I had to explain a new procedure or technique, I would prefer talking about it.
_____ 11. With my free time I am most likely listen to music.
_____ 12. If my boss has a message for me, I am most comfortable when he or she calls me on the phone.

Total for Auditory _____

SECTION 3- KINESTHETIC

_____ 1. I am not good at reading or listening to directions. I would rather just start working on the task or project at hand.
_____ 2. When talking to someone, I have a difficult time understanding those who do not show any kind of emotional or physical support.
_____ 3. I take notes, doodle, and /or make mind maps, but I rarely go back and look at them.
_____ 4. When reading a novel, I pay a lot of attention to passages revealing feelings, moods, action, drama etc.
_____ 5. When I am reading, I move my lips.
_____ 6. I often exchange words, such as places or things, and use my hands a lot when I can't remember the right thing to say.
_____7. My desk appears disorganized.
_____8. When I am at a party, one of the things I love to do is to enjoy the activities such as dancing, games, and totally losing myself in the action.
_____ 9. I like to move around, I feel trapped when seated at a meeting or a desk.
_____10. If I had to explain a new procedure or technique, I would prefer actually demonstrating it.
_____11. With my free time, I am most likely to exercise.
_____12. If my boss/leader has a message for me, I am most comfortable when she talks me in a person.
Total for Kinesthetic _____
SCORES

VISUAL	AUDITORY	KINESTHETIC
Points _____	Points _____	Points _____

Adapted from Don Clark (2005)

APPENDIX C
Initial Draft of 100-Item Achievement Test

Philippine Normal University
Taft Avenue, Manila

College of Graduate Studies and Teacher Education Research

Achievement Test
In
Biology 8
S.Y. 2015-2016

1. What is the function of the esophagus?
   a. This is where final digestion takes place.
   b. This is where water reabsorption takes place.
   c. This is where enzymes are being released during digestion.
   d. This is where bolus is transported down to stomach.

2. Can you identify the organ which is NOT involved in chemical digestion?
   a. stomach
   b. small intestine
   c. large intestine
   d. none of the above

3. Can you identify the organ which is NOT a part of the digestive tract?
   a. esophagus
   b. large intestine
   c. liver
   d. stomach

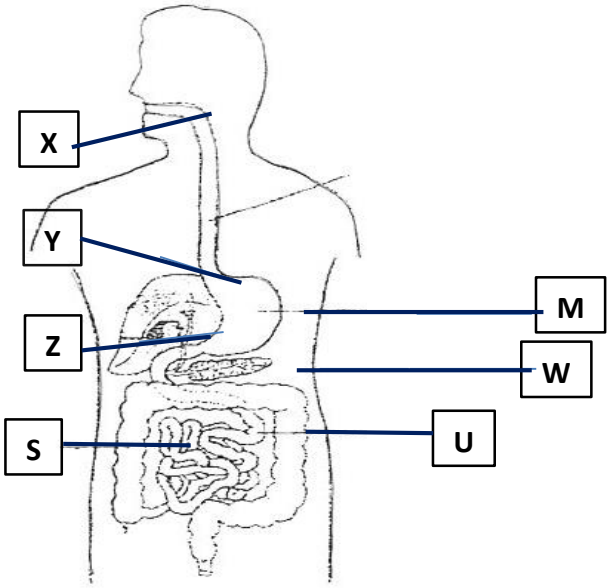
4. What structure in the small intestine absorbs the nutrients that result from the digestive process?
   a. duodenum
   b. villi
   c. intestinal gland
   d. jejunum

5. What is the function of the small intestine?
   a. It is responsible for water reabsorption.
   b. It is responsible for final digestion of food.
   c. It is responsible for fecal removal.
   d. It is responsible for digestion of proteins.

6. Can you identify the organ of the digestive system which is involved in mechanical digestion of food?
   a. large intestine
   b. small intestine
   c. mouth
   d. stomach

7. Which of the following is NOT a function of saliva?
   a. digestion of starch
   b. lubrication of food
   c. digestion of protein
   d. moistens the food

For numbers 8-10, refer to the diagram below.



8. Which organ produces pancreatic amylase?
   a. W
   b. X
   c. Y
   d. Z

9. Which organ produces a chemical that emulsifies fats?
   a. W
   b. X
   c. Y
   d. Z

10. What specific food group is broken down in organ X?
   a. fats
   b. lipids
   c. proteins
   d. carbohydrates

11. Can you identify which among the digestive enzymes are incorrectly matched?
   a. lipase-fat
   b. pepsin-protein
   c. pancreatic amylase- protein
   d. salivary amylase-carbohydrates

12. Which enzymes change fat droplets to fatty acids and glycerol?
   a. sucrase
   b. lipase
   c. maltase
   d. lactase

13. What is the function of carbohydrates in our body?
   a. Serves as the main source of energy.
   b. Strengthens the immune system.
   c. Eliminates the body's waste products.
   d. Regulates the temperature of the body.

14. Which among the following is NOT a source of proteins?
a. meat
b. egg
c. fish
d. cereals

15. Which among the essential nutrients is responsible for the growth, repair and replacement of cells and tissues?
a. carbohydrates
b. proteins
c. minerals
d. vitamins

16. How many glasses of water should be taken in by our body regularly?
a. 2.5 liters
b. 3.5 liters
c. 4.5 liters
d. 5.5 liters

17. How will you illustrate the correct pathway of food?
a. mouth → esophagus → stomach → large intestine → small intestine
b. mouth → esophagus → stomach → small intestine → large intestine
c. mouth → esophagus → villi → small intestine → large intestine
d. mouth → esophagus → small intestine → stomach → large intestine

18. Which organ serves as the pathway for both air and food?
a. esophagus
b. pharynx
c. intestine
d. epiglottis

19. Which among the organs of the digestive system is responsible for transporting the food from the mouth to the stomach through the process known as peristalsis?

a. small intestine
b. esophagus
c. pharynx
d. epiglottis

20. If the epiglottis does NOT function correctly, what might happen?
a. peristalsis will stop
b. blocking of windpipe may happen
c. incomplete digestion of food
d. acid reflux will damage the esophagus

21. What do you call the system of giving each organism a scientific name with two parts?
a. binomial nomenclature
b. common name
c. scientific name
d. trinomial nomenclature

22. In Homo sapiens, what taxonomic level "sapiens" represents?
a. class
b. family
c. genus
d. species

23. How will you categorize organisms with nucleus including protists, plants, fungi and animals?
a. Archae
b. Bacteria
c. Archaebacteria
d. Eukarya

24. How would you classify bacteria that can live in a very extreme environment?
a. Archaebacteria
b. Eukarya
c. Bacteria
d. Monera

25. How would you classify the multicellular organisms which have cell walls containing cellulose?
a. Animalia
b. Protista
c. Fungi
d. Plantae

26. A biologist examines a group of cells of unknown origin under the microscope and notices the presence of nuclei within these cells. Chemical tests also reveal that each cell is surrounded by a cell wall composed of chitin. Based from the following data, can you identify in which kingdom these cells belong?
a. Fungi
b. Protista
c. Monera
d. Animalia

27. Another group of cells was examined by a biologist. These cells lack nucleus and membrane bound organelles. They have cell walls made up of peptidoglycan, can you identify in which kingdom these cells belong?
a. Monera
b. Protista
c. Animalia
d. Fungi``

28. Suppose you discovered a new single celled microorganism. It has a nucleus, long tail like structures that make it move. Chemical tests revealed that this microorganism has chlorophyll. In which kingdom would you categorize this organism?
a. Plantae
b. Fungi
c. Monera
d. Protista

29. Which kingdom includes the dinoflagellates and algae?
a. Protista
b. Plantae
c. Animalia
d. Monera

30. Which among the organism is NOT a plant?
a. Water lily
b. Cactus
c. Mushroom
d. Grass

31. Which type of bacteria can thrive in an environment with a very high temperature such as craters of volcanoes?
a. Methanogens
b. Acidophiles
c. Thermophiles
d. Halophiles

32. Which group of animals are warm blooded and have a mammary gland?
a. Reptiles
b. Bird
c. Amphibians
d. Mammal

For items 33-34, use the data in the table below to answer the question.

CHARACTERISTICS OF ECOSYSTEM	ECOSYSTEM		
	I	II	III
High species diversity	√		√
High productivity in terms of products		√	
High maintenance cost		√	
Low energy input	√		
Tends to pollute water		√	
Tends to recycle nutrients	√		√
Low labor input	√		√

33. What inference can you make based on the information given?
   a. I and II are human- made ecosystems
   b. I and III are human made ecosystems
   c. I and II are natural ecosystems
   d. I and III are natural ecosystem

34. How would you classify ecosystem III?
   a. natural ecosystem
   b. human made ecosystem
   c. artificial ecosystem
   d. none of the above

35. Which among the ecosystems have a high biodiversity?
   a. rainforest
   b. natural park
   c. river
   d. both a and c

36. How will you compare an ecosystem with high biodiversity from an ecosystem with low biodiversity?
a. Ecosystem with high biodiversity has less biotic factors than the ecosystem with low biodiversity.
b. Ecosystem with high biodiversity recycle nutrients naturally compare to ecosystem with low biodiversity.
c. Ecosystem with high biodiversity has high maintenance compare to ecosystem with low biodiversity.
d. Ecosystem with high biodiversity has low number of species compare to ecosystem with low biodiversity.

37. Can you identify which among the following is INCORRECTLY paired??
   a. Muro-ami: Coral reefs destruction
   b. Severe Flooding: Deforestation
   c. Ozone depletion: CFC buildup
   d. Fish kill: Carbon Dioxide pollution

38. Which is the main cause of greenhouse effect?
   a. Transpiration of plants
   b. Accumulation of carbon dioxide
   c. Depletion of ozone layer
   d. Formation of acid rain

39. Which of the following statements is NOT TRUE?
   a. Man's activities damage and upset ecological balance.
   b. Waste disposal is not a problem as the population increases.
   c. Forest destruction caused extinction of many species.
   d. Overproduction is the result of excessive demands of supply needed.

40. Which among the following threats to biodiversity has major impact in the environment?
   a. Environmental Pollution
   b. Habitat destruction
   c. Over collection of organism
   d. Population increase

For items 41-44, refer to the food chain below.

Wheat → Caterpillar → Chicken → Man

41. How would you categorize the role of chicken in the food chain?
   a. producer
   b. secondary consumer
   c. primary consumer
   d. decomposer

42. How would you categorize the role of caterpillar?
   a. decomposer
   b. primary consumer
   c. producer
   d. secondary consumer

43. How would you construct a food chain in which man will have the highest amount of energy obtained. Which among the following food chains will you choose?
   a. cow → man → wheat
   b. wheat → cow → man
   c. wheat → man → cow
   d. man → cow → wheat

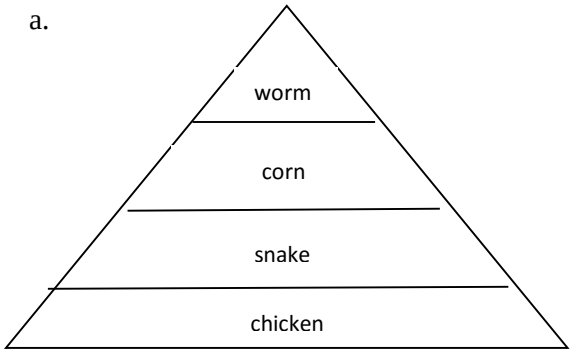
44. Based from the food chain below, can you identify which organism has the least amount of energy obtained?

corn → caterpillar → chicken → snake

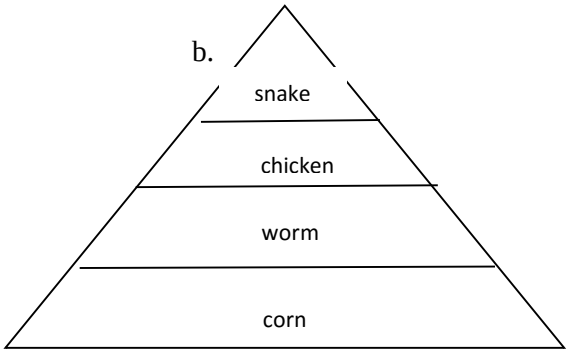
   a. corn
   b. snake
   c. chicken
   d. caterpillar

45. Given the list of organism construct an energy pyramid, choose from the choices below.
chicken, snake, corn, worm

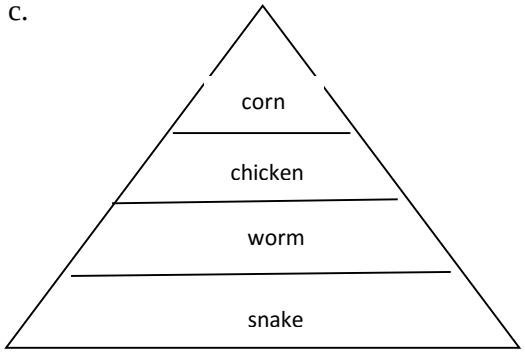
a.



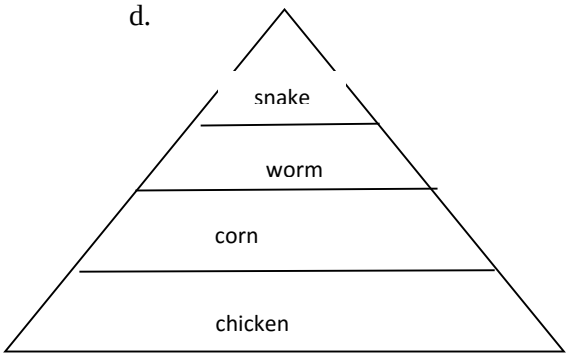
b.



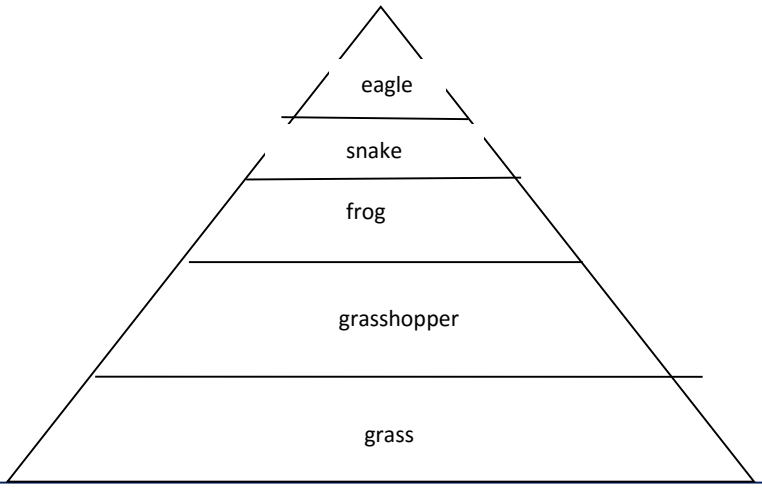
c.



d.



For items 46-49 refer to the energy pyramid below.



46. Grass has 5,000 kJ of energy, how much energy will be consumed by grasshopper?
a. 50 kJ b. 500 kJ c. 5,000 kJ d. 5 kJ

47. Which among the organism will consume 50 kJ of energy?
a. grasshopper
b. frog
c. snake
d. eagle

48. How much energy will be consumed by eagle?
a. 5 kJ
b. 50 kJ
c. .5 kJ
d. 500 kJ

49. What conclusion can you make based on the energy pyramid?
a. Frog obtained the least amount of energy.
b. Grass obtained the greatest amount of energy.
c. All organisms obtained the same amount of energy.
d. Bacteria obtained the greatest amount of energy.

50. Which among the gases is the most abundant in the atmosphere which is about 78 percent of the atmosphere?
a. oxygen b. carbon c. nitrogen d. hydrogen

51. What do you call the process wherein nitrogen in the form of ammonia is converted into nitrite?
a. denitrification
b. nitrafication
c. nitrification
d. ammonification

52. Which among the following DOES NOT contribute water vapor in the atmosphere?
a. animals
b. river
c. plants
d. clouds

53. Which among the following plants can obtain nitrogen directly from the insects?
a. orchids
b. pitcher plant
c. cactus
d. rafflesia

54. Can you identify which among the following is NOT involved in carbon dioxide production?
a. cellular respiration
b. combustion of fuels
c. decomposition of organisms
d. process of photosynthesis

55. Which among the following human activities can cause damage in the ecosystem?
a. using biological control
b. use of organic fertilizers
c. use of monoculture
d. growing of variety of crops

56. Why herbicides and insecticides are considered harmful in our ecosystem?
    a. it deprive many animals of their food.
    b. damage the habitat of the animals
    c. it accumulates in the body of organisms
    d. it destroys the balance of ecosystem

57. What do you call the process wherein insects are being used to control other harmful insects?
    a. monoculture
    b. biological control
    c. strip cropping
    d. organic farming

58. Which among the following events take place during S phase (Synthesis) of the cell cycle?
    a. increase in the number of organelles
    b. cell division takes place
    c. synthesis of enzymes and proteins
    d. DNA replication takes place

59. Which among the following stages of cell cycle is characterized by cell division?
    a. Gap 1
    b. Gap 2
    c. Mitotic phase
    d. Synthesis

60. Which among the following is the longest phase of the cell cycle?
    a. Mitotic
    b. Karyokinesis
    c. Prophase
    d. Interphase

61. Can you identify the correct sequence of steps in cell cycle?
    a. interphase, prophase, metaphase, telophase, anaphase
    b. prophase, telophase, metaphase, interphase, anaphase
    c. interphase, prophase, metaphase, anaphase, telophase
    d. telophase, metaphase, anaphase, prophase, interphase

62. In which stage of mitosis, shows that chromosomes are align at the equatorial plate?
    a. prophase
    b. metaphase
    c. anaphase
    d. telophase

63. What process takes place when cytoplasm divide?
    a. meiosis
    b.mitosis
    c. cytokinesis
    d. karyokinesis

64. A group of students observes that the chromatids are moving at the opposite poles of the cell. What stage of mitosis is being observed by the students?
    a. telophase b. anaphase c. metaphase d. prophase

65. How many chromosomes would each daughter cell have after mitosis, if the parent cell has 18 chromosomes?

a. 9 b. 18 c. 36
d. 45

66. Four cells will undergo mitosis, how many daughter cells will be produced?
a. 4 b. 8 c. 16 d. 32

67. Why is meiosis I sometimes called the reduction division stage?
a. size of the parent cell is reduced into half during the formation of daughter cells
b. daughter cells contain only half number of chromosomes compared to the parent cell
c. each daughter cells have the same number of chromosomes as with their parent cells
d. meiosis results to differentiation reproduction and variation among organisms

68. In which stage of meiosis wherein there are two new cells are being formed?
a. Prophase I c. Telophase I Metaphase II
d. Prophase II

69. How many times the cell divides during meiosis?
a. one b. twice c. thrice d. four times

70. In meiosis, what happens to the number of chromosomes of daughter cells?
a. half the number of chromosomes as with the parent cell
b. twice the number of chromosomes of the parent cell
c. the same as the number of chromosomes of the parent
d. thrice the number of chromosomes of the parent

71. How will you compare prophase of mitosis with prophase I of meiosis?
I. No synapsis occur in meiosis I
II. Synapsis occur in prophase I of meiosis
III. Chromosomes move to the spindle fibers individually during prophase of mitosis but in pairs during meiosis
IV. Both have the same features

a. I and III b. II and III c. I and IV d. II and IV

72. Peter is making a poster to describe the two types of cell division. He draws an outline of a human body on a paper. He wants to show the diagram of mitosis and meiosis working out from the different parts of the body and where they take place. Which of these choices correctly shows a location for each type of cell division?
a. bone - meiosis c. stomach - meiosis
b. testes – mitosis d. skin – mitosiS

73. Which of the following is NOT a difference between mitosis and meiosis?

a. Mitosis occurs in somatic cells while meiosis occurs in sex cells
b. Mitosis produces a diploid cell while meiosis produces a haploid cell
c. Mitosis produces two daughter cells while meiosis produces four daughter cells
d. Mitosis is needed in sexual reproduction wherein meiosis is needed for growth of an organism

74. In mitosis, one parent cell will produce two daughter cells , how about if there are four parent cells that will undergo meiosis how many cells will be produced?

a. 2 b. 4 c. 6 d. 16

75. In which type of cells does meiosis takes place?

a. bone cells
b. brain cells
c. sex cells
d. skin cells

76. What do you call a condition wherein chromosomes fail to separate during meiosis and results to extra chromosome in number 21?

a. Turner syndrome
b. Klinefelter syndrome
c. Down syndrome
d. Patau syndrome

77. What do you call a condition wherein there a part of chromosome number 5 is being lost?

a. Cri-du-chat syndrome
b. Patau syndrome
c. Edward syndrome
d. Turner syndrome

78. Who is the scientist who discovered a disorder caused by trisomy 21?

a. Dr. Leila Down
b. Dr. Leonard Down
c. Dr. Langdon Down
d. Dr. Leiilyn Down

79. What do you call a condition wherein there is an extra chromosome in chromosome number 18?

a. Edward syndrome
b. Patau syndrome
c. Down syndrome
d. Cri du chat syndrome

80. What will be the genotype of a hybrid tall?

a. TT b. Tt c. tt d. tT

81. What will be the genotype of a homozygous tall?

a. tT b. TT c. Tt d. tt

82. Which among the following gives the phenotype of tt?

a. tall
b. homozygous short
c. short
d. heterozygous tall

83. How will you write the symbol for heterozygous round?

a. Rr b. rR c. rr d. RR

84. Which among the following shows a dominant genotype?

a. bB b. bb c. Bb d. ab

85. If you cross a heterozygous tall pea plant with a shorter pea plant, what will be the genotype of their offspring that are tall?

a. tt b. Tt c. TT d. TT and Tt

86. How will you write the classic Mendelian phenotypic ratio when a heterozygote is self-crossed?

a. 1:1 b. 3:1 c. 1:2:1 d. 9:3:3

87. A green (pod color) is crossed with another pea plant of the same phenotype. Can you identify the phenotype of the offspring?

a. ¾ yellow, ¼ green
b. ½ yellow, ½ green
c. 100% green
d. 100% yellow

88. In a cross between heterozygous round and wrinkled, Can you solve for the phenotypic ratio of the offspring?

a. 3:1 b. 2:2 c. 4:0 d. none of the above

For items 89-92, refer to the problem below.
A cross between two homozygous round and yellow seeded plants with wrinkled and green (WWGG x wwgg).

89. Which among the following represents the genotype of F1?

a. WwGG b. WwGg c. wwgg d. Wwgg

90. Can you identify the phenotype of F1?

a. round and yellow seeds
b. round and green seeds
c. wrinkled and green seeds
d. wrinkled and yellowseeds

91. How many percent are wrinkled and green seeds?

a.75% b. 25% c. 0% d. 50%

92. How many percent are round and yellow seeds?

a. 25% b. 50% c. 100% d. 0%

For items 93-94, refer to the problem below. Given that letter S is for bent little finger, s for straight little finger, A for normal skin color and a for albinism. Assume that the characters are strictly Mendelian.

93. If the mother's genotype is AaSs, what is the mother's phenotype?

a. normal skin color with bent little finger
b. normal skin color with straight little finger
c. albino with straight little finger
d. albino with bent little finger

94. If the father's genotype is aaSs, can you infer the father's phenotype?

a. albino with bent little finger
b. albino with straight little finger
c. normal skin color with bent little finger
d. normal skin color with straight little finger

95. The two factors for each trait separate during the formation of gamete. Which Mendel's law explains the statement?
a. Law of Segregation
b. Law of Independent Assortment
c. Law of Dominance
d. all of the above

96. A cross between homozygous round and wrinkled seed pea plant will have all round pea plants. Which Mendel's law best explain the situation?
a. Law of Dominance
b. Law of Independent Assortment
c. Law of Segregation
d. all of the above

97. When do pair of alleles segregate?
a. during meiosis
b. during mitosis
c. after meiosis
d. after mitosis

98. Which Mendel's law states that traits are inherited independently from one another?
a. Law of Segregation
b. Law of Independent Assortment
c. Law of Dominance
d. none of the above

99. Which Mendel's law states that "There is a total masking of recessive traits by a dominant trait?
a. Law of Independent Assortment
b. Law of Segregation
c. Law of Dominance
d. none of the above

100. Which Mendelian law explains the inheritance of the recessive character of some of the members of the second filial generation?
a. Law of Independent Assortment
b. Law of Segregation
c. Law of Dominance
d. none of the above

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APPENDIX D

PHILIPPINE NORMAL UNIVERSITY

Taft Avenue, Manila

TABLE OF SPECIFICATIONS 100 ITEM ACHIEVEMENT TEST

TOPIC/OBJECTIVES	NO. OF DAYS TAUGHT	%	NO. OF ITEMS	ITEM PLACEMENT		
				K	P	U
A. Digestive System						
1. Demonstrates understanding about the different organs and functions of the digestive system.	3	6	6	4		1,2,3,5,6
2. Identify the different organs and enzymes involve in digestion.	3	6	6	8,9,10,12		7,11
3. Recognize the importance of different food nutrients in our body.	2	4	4	14,15,16		13
4. Trace the pathway of food.	2	4	4	18,19	20	17
B. Biodiversity						
1. Recognize the binomial system of classification.	1	2	2	21,22		
2. Differentiate the three domains from one another.	1	2	2			23,24
3. Identify the characteristics and representatives of each kingdom.	4	8	8		26-28	25,29-32
4. Distinguish an ecosystem with high and low biodiversity.	2	4	4	35,36		33,34
5. Explain the causes of loss of biodiversity .	2	4	4	37-40		
C. Interactions						
1. Identify the components of a food chain.	1	1	2			41-42
2.Construct an energy pyramid.	1	2	3		43-45	
3. Calculate the amount of energy obtained by organism in each	1	4	4		46-49	
4. Explain the processes involved in nitrogen cycle, water cycle	2	5	5	50-53		
5. Develop awareness about the different human activities	1	2	3	55-57		
and oxygen carbon cycle.						
D. Cellular Division						
1. Identify the different events that take place during cell cycle.	2	5	4	58-61		
2. Explain the different stages and importance of mitosis.	2	5	5	62-66		
3. Discuss the different stages of meiosis.	2	5	4	67-70		
4. Differentiate mitosis from meiosis.	2	5	5	71-75		
5. Identify the different human disorders caused by abnormalities	2	5	4	76-79		
in chromosomes.						
E. Genetics						
1. Identify the phenotype and genotype of an organism.	2	5	5	80-84		
2. Infer the genotype and phenotype of an offspring using a monohybrid cross.	2	5	4	85-88		
3. Calculate the phenotype and genotype of an offspring using	2	5	6		89-94	
a dihybrid cross.						
4.Recognize Mendel's law of inheritance.	3	6	6	95-100		
TOTAL NUMBER OF DAYS	**45**					
TOTAL NUMBER OF ITEMS	**100**					

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APPENDIX E
Science Achievement Test Evaluation (Adapted from Gronlund)

Validation Instrument for the Achievement Test
Science Achievement Test Evaluation (Gronlund, N. 2003)

Please check the appropriate column B, rate the extent on how the science achievement meets the criteria below.

Specifically meets the criteria	**4**
Meets the criteria	**3**
Partially meets the criteria	**2**
Does not meet the criteria	**1**

I. Test Specifications	EXPERT 1	EXPERT 2	EXPERT 3	MEAN	INTERPRETATION
1. Do the test specifications describe the nature and limits of the achievement domain to be measured?	3	3	4	**3.33**	MEETS THE CRITERIA
2. Are the intended learning outcomes stated in performance (measurable) terms?	3	3	4	**3.33**	MEETS THE CRITERIA
3. Do the test specifications indicate the nature and distribution of items to be included in the test?	3	3	4	**3.33**	MEETS THE CRITERIA
OVERALL				**3.33**	MEETS THE CRITERIA
II. Test Format and Directions					
1. Does the item arrangement on the page contribute to ease of reading and responding?	3	3	3	**3.00**	MEETS THE CRITERIA
2. Are the items of the same type placed together in the test to minimize the number of directions needed)?	3	4	4	**3.67**	SPECIFICALLY MEETS THE CRITERIA
3. Are the items arranged in order of increasing difficulty within each section of the test?	3	4	3	**3.33**	MEETS THE CRITERIA
4. Do the method of answering and the location of answer space contribute to efficient test taking?	3	3	3	**3.00**	MEETS THE CRITERIA
5. Are the items numbered in consecutive order throughout the test?	4	4	4	**4.00**	SPECIFICALLY MEETS THE CRITERIA
6. Is there a balanced proportion of correct answers (that is A, B, C, D) and is sequence of answers free from patterning (that is A, B, A,B)	3	4	4	**3.67**	SPECIFICALLY MEETS THE CRITERIA
7. Are clear and concise directions provided for the test and for each separate section?	3	2	4	**3.00**	MEETS THE CRITERIA
8. Is the final copy of the test satisfactory in terms of spacing, legibility and freedom from errors?	3	2	4	**3.00**	MEETS THE CRITERIA
OVERALL				**3.00**	MEETS THE CRITERIA
III. Test Items					
A. General					
1. Is each test item relevant to an important learning nature?	3	4	4	**3.67**	SPECIFICALLY MEETS THE CRITERIA
2. Is each item type appropriate for the particular learning outcomes to be measured?	2	4	3	**3.00**	MEETS THE CRITERIA
3. Does each item present a clearly formulated task?	3	4	4	**3.67**	SPECIFICALLY MEETS THE CRITERIA
4. Is each item free of non-functional material?	3	3	3	**3.00**	MEETS THE CRITERIA
5. Is each item free from extraneous clues?	3	3	4	**3.33**	MEETS THE CRITERIA
6. Is the difficulty of each item appropriate for the task and for the use to be made of the results?	3	4	4	**3.67**	SPECIFICALLY MEETS THE CRITERIA
7. Is there an adequate number of items for each interpretation to be made?	3	4	4	**3.67**	SPECIFICALLY MEETS THE CRITERIA
8. Are the items sufficiently independent that one item does not aid in answering another?	3	4	3	**3.33**	MEETS THE CRITERIA
9. Are the items free from race, ethnic and sex bias?	3	4	4	**3.67**	SPECIFICALLY MEETS THE CRITERIA
OVERALL				**3.67**	SPECIFICALLY MEETS THE CRITERIA

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B. Multiple Choice Items					
1. Does the stem of the item present a single clearly formulated	2	4	4	3.33	MEETS THE CRITERIA
problem?					
2. Is the stem stated in simple, readable language?	2	4	4	3.33	MEETS THE CRITERIA
3. Is the stem worded so that there is no repetition of material	3	4	4	3.67	MEETS THE CRITERIA
in the alternatives?					
4. Is the stem stated in positive form whenever possible?	3	3	4	3.33	MEETS THE CRITERIA
5. If the negative wording is used in the stem, is it emphasized by	4	4	4	4.00	SPECIFICALLY MEETS THE CRITERIA
(underlines or capital letters)?					
6. Is the intended answer correct or clearly best?	3	3	3	3.00	MEETS THE CRITERIA
7. Are all alternatives grammatically consistent with the stem and	2	3	3	2.67	MEETS CRITERIA
parallel in form?					
8. Are the alternatives free from verbal clues to the correct answer?	3	3	4	3.33	MEETS THE CRITERIA
9. Are the distracters plausible and attractive to the uninformed?	3	3	3	3.00	MEETS THE CRITERIA
10. Is the relative length of the correct answer varied to elements	3	4	4	3.67	SPECIFICALLY MEETS THE CRITERIA
length as a clue?					
11. Is the position of the correct answer varied so that there is no	3	4	4	3.67	SPECIFICALLY MEETS THE CRITERIA
detectable pattern?					
12. Has the alternatives " all of the above" been allowed and " none	4	3	4	3.67	SPECIFICALLY MEETS THE CRITERIA
of the above" used only when appropriate?					
OVERALL				3.67	SPECIFICALLY MEETS THE CRITERIA
FINAL AVERAGE	3.42				MEETS THE CRITERIA

APPENDIX F
Item Analysis of 100-Item Achievement Test

Item Number	Frequency of Top 27%	Proportion of Top 27%	Frequency of Bottom 27%	Proportion of Bottom 27%	Difficulty Index	Interpret.	Discrimination Index	Interp.	Decision
1	16	1.00	11	0.69	0.59	AVERAGE	0.21	POOR	REJECT
2	16	1.00	16	1.00	1.00	EASY	0.00	POOR	REJECT
3	9	0.56	13	0.81	0.69	AVERAGE	-0.25	POOR	REJECT
4	10	0.63	6	0.38	0.50	AVERAGE	0.25	MODERATE	RETAIN
5	13	0.81	6	0.38	0.59	AVERAGE	0.44	GOOD	RETAIN
6	15	0.94	10	0.63	0.78	AVERAGE	0.31	GOOD	RETAIN
7	7	0.44	3	0.19	0.31	AVERAGE	0.25	MODERATE	RETAIN
8	14	0.88	5	0.31	0.59	AVERAGE	0.56	GOOD	RETAIN
9	10	0.63	4	0.25	0.44	AVERAGE	0.38	GOOD	RETAIN
10	12	0.75	9	0.56	0.66	AVERAGE	0.19	POOR	REJECT
11	8	0.50	4	0.25	0.38	AVERAGE	0.25	MODERATE	RETAIN
12	12	0.75	5	0.31	0.53	AVERAGE	0.44	GOOD	RETAIN
13	12	0.75	9	0.56	0.66	AVERAGE	0.19	POOR	REJECT
14	14	0.88	13	0.81	0.84	EASY	0.06	POOR	REJECT
15	8	0.50	4	0.25	0.38	AVERAGE	0.25	MODERATE	RETAIN
16	6	0.38	6	0.38	0.38	AVERAGE	0.00	POOR	RETAIN
17	12	0.75	9	0.56	0.66	AVERAGE	0.19	POOR	REJECT
18	7	0.44	5	0.31	0.38	AVERAGE	0.13	POOR	REJECT
19	14	0.88	10	0.63	0.75	AVERAGE	0.25	MODERATE	RETAIN
20	13	0.81	6	0.38	0.59	AVERAGE	0.44	GOOD	RETAIN
21	16	1.00	14	0.88	0.94	EASY	0.13	POOR	REJECT
22	16	1.00	4	0.25	0.63	AVERAGE	0.75	GOOD	RETAIN
23	14	0.88	3	0.19	0.53	AVERAGE	0.69	GOOD	RETAIN
24	13	0.81	13	0.81	0.81	EASY	0.00	POOR	REJECT
25	14	0.88	7	0.44	0.66	AVERAGE	0.44	GOOD	RETAIN
26	11	0.69	4	0.25	0.47	AVERAGE	0.44	GOOD	RETAIN
27	10	0.63	12	0.75	0.69	AVERAGE	-0.13	POOR	REJECT
28	8	0.50	6	0.38	0.44	AVERAGE	0.13	POOR	REJECT
29	13	0.81	6	0.38	0.59	AVERAGE	0.44	GOOD	REJECT
30	16	1.00	16	1.00	1.00	EASY	0.00	POOR	REJECT
31	14	0.88	7	0.44	0.66	AVERAGE	0.44	GOOD	RETAIN
32	16	1.00	14	0.88	0.94	EASY	0.13	POOR	REJECT
33	15	0.94	8	0.50	0.72	AVERAGE	0.44	GOOD	RETAIN
34	12	0.75	5	0.31	0.53	AVERAGE	0.44	GOOD	RETAIN
35	14	0.88	13	0.81	0.84	EASY	0.06	POOR	REJECT

36	13	0.81	1	0.06	0.44	AVERAGE	0.75	GOOD	RETAIN
37	14	0.88	7	0.44	0.66	AVERAGE	0.44	GOOD	RETAIN
38	13	0.81	6	0.38	0.59	AVERAGE	0.44	GOOD	RETAIN
39	16	1.00	4	0.25	0.63	AVERAGE	0.75	GOOD	RETAIN
40	14	0.88	14	0.88	0.88	EASY	0.00	POOR	REJECT
41	15	0.94	14	0.88	0.91	EASY	0.06	POOR	REJECT
42	16	1.00	16	1.00	1.00	EASY	0.00	POOR	REJECT
43	16	1.00	16	1.00	1.00	EASY	0.00	POOR	REJECT
44	5	0.31	7	0.44	0.38	AVERAGE	-0.13	POOR	REJECT
45	16	1.00	5	0.31	0.66	AVERAGE	0.69	GOOD	RETAIN
46	16	1.00	13	0.81	0.91	EASY	0.19	POOR	REJECT
47	15	0.94	14	0.88	0.91	EASY	0.06	POOR	REJECT
48	15	0.94	15	0.94	0.94	EASY	0.00	POOR	REJECT
49	14	0.88	15	0.94	0.91	EASY	-0.06	POOR	REJECT
50	2	0.13	15	0.94	0.53	AVERAGE	-0.81	POOR	REJECT
51	14	0.88	15	0.94	0.91	EASY	-0.06	POOR	REJECT
52	13	0.81	10	0.63	0.72	AVERAGE	0.19	POOR	REJECT
53	13	0.81	5	0.31	0.56	AVERAGE	0.50	GOOD	RETAIN
54	10	0.63	1	0.06	0.34	AVERAGE	0.56	GOOD	RETAIN
55	10	0.63	4	0.25	0.44	AVERAGE	0.38	GOOD	RETAIN
56	15	0.94	8	0.50	0.72	AVERAGE	0.44	GOOD	RETAIN
57	9	0.56	4	0.25	0.41	AVERAGE	0.31	GOOD	RETAIN
58	4	0.25	2	0.13	0.19	DIFFICULT	0.13	POOR	REJECT
59	8	0.50	10	0.63	0.56	AVERAGE	-0.13	POOR	REJECT
60	5	0.31	2	0.13	0.22	AVERAGE	0.19	POOR	REJECT
61	10	0.63	2	0.13	0.38	AVERAGE	0.50	GOOD	RETAIN
62	11	0.69	3	0.19	0.44	AVERAGE	0.50	GOOD	RETAIN
63	12	0.75	6	0.38	0.56	AVERAGE	0.38	GOOD	RETAIN
64	16	1.00	6	0.38	0.69	AVERAGE	0.63	GOOD	RETAIN
65	11	0.69	11	0.69	0.69	AVERAGE	0.00	POOR	REJECT
66	16	1.00	10	0.63	0.81	EASY	0.38	GOOD	REJECT
67	6	0.38	7	0.44	0.41	AVERAGE	-0.06	POOR	REJECT
68	8	0.50	3	0.19	0.34	AVERAGE	0.31	GOOD	RETAIN
69	14	0.88	10	0.63	0.75	AVERAGE	0.25	MODERATE	RETAIN
70	14	0.88	7	0.44	0.66	AVERAGE	0.44	GOOD	RETAIN
71	11	0.69	4	0.25	0.47	AVERAGE	0.44	GOOD	RETAIN
72	13	0.81	9	0.56	0.69	AVERAGE	0.25	MODERATE	RETAIN
73	12	0.75	9	0.56	0.66	AVERAGE	0.19	POOR	REJECT
74	5	0.31	7	0.44	0.38	AVERAGE	-0.13	POOR	REJECT
75	11	0.69	6	0.38	0.53	AVERAGE	0.31	GOOD	RETAIN
76	13	0.81	2	0.13	0.47	AVERAGE	0.69	GOOD	RETAIN

77	6	0.38	2	0.13	0.25	AVERAGE	0.25	MODERATE	RETAIN
78	14	0.88	12	0.75	0.81	EASY	0.13	POOR	REJECT
79	14	0.88	11	0.69	0.78	AVERAGE	0.19	POOR	REJECT
80	9	0.56	6	0.38	0.47	AVERAGE	0.19	POOR	REJECT
81	9	0.56	6	0.38	0.47	AVERAGE	0.19	POOR	REJECT
82	11	0.69	9	0.56	0.63	AVERAGE	0.13	POOR	REJECT
83	15	0.94	11	0.69	0.81	EASY	0.25	MODERATE	REJECT
84	13	0.81	10	0.63	0.72	AVERAGE	0.19	POOR	REJECT
85	10	0.63	10	0.63	0.63	AVERAGE	0.00	POOR	REJECT
86	5	0.31	2	0.13	0.22	AVERAGE	0.19	POOR	REJECT
87	15	0.94	3	0.19	0.56	AVERAGE	0.75	GOOD	RETAIN
88	4	0.25	1	0.06	0.16	DIFFICULT	0.19	POOR	REJECT
89	14	0.88	7	0.44	0.66	AVERAGE	0.44	GOOD	RETAIN
90	7	0.44	1	0.06	0.25	AVERAGE	0.38	GOOD	RETAIN
91	9	0.56	6	0.38	0.47	AVERAGE	0.19	POOR	REJECT
92	8	0.50	2	0.13	0.31	AVERAGE	0.38	GOOD	RETAIN
93	4	0.25	4	0.25	0.25	AVERAGE	0.00	POOR	REJECT
94	11	0.69	4	0.25	0.47	AVERAGE	0.44	GOOD	RETAIN
95	9	0.56	5	0.31	0.44	AVERAGE	0.25	MODERATE	RETAIN
96	13	0.81	4	0.25	0.53	AVERAGE	0.56	GOOD	RETAIN
97	13	0.81	7	0.44	0.63	AVERAGE	0.38	GOOD	RETAIN
98	10	0.63	6	0.38	0.50	AVERAGE	0.25	MODERATE	RETAIN
99	14	0.88	11	0.69	0.78	AVERAGE	0.19	POOR	REJECT
100	14	0.88	14	0.88	0.88	EASY	0.00	POOR	REJECT

instructions:

1. arrange the paper from highest to lowest

2. get the upper 27% and the lower 27%

3. count the number of students who got an item correct from the upper and lower 27%

4. get the percentage by dividing the formula:

Percentage = no. of students who got at item correct from upper 27% / total number of the upper 27%

Difficulty index --> already in formula

interpretation --> .8 and above = easy item; .2 below difficult; .21-.79 = average

Discrimination index --> already in formula

interpretation -->.2 and below = poor; .22-.29 = moderate; .3 and above = good; closer to one is very good

Decision: For classroom exam if the discrimination index is moderate or good and the difficulty is average --> RETAIN THE ITEM; easy items or difficult could be re-written

Philippine Normal University
National Center for Teacher Education

APPENDIX G
50 Item Achievement Test

Philippine Normal University
Taft Avenue, Manila

College of Graduate Studies and Teacher Education Research

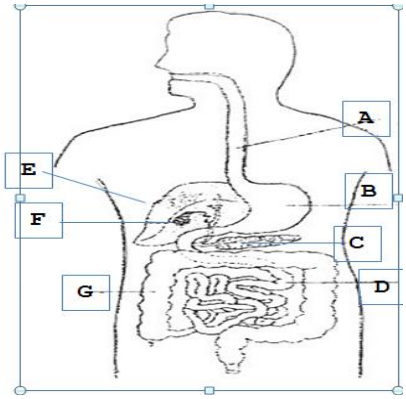
Achievement Test
In
Biology 8
S.Y. 2015-2016

I. Direction: Write the letter of the correct answer.

1. What is the function of the esophagus?
   a. This is where final digestion takes place.
   b. This is where water reabsorption takes place.
   c. This is where enzymes are being released during digestion.
   d. This is where bolus is transported down to stomach.

2. What do you call the fingerlike structures in the small intestine that absorb the nutrients that result from the digestive process?
   a. duodenum
   b. villi
   c. intestinal gland
   d. jejunum

For numbers 3-4, refer to the diagram below.



3. Which organ produces pancreatic amylase?
   a. E
   b. G
   c. F
   d. C

4. Which organ produces an emulsifier which digests fats into tiny droplets?
   a. E
   b. G
   c. F
   d. H

5. Which among the digestive enzymes are incorrectly matched?
   a. lipase-fat
   b. pepsin-protein
   c. pancreatic amylase- protein
   d. salivary amylase-carbohydrates

6. Which enzyme change fat droplets to fatty acids and glycerol?
   a. peptidase
   b. lipase
   c. maltase
   d. lactase

7. Which among the following is **NOT** a good source of proteins?
   a. meat
   b. egg
   c. fish
   d. cassava

8. Which among the following is **NOT** a good source of carbohydrates?
   a. corn
   b. cassava
   c. bread
   d. cheese

9. If the epiglottis does **NOT** function correctly, what might happen to the transport of bolus?
   a. Food moves into the trachea.
   b. Blocking of windpipe may happen.
   c. Incomplete digestion of food.
   d. Acid reflux will damage the esophagus.

10. Which is **INCORRECTLY** matched?
   a. bolus-mouth
   b. chyme- stomach
   c. bile- liver
   d. hydrochloric acid- esophagus

11. Which scientific name is **CORRECTLY** written?
   a. *Homo Sapiens*
   b. *homo sapiens*
   c. *Homo sapiens*
   d. *Homo Sapiens*

12. How will you categorize organisms with nucleus including protists, plants, fungi and animals?
   c. Archae
   d. Bacteria
   c. Archaebacteria
   d. Eukarya

13. A biologist examines a group of cells of unknown origin under the microscope and notices the presence of nuclei within these cells. Chemical tests also reveal that each cell is surrounded by a cell wall composed of chitin. Based from the following data, in which kingdom these cells belong?

c. Fungi c. Monera
d. Protista d. Plantae

14. Another group of cells was examined by a biologist. These cells lack nucleus and membrane bound organelles. They have cell walls made up of peptidoglycan, in which organism these cells belong?

c. dinoflagellates c. bacillus
d. euglena d. paramecium`

15. Suppose you discovered a new single celled microorganism. It has a nucleus, long tail like structures that make it move. Chemical tests revealed that this microorganism has chlorophyll. In which kingdom would you categorize this organism?

c. Plantae c. Monera
d. Fungi d. Protista

16. Which among the organisms can cause red tide?

a. algae c. planarians
b. dinoflagellates d. amoeba

17. Which among the organisms is an example of thermophiles?

a. *Escherichia coli* c. *Thermus aquaticus*
b. *Staphylococcus pneumonia* d. *Lactobacillus bulgaricus*

For number 18, use the data in the table below to answer the question.

CHARACTERISTICS OF ECOSYSTEM	**ECOSYSTEM**		
	I	II	III
High species diversity	√		√
High productivity in terms of products		√	
High maintenance cost		√	
Low energy input	√		
Tends to pollute water		√	
Tends to recycle nutrients	√		√
Low labor input	√		√

18. Based from the given information, which is a man-made ecosystem?

a. ecosystem I b. ecosystem II
c. ecosystem III d. none of the above

19. Which among the following statements **CORRECTLY** describe a high biodiversity and low biodiversity?

a. High biodiversity has one type of organism while a low biodiversity has various types of organism that thrive.
b. High biodiversity is less sustainable while low biodiversity is more sustainable.
c. High biodiversity has higher number of species while low biodiversity has lower number of species.
d. High biodiversity is more prone to extinction while low biodiversity is less prone to extinction.

20. Which of the following is a result of deforestation?

a. Water washes soil into rivers and streams causing siltation.
b. Water washes off the mountain slopes and rapidly causing flood.
c. There is an increase of carbon dioxide in the ecosystem.
d. All of the above

21. As pesticides move through the food chain, their concentration increases at each trophic level. What idea is being illustrated?

a. biological pest control b. ecological balance
c. biomagnification d. ecological backlash

22. Which shows the correct sequence of a food chain?

a. rice plant rat snake grasshopper frog
b. bacteria snake grasshopper rice plant rat snake
c. rice plant grasshopper frog rat snake
d. grasshopper rice plant rat frog snake

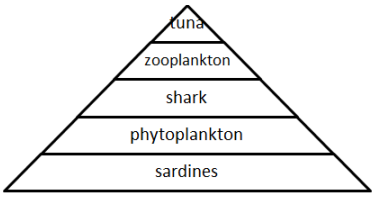
For number 23, refer to the food chain below.

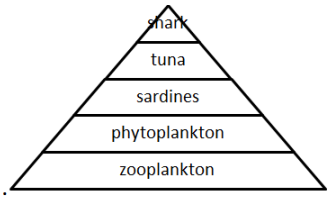
grass → catterpillar → chicken → human

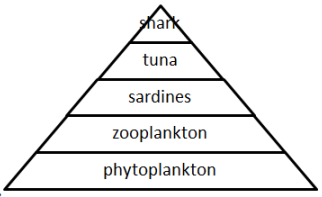
23. Which of the following organisms receive the most amount of energy?

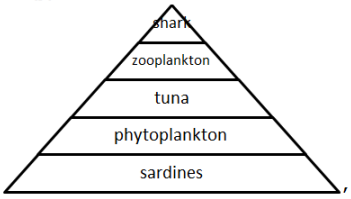
a. catterpillar c. grass
b. chicken d. human

24. Which energy pyramid has the proper arrangement of organisms based on energy they obtained?

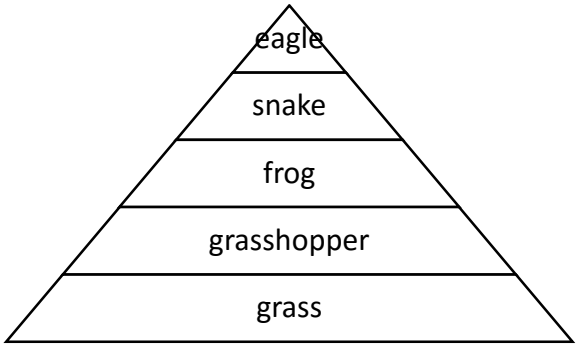
a.


b.


c.


d.


For numbers 25-27, refer to the energy pyramid below.



25. Given an amount of 5,000 calories of energy obtained by grass, which among the organism will obtain 50 calories of energy?

a. grasshopper
b. snake
c. frog
d. eagle

26. Which among the organisms will obtain the least amount of calories?

a. frog
b. eagle
c. grasshoper
d. snake

27. How much energy can be transferred to the eagle?

a. 5 calories
b. 50 calories
c. 0.5 calories
d. 500 calories

28. Which among the gases is the most abundant in the atmosphere?
    a. oxygen
    b. nitrogen
    c. carbon
    d. hydrogen

29. Which among the following is **NOT** involved in carbon dioxide production?
    a. burning of wood
    b. combustion of fuels
    c. decomposition of organisms
    d. process of photosynthesis

30. Why herbicides and insecticides are considered harmful in our ecosystem?
    a. It deprives many animals of their food.
    b. Damage the habitat of the animals.
    c. It destroys the balance of ecosystem.
    d. All of the above

31. Which among the practices are used to recycle soil nutrients?
    a. monoculture farming
    b. use of chemical pesticides
    c. use of herbicides
    d. growing of variety of crops

32. Which among the following stages of cell cycle is characterized by cell division?
a. Gap 1 b. Gap 2 c. Mitotic phase d. Synthesis

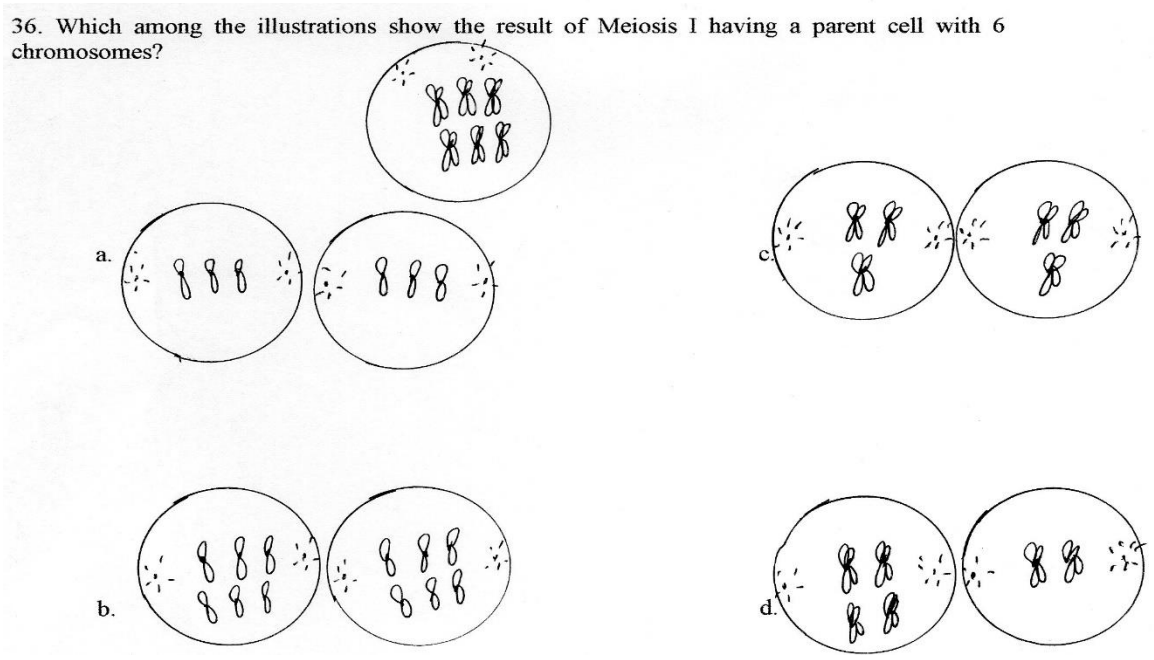
33. Which among the following statements describe the interphase stage of the cell cycle?

    a. The cell divides during interphase.
    b. The cell increases in size during interphase.
    c. The chromosomes replicate during interphase.
    d. Both b and c

34. In which stage of mitosis, shows that chromosomes are align at the equatorial plate?
    a. prophase
    b. metaphase
    c. anaphase
    d. telophase

35. A group of students observes that the chromatids are located at the opposite poles of the cell. What stage of mitosis is being observed by the students?
    a. telophase
    b. metaphase
    c. anaphase
    d. prophase

36.



37. What stage of meiosis results to the production of two cells?

a. Prophase I
b. Telophase I
c. Metaphase II
d. Prophase I

38. Which among the following is true about mitosis and meiosis?

a. Mitosis produces gametes while meiosis produces somatic cells.
b. Meiosis produces haploid cells while mitosis produces diploid cells.
c. Meiosis has four successive cell divisions while mitosis has two successive cell divisions.
d. Meiosis produces two daughter cells from one parent cell while mitosis produces four daughter cells from one parent cell.

39. Rene is making a poster to describe the two types of cell division. He draws an outline of a human body on a paper. He wants to show the diagram of mitosis and meiosis working out from the different cells of the body and where they take place. Which of these choices correctly shows a location for each type of cell division?

a. bone cells : meiosis, skin cells : mitosis
b. brain cells : meiosis, egg cells: mitosis
c. germ cells : mitosis, stomach cells : meiosis
d. germ cells : meiosis, liver cells : mitosis

40. What causes Down syndrome?

a. Deletion of chromosome number 20.
b. Extra chromosome in number 21.
c. Deletion of chromosome number 21.
d. Extra chromosome in number 20

41. Which is **NOT** a characteristic of a person suffering from Down syndrome?

a. moon face c. webbed neck
b. mentally retarded d. cleft palate

42. What will be the genotype of a heterozygous round?
a. RR c. Rr
b. rr d. rR

43. What will be the genotype of a homozygous tall?
a. tT c. TT
b. Tt d. tt

44. In a cross between Rr x rr, Can you solve for the phenotypic ratio of the offspring?
a. 3:1 b. 2:2 c. 4:0 d. none of the above

45. What are the genotypes of the parents if the phenotypic ratio of their offspring is 3:1?
a. GG x Gg b. Gg x Gg c. gg x Gg d. GG x gg

46. What will be the phenotype of F1 in a cross between both homozygous tall, round and short, wrinkled pea plants?
a. tall and wrinkled seeds c. short and round seeds
b. tall and round seeds d. short and wrinkled seeds

For number 47, Refer to question number 46 for the parent (P1)

47. How many percent are tall and wrinkled seeds?
a.75% b. 25% c. 0% d. 50%

48. The two alleles for each trait separate during the formation of gamete. Which Mendel's law explains the statement?
a. Law of Segregation
b. Law of Dominance
c. Law of Independent Assortment
d. all of the above

49. Which Mendelian law explains the expression of the recessive traits of the second filial generation?
a. Law of Dominance
b. Law of Segregation
c. Law of Independent Assortment
d. none of the above

50. Which Mendelian law best explains the separation of homologous chromosomes during meiosis?
a. Law of Dominance
b. Law of Segregation
c. Law of Independent Assortment
d. None of the above

Philippine Normal University
National Center for Teacher Education

APPENDIX H
TABLE OF SPECIFICATIONS (50-ITEM ACHIEVEMENT TEST)

TOPIC/OBJECTIVES	NO. OF DAYS TAUGHT	%	NO. OF ITEMS	ITEM PLACEMENT		
				K	P	U
A. Digestive System						
1. Demonstrates understanding about the different organs and functions of the digestive system.	2	4	2	1		2
2. Identify the different organs and enzymes involve in digestion.	3	7	4	3,4,5,6		
3. Recognize the importance of different food nutrients in our body.	2	4	2	7		8
4. Trace the pathway of food.	2	4	2	9	10	
B. Biodiversity						
1. Recognize the binomial system of classification.	1	3	1	11		
2. Differentiate the three domains from one another.	1	3	1		12	
3. Identify the characteristics and representatives of each kingdom.	4	9	5	13,14,15,16		17
4. Distinguish an ecosystem with high and low biodiversity.	2	4	2	18,19		
5. Explain the causes of loss of biodiversity .	2	4	2	20-21		
C. Interactions						
1. Identify the components of a food chain.	1	3	1	22		
2.Construct an energy pyramid.	2	4	2		23-24	
3. Calculate the amount of energy obtained by organism in each	2	5	3		25-27	
trophic level in an energy pyramid.						
4. Explain the processes involved in nitrogen cycle, water cycle	2	5	2			28,29
and oxygen carbon cycle.						
5. Develop awareness about the different human activities	2	4	2		30-31	
which affect the ecosystem						
D. Cellular Division						
1. Identify the different events that take place during cell cycle.	2	4	2		32-33	
2. Explain the different stages and importance of mitosis.	2	4	2			34-35
3. Discuss the different stages of meiosis.	2	4	2	36,37		
4. Differentiate mitosis from meiosis.	2	4	2	38-39		
5. Identify the different human disorders caused by abnormalities	2	4	2	40,41		
in chromosomes.						
E. Genetics						
1. Identify the phenotype and genotype of an organism.	2	5	2		42,43	
2. Infer the genotype and phenotype of an offspring using a monohybrid cross.	1	3	2		44,45	
3. Calculate the phenotype and genotype of an offspring using	1	3	2		46,47	
a dihybrid cross.						
4.Recognize Mendel's law of inheritance.	3	6	3	48,49,50		
TOTAL NUMBER OF DAYS	**45**					
TOTAL NUMBER OF ITEMS	**50**					

Philippine Normal University
National Center for Teacher Education

APPENDIX I
Differentiated Lesson Plans
Law of Segregation and Law of Independent Assortment

Republic of the Philippines
Department of Education
REGION IV-A CALABARZON
Division of Imus City

GEN. EMILIO AGUINALDO NATIONAL HIGH SCHOOL-MAIN
Palico IV, City of Imus, Cavite

Differentiated Lesson Plan
Law of Segregation and Law of Independent Assortment

GOALS

I. Objectives

1. Explain Mendel's Law of Segregation and Law of Independent Assortment.
2. Simulate the concept of Law of Segregation and Law of Independent Assortment.
3. Illustrate the phenotype of an organism.
4. Demonstrate a dihybrid cross.

TOPIC

II. Subject Matter

A. Topic: Mendelian Genetics
B. Subtopic: Law of Segregation & Law of Independent Assortment
C. Reference: Biology, Evangelista & Malonzo pp.150, http.//www.nclarck.net./traits generation
D. Materials: Visual aids, projector, laptop
E. Strategy/Strategies : Cooperative Learning, Tiered Assignment, Anchoring Activity

LESSON SEQUENCE

Time/ Duration	The Lesson Plan/Strategy
1 day	
	III. Procedures A. Priming 1. Recall: What is Law of Dominance? What are alleles? How does genotype differ from phenotype? 2. Motivation: a. Show pictures of a family. Ask them to identify the phenotypes of each members of the family? **Questions:** 1. Are the siblings look exactly the same as with the parents? Why? Why not? 2. Where do the traits of the children come from? How does it happen? b. The teacher will instruct them that they are going to simulate Mendelian pattern of inheritance. 3. Unlocking of Terms Law of Segregation, Law of Independent Assortment, Dihybrid Crosss
	IV. Lesson Proper 1. Pre- Activity: a. The teacher will give instructions about the activity entitled Genetics Stix. (Please refer to attached activity sheet) b. Each group of learners such visual, auditory, kinesthetic group will be given an assigned task. Visual- They will decode the phenotypes of the resulting alleles based on the figure. Kinesthetic- After decoding phenotypes, they will

LESSON SEQUENCE

draw the phenotypes of the baby.

Auditory- They will discuss the data of their activity.

2. Activity Proper:

a. Let the students work in groups.

V. Analysis

1. Post – Activity

a. Let the group present their work.

b. Discussion of the result's of the activity.

c. The teacher will demonstrate on how to solve problems using a dihybrid cross.

Sample Problem:

Both parents are heterozygous curly (C) and heterozygous dark Complexion (D).Identify the possible phenotypes and genotypes.

Guide Questions

1. What does each pair of sticks represent?

2. What do the 4 sticks represent?

3. Does your baby have exactly the same phenotypes as with their Parent?Why?

4. How about from the other group, does your baby have exactly the same phenotypes as with the other group? Why?

5. What is Mendel's Law of Segregation?

VI. Abstraction

1. The teacher will emphasize that inherited traits can be traced back to the production of egg and sperm cells during the process of meiosis, and these egg cells and sperm cells carry the hereditary factors. The Law of Segregation describes the behavior of the chromosomes during meiosis. Law of Independent Assortment , states that the alleles of different genes separate independently from each other during gamete formation.

VII. Assessment

Solve the following problems.

1. Both parents are heterozygous tall (T) and heterozygous dark complexion (D). Identify the possible phenotypes and genotypes.

VIII. Assignment

Tiered Assignment

Easy:

Give the corresponding phenotypes of the following. Be guided by the given traits.

Presence of Dimples

D- Without Dimples
d- With Dimples

Height **S-Tall**
s- short

1. DDSs = Without dimples, Tall
2. DdSs = Without dimples, Tall
3. ddSS = With dimples, tall
4. ddss = With dimples, short
5. Ddss = Without dimples, short

Average:

Alden possible genotypes are ddSs . What are possible genotypes of Alden's Parents?

ANSWERS

Ss DdSS x DdSs, ddSS x ddSs, DdSs x DdSs

Note: Presence of Dimples
D- without dimples
d- with dimples

Height
S- Tall
s- Short

Difficult:

In the cross of DdSs (without dimples and height is tall,) and DdSS (without dimples and height is tall), what is the probability that a given offspring will have the following genotypes

ddSS = 1/16
Ddss = 2/16
DdSs = 4/16

DdSs – without dimples and height is tall
DdSs – without dimples and height is tall

DdSs x DdSs

	DS	Ds	dS	ds
DS	DDSS	DDSs	DdSS	DdSs
Ds	DDSs	DDss	DdSs	Ddss
dS	DdSS	DdSs	ddSS	ddSs
ds	DdSs	Ddss	ddSs	ddss

Assessment:

TtDd x TtDd

T- tall
t- short
D- with dark complexion
d- with fair complexion

	TD	Td	tD	td
TD	TTDD	TTDD	TtDD	FfRr
Td	TTdd	TTdd	TtDd	TtDd
tD	TtDD	TtDd	ttDD	ttDd
td	TtDd	Ttdd	ttDd	ttdd

Genotype: 1TTDD: 2 TTDd: 2 TtDd : 1 TTdd: 2 Ttdd ; 2 ttDd: 1 ttDD: 1ttdd
Phenotype: 9 tall with dark complexion: 3 short with dark complexion
3 tall with fair complexion : 1 short with fair complexion

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APPENDIX J
LESSON PLAN EVALUATION

Instruction: Check the appropriate level. Be guided with the following criteria.

EXCELLENT	**4**
HIGHLY SATISFACTORY	**3**
SATISFACTORY	**2**
BELOW SATISFCATORY	**1**

Teacher Checklist for Lesson Plans (Traditional)	**Level of Performance**			
Overall Plan	Excellent	Highly Satisfactory.	Satisfactory	Below Satisfactory
1. Is written in clear and understandable manner?				
2. Is practical (can be carried out in an actual school situation?				
3. Is geared to the level of the students for which it was prepared?				
4. Includes the use of supportive or illustrative audio or visual aids?				
Preliminary Material				
5. Includes a clear title for the lesson that accurately				
reflects the lesson content?				
6. Includes resources and identification of				
prerequisite assignments designed to prepare students for class?				
7. Include a complete list of all supplies and				
materials needed for the lesson.				
Objectives				
8. As stated in terms of behavior?				
9. Are clear, concise and esaily understood?				
10. Are designed to support, identified student " outcomes" for				
the entire course as stated in the course outline?				

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	Excellent	Highly Satisfactory.	Satisfactory	Below Satisfactory
Lesson Introduction				
11. Provides students with logical orientation to the content				
of the presentation to follow?				
12. Serves to involve students as active participants				
in the presentation to follow?				
Lesson Presentation				
13. Uses methods, techniques and learning				
experiences appropriate to the lesson objectives?				
14. Provides students with opportunities to become				
actively engaged				
15. Meets student's needs, interests and abilities?				
Content				
16. Is sufficient and appropriate to the level of				
the students and the levelof the course?				
17. Includes information necessary for the achievement				
of stated objectives?				
Closure				
18. Allows for "loose ends" to be pulled together?				
19. Allows students to draw conclusions consistent with the				
objectives of the lesson?				
20.Allows student to participate in summarizing what				
they have learned?				
Assessment				
21. Assessment aligned with the stated objectives and				
the type of performanceappropriate to the desired				
student outcomes for the lesson?				
22. . Assessment aligned with the stated objectives and				
the type of performanceappropriate to the desired student				
outcomes for the course?				

Reference: Adapted from http://faculty.weber.edu/kristinhadley/ed3100/Lesson%20Planning/Checklist%20for%20%Lesson%20Plans.Pdf

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APPENDIX K
DIFFERENTIATED LESSON PLAN EVALUATION

Teacher's Checklist: Performance Standard 4: Diffferentiated Instruction

(Adapted from Georgia Department of Education, Teacher Keys Effectiveness System Fact Sheets)

Instruction: Kindly check the corresponding box.

EXCELLENT 4
HIGHLY SATISFACTORY 3
SATISFACTORY 2
BELOW SATISFACTORY 1

Quality		EXCELLENT	HIGHLY SATIS.	SATISFACTORY	BELOW SATIS.
Differentiating Content	Increase the breadth of learning materials to enhance student learning motivation.				
	Offer multiple modes of learning for students to be exposed to the target content through their learning style preference (such as reading, listening or doing).				
	Extent and enrich the thinking or skills of advanced learners.				
Differentiating Process	Vary instructional strategies and activities for sudents.				
	Vary types of assignment to assess student learning.				
	Routinely combine instructional techniques that involve individual small -group and whole class discussion				
	Offer optimal amount of support/ intervention and structure learning tasks to ensure the learning demand is appropriately challenging.				
Differentiating Product	Provide students with choices regarding the method to express required learning, such as presentationportfolios, or formal tests.				
	Use rubrics that match and extend student's varied ability levels.				

		EXCELLENT	HIGHLY SATIS.	SATISFCATORY	BELOW SATIS.
	Encourage student to produce their own product assignment.				
	Allow students to work alone or in small groups on project.				
Learning Environment	Create an environment in which student differences in ability, cultural background, academic needs and interest are respected and treated as asset.				
	Know and understand students as individual in term sof ability, achievement, learning styles and needs.				

Reference:
Retrieved from: http://www.gadoe.org/School-Improvement/Teacher-and-Leader-Effectiveness/Documents/TKES%20Fact%20%20Sheets%207-11-2012.pdf
Date Retrieved: December 8, 2015

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APPENDIX L
Traditional Lesson Plans

Republic of the Philippines
Department of Education
REGION IV-A CALABARZON
Division of Imus City

GEN. EMILIO AGUINALDO NATIONAL HIGH SCHOOL-MAIN
Palico IV, City of Imus, Cavite

Traditional Lesson Plan:
Law of Segregation & independent Assortment

GOALS

I. Objectives

1. Explain Mendel's Law of Segregation and Law of Independent Assortment.
2. Simulate the concept of Law of Segregation and Law of Independent Assortment.
3. Identify the phenotype and genotype of an organism.
4. Demonstrate a dihybrid cross.

TOPIC

II. Subject Matter

A. Topic: Mendelian Genetics
B. Subtopic: Law of Segregation & Law of Independent Assortment
C. Reference: Biology, pp.150-152 Evangelista, Malonzo and Sotto. (2002). SIBS Publishing House.
D. Materials: Visual aids, projector, laptop
E. Strategy: Discussion

LESSON SEQUENCE

Time/ Duration	The Lesson Plan/Strategy
1 day	
	III. Procedures A. Priming 1. Recall: What are alleles? 2. Motivation: The teacher will show a video clip of meiosis, she will emphasize that during meiosis, 2 Mendelian Laws are observe, Law of Segregation and Law of Independent Assortment. Independent Assortment takes place during the alignment of the homologous chromosomes during metaphase I while Law of Segregation is observed during anaphase II, when pairs of alleles segregate. 3. Unlocking of Terms Law of Segregation, Law of Independent Assortment, Dihybrid Cross
	IV. Lesson Proper 1. Pre- Activity: a. The teacher will tell the class, that they are going to perform the activity entitled " Our Baby". (Please refer to attached activity sheet) 2. Activity a. Let the students perform the activity.
	V. Analysis 1. Post – Activitty a. Ask for at least 2-3 volunteers to present their work b. The teacher will demonstrate on how to solve a dihybrid

LESSON SEQUENCE

	cross. Sample Problem: Both parents are heterozygous curly (C) and heterozygous dark complexion (D). Identify the possible phenotypes and genotypes. Guide Questions: 1. How many gametes are formed? 2. How many alleles does each gametes have? 3. Does your baby have exactly the same phenotypes as with their parent? Why? 4. How about from the other pair, does your baby have exactly the same phenotypes as with the other group? Why? 5. What is Mendel's Law of Segregation? 6. In which part of the activity shows the simulation of Mendel's Law of Segregation? Explain . 7. What is Mendel's Law of Independent Assortment? Explain 8. In which part of the activity simulates Law of Independent Assortment?
	VI. Abstraction 1. Variations among organism exist and meiosis plays an important role in ensuring variations. What do you think is the importance of Law of Segregation?
	VII. Assessment 1. Both parents are heterozygous tall (T) and heterozygous dark complexion (D). Identify the possible phenotypes and genotypes.

APPENDIX M
TALLY SHEET OF THE LEARNING STYLES

AUDITORY LEARNERS

	VISUAL	AUDITORY	KINESTHETIC
Student 1	6	7	5
Student 2	7	9	6
Student 3	6	7	4
Student 4	7	8	4
Student 5	7	8	4
Student 6	7	8	6
Student 7	5	9	4
Student 8	6	10	6
Student 9	9	11	5
Student 10	6	10	5
Student 11	9	10	5
Student 12	6	8	7
Student 13	5	9	7
Student 14	6	9	8
Student 15	8	10	4
Student 16	4	6	4

KINESTHETIC LEARNERS

	VISUAL	AUDITORY	KINESTHETIC
Student 1	5	6	7
Student 2	10	3	11
Student 3	5	6	10
Student 4	6	7	11
Student 5	6	8	9
Student 6	8	7	10
Student 7	8	7	9
Student 8	7	6	8
Student 9	7	6	9
Student 10	8	6	9
Student 11	6	8	9
Student 12	5	7	10

VISUAL LEARNERS

	VISUAL	AUDITORY	KINESTHETIC
Student 1	8	6	5
Student 2	11	7	5
Student 3	9	6	7
Student 4	11	6	6
Student 5	9	8	4
Student 6	10	9	8
Student 7	9	7	6
Student 8	8	3	5
Student 9	8	5	4
Student 10	8	7	5
Student 11	10	7	4
Student 12	9	7	6
Student 13	6	4	5
Student 14	9	8	6
Student 15	7	6	5
Student 16	11	9	7
Student 17	8	7	5
Student 18	9	7	6
Student 19	9	8	5
Student 20	6	5	4
Student 21	7	6	4
Student 22	8	7	6
Student 23	8	5	4
Student 24	7	6	5
Student 25	8	5	6
Student 26	7	6	4
Student 27	11	9	8
Student 28	8	7	5
Student 29	7	6	5

APPENDIX N
30-Item Pretest

Philippine Normal University
Taft, Avenue Manila
College of Graduate Studies and Teacher Education Research

Achievement Test (PRE TEST)
In
Biology 8
S.Y. 2015-2016

I. Direction: Encircle the letter of the correct answer.

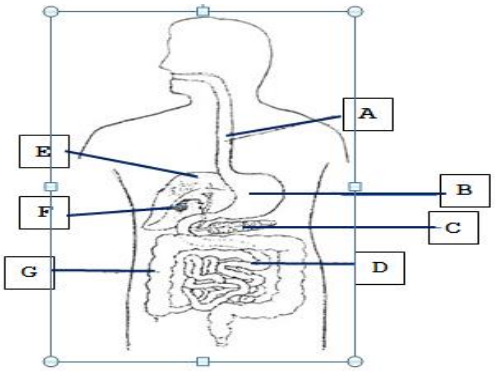
1. What is the function of the esophagus?

a. This is where final digestion takes place.
b. This is where water reabsorption takes place.
c. This is where enzymes are being released during digestion.
d. This is where bolus is transported down to stomach.

2. What do you call the fingerlike structures in the small intestine that absorb the nutrients that result from the digestive process?

a. duodenum
b. villi
c. intestinal gland
d. jejunum

For numbers 3-4, refer to the diagram below.



3. Which organ produces pancreatic amylase?

a. E
b. G
c. F
d. C

4. Which organ produces an emulsifier which digests fats into tiny droplets?

a. E
b. G
c. F
d. H

5. Which among the digestive enzymes are **INCORRECTLY** matched?

a. lipase-fat
b. pepsin-protein
c. pancreatic amylase- protein
d. salivary amylase-carbohydrates

6. Which enzyme change fat droplets to fatty acids and glycerol?

a. peptidase
b. lipase
c. maltase
d. lactase

7. Which among the following is **NOT** a good source of proteins?

a. meat
b. egg
c. fish
d. cassava

8. Which among the following is **NOT** a good source of carbohydrates?

a. corn
b. cassava
c. bread
d. cheese

9. If the epiglottis does **NOT** function correctly, what might happen to the transport of bolus?

a. Food moves into the bronchi.
b. Blocking of windpipe may happen.
c. Incomplete digestion of food.
d. Acid reflux will damage the esophagus.

10. Which is **INCORRECTLY** matched?

a. bolus-mouth
b. chyme- stomach
c. bile- liver
d. hydrochloric acid- esophagus

11. Which among the following stages of cell cycle is characterized by cell division?

a. Gap 1 b. Gap 2 c. Mitotic phase d. Synthesis Stage

12. Which among the following statements describe the interphase stage of the cell cycle?

a. The cell divides during interphase.
b. The cell increases in size during interphase.
c. The chromosomes replicate during interphase.
d. Both b and c

13. In which stage of mitosis, shows that chromosomes are align at the equatorial plate?

a. prophase
b. metaphase
c. anaphase
d. telophase

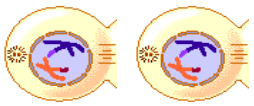
14. A group of students observes that the chromatids are located at the opposite poles of the cell. What stage of mitosis is being observed by the students?

a. telophase
b. metaphase
c. anaphase
d. prophase

15. One parent cell with 4 chromosomes divide through meiosis, which among t5he diagram shows the number of chromosomes and daughter cells produced after meiosis I?

c.

b.



d.

16. What stage of meiosis results to the production of two cells?

a. Prophase I
b. Telophase I
c. Metaphase II
d. Prophase I

17. Which among the following is **TRUE** about mitosis and meiosis?

a. Mitosis produces gametes while meiosis produces somatic cells.
b. Meiosis produces haploid cells while mitosis produces diploid cells.
c. Meiosis has four successive cell divisions while mitosis has two successive cell divisions.
d. Meiosis produces two daughter cells from one parent cell while mitosis produces four daughter cells from one parent cell.

18. Rene is making a poster to describe the two types of cell division. He draws an outline of a human body on a paper. He wants to show the diagram of mitosis and meiosis working out from the different cells of the body and where they take place. Which of these choices correctly shows a location for each type of cell division?

a. bone cells : meiosis, skin cells : mitosis
b. brain cells : meiosis, egg cells: mitosis
c. germ cells : mitosis, stomach cells : meiosis
d. germ cells : meiosis, liver cells : mitosis

19. What causes Down syndrome?

a. Deletion of chromosome number 20.
b. Extra chromosome in number 21.
c. Deletion of chromosome number 21.
d. Extra chromosome in number 20

20. Which is **NOT** a characteristic of a person suffering from Down syndrome?

a. moon face
b. mentally retarded
c. webbed neck
d. cleft palate

21. What will be the genotype of a heterozygous round?

a. RR
b. rr
c. Rr
d. rR

22. What will be the genotype of a homozygous tall?

a. tT
b. Tt
c. TT
d. tt

23. In a cross between Rr x rr, Can you solve for the phenotypic ratio of the offspring?

a. 3:1 b. 2:2 c. 4:0 d. none of the above

24. What are the genotypes of the parents if the phenotypic ratio of their offspring is 3:1?

a. GG x Gg b. Gg x Gg c. gg x Gg d. GG x gg

25. What will be the phenotype of F1 in a cross between both homozygous tall, round and short, wrinkled pea plants?

a. tall and wrinkled seeds
b. tall and round seeds
c. short and round seeds
d. short and wrinkled seeds

For number 26, Refer to question number 25 for the parent (P1)

26. How many percent are tall and wrinkled seeds?

a.75% b. 25% c. 0% d. 50%

27. The two alleles for each trait separate during the formation of gamete. Which Mendel's law explains the statement?

a. Law of Segregation
b. Law of Dominance
c. Law of Independent Assortment
d. all of the above

28. Which Mendelian law explains the expression of the recessive traits of the second filial generation?

a. Law of Dominance
b. Law of Segregation
c. Law of Independent Assortment
d. none of the above

29. Which Mendelian law best explains the separation of homologous chromosomes during meiosis?

a. Law of Dominance
b. Law of Segregation
c. Law of Independent Assortment
d. None of the above

30. Seed shape of pea plants can be round or wrinkled. A cross between round and wrinkled give rise to a seed shape which is all round. Which Mendelian Law best explains this cross?

a. Law of Dominance
b. Law of Segregation
c. Law of Independent Assortment
d. None of the above

Appendix O
Summary of Change Scores Posttest Pretest of the Traditional and Differentiated Group

Traditional Group

Test	N	Lowest Value	Highest Value	Mean	SD	Coefficient of Variation %
Pretest	30	4	16	8.6	2.76	32.11
Posttest	30	10	26	18.4	4.63	25.15
Change		6	10	9.8	1.87	6.96

Differentiated Group

Test	N	Lowest Value	Highest Value	Mean	SD	Coefficient of Variation %
Pretest	30	4	13	9.07	22.33	25.73
Posttest	30	19	29	25.05	2.86	11.42
Change		15	16	15.96	0.53	14.31

APPENDIX P

RAW DATA OF PRETEST POST TEST

	EXPERIMENTAL			CONTROL	
	PRETEST	POST TEST		PRETEST	POST TEST
E1	9	25	C1	8	24
E2	10	27	C2	9	14
E3	6	24	C3	14	25
E4	7	28	C4	16	18
E5	10	23	C5	11	15
E6	10	28	C6	9	17
E7	11	21	C7	6	10
E8	11	24	C8	9	20
E9	9	26	C9	10	17
E10	11	29	C10	7	22
E11	8	26	C11	6	11
E12	7	24	C12	12	22
E13	7	27	C13	7	12
E14	12	26	C14	9	24
E15	13	27	C15	7	16
E16	9	27	C16	12	19
E17	12	27	C17	7	23
E18	12	29	C18	9	17
E19	5	28	C19	4	23
E20	7	27	C20	9	17
E21	9	23	C21	8	24
E22	12	19	C22	4	24
E23	7	21	C23	7	16
E24	10	24	C24	8	12
E25	7	22	C25	11	15
E26	4	19	C26	7	15
E27	6	28	C27	10	17
E28	10	22	C28	6	23
E29	10	23	C29	11	26
E30	11	27	C30	5	14

APPENDIX Q
POSTTEST
Philippine Normal University
Taft Avenue, Manila

College of Graduate Studies and Teacher Education Research

Achievement Test
In
Biology 8
S.Y. 2015-2016

i. DIRECTION: Encircle the letter of the correct answer.

1. After the food is being chewed in the mouth, it will be transported down to the stomach for further digestion, what part of the digestive system is responsible for transporting the bolus to the stomach?

a. Tongue c. Esophagus

b. Small intestine d Large intestine

2. Which among the following statements **BEST** describe a villi?

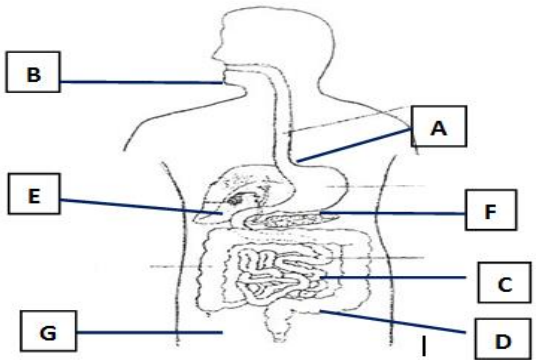
a. It is a muscular, elastic and pear shaped organ through which stores and mixes food.

b. It is a muscular tube through which food passes from the pharynx to the stomach.

c. It is a fingerlike structure in the small intestine that absorbs the nutrients.

d. It is the longest organ of the digestive system where final digestion takes place.

For numbers 3-4, refer to the diagram on the second page .



3. What do you call the enzyme produced by organ C?

a. Bile b. Hydrochloric Acid c. Pepsin d. pancreatic amylase

4. What do you call the emulsifier produced by organ E?

a. Bile c. Pepsin

b. Lipase d. Protease

5. Which among the enzymes are CORRECTLY matched?

a. salivary amylase ⟶ fats

b. lipase ⟶ carbohydrates

c. pepsin ⟶ protein

d. pancreatic amylase ⟶ sugar

6. How does lipase act on fat droplets?

a. It changes fat droplet into fatty acid and amino acid.

b. It changes fat droplets into fatty acid and polypeptides.

c. It changes fat droplets into fatty acid and nucleotides.

d. It changes fat droplets into fatty acid and glycerol

7. Which among the following statements **BEST** describes the following samples of food?

Cassava, Fish, Corn, Bread

a. All of them are good sources of carbohydrates.
b. Cassava, corn and bread are good sources of calcium except for fish which is a good source of protein.

c. Cassava and corn are good sources of energy while fish and bread are good sources of protein.
d. Cassava, corn and bread are good sources of carbohydrates while fish is a good source of protein.

8. All of these statements correctly describe the nutrients that can be obtained from food EXCEPT for one?

a. Meat and nuts are good sources of proteins which repair and build tissues.

b. Carrots contain Vitamin A, which improve vision.

c. Vegetables contain carbohydrates which maintains healthy skin.

d. Vitamin D keeps the bones strong and healthy

9. Why is it important to refrain from talking while chewing the food?

a. Because food will not be completely digested.

b. Because food may block the trachea which may cause choke.

c. Because acid reflux may take place.

d. Because it will take time to digest the food.

10. Which among the following is **CORRECTLY** matched?

a. mouth : chyme

b. pancreatic amylase : liver

c. ptyalin : salivary amylase

d. pancreas : bile

11. Cell cycle is consist of a series of important events ,during mitotic phase, what happens to the cell?

a. The cell increases in size.

b. Replication of chromosomes takes place.

c. Cell division takes place.

d. Duplication of organelles takes place.

12. In this phase of cell cycle, growth of cell takes place.

a. Mitotic phase b. Meotic phase

c. Interphase d. Synthesis

13. What happens during metaphase stage of mitosis?

a. Karyokinesis and cytokinesis take place.

b. Single stranded chromosome moves to the opposite poles.

c. Double stranded chromosomes are formed while nuclear envelope starts to disappear

d. Spindle fibers are attached to the kinetochore of each chromosomes wherein the chromosomes are at the equator.

14. Which stage of mitosis is being shown by the diagram below?

a. Prophase c. Metaphase

b. Anaphase d. Telophase

15. The diagram below shows the daughter cells and number of chromosomes produced after meiosis , which among the statements describe the parent cells of these daughter cells below?

a. One parent cell with four chromosomes each undergoes meiosis I and produces four daughter cells with two chromosomes each.

b. Two parent cells with six chromosomes each undergo meiosis I and produces two daughter cells with three chromosomes each.

c. One parent cell with four chromosomes undergoes meiosis II and produces four daughter cells with two single stranded chromosomes each.

d. One parent cell with four chromosomes each undergoes meiosis II and produces four daughter cells with diploid chromosomes each.

16. If there are four parent cells, that will divide through meiosis, how many daughter cells will be produced at the end of meiosis I?

a. 8 c. 32

b. 16 d. 64

17. All of these statements INCORRECTLY describe the main difference in the outcome of daughter cells of mitosis from meiosis EXCEPT

a. Mitosis produces four gametes cells while meiosis produces four somatic cells.

b. Mitosis results in two diploid daughter cells while meiosis produces four haploid daughter cells.

c. Mitosis produces two identical daughter cells while meiosis produces four diploid daughter cells.

d. Mitosis produces two haploid daughter cells while meiosis four diploid daughter cell

18. During their science class, Jose's teacher asked them to complete the following analogy and give a short explanation. If you are José, what will be your answer

Germ cells: Meiosis: Liver cell: _____

a. The answer is meiosis, because germ cells and liver cells divide through meiosis.

b. The answer is mitosis, because both liver cells and germ cells divide through mitosis.

c. The answer is mitosis, because germ cells divide through meiosis while liver cells divide through mitosis.

d. None of these are correct.

19. Down syndrome is caused by chromosomal translocation, this result to having an extra chromosome. What chromosome number where you can find this extra chromosome?

a. Chromosome number 20 c. Chromosome number 22

b. Chromosome number 21 d. Chromosome number 23

20. Daphne is mentally retarded, has moon face and has 47 total number of chromosome. Based from the description, what do you call Daphne's condition?

a. Klinefelter Syndrome c. Down Syndrome

b. Cri du chat Syndrome d. Turner Syndrome

21. Which among the following is an example of hybrid genotype?

a. Rr c. RR

b. heterozygous round d. both a and b

22. If you were asked to read this genotype TT, how will you read it?

a. tall c. homozygous tall

b. heterozygous tall d. dominant tall

23. Given the following phenotypic ratio, 2 round: 2 wrinkled, what are the genotypes of the parents? (Note: R- round,

r- wrinkled)

a. RR x rr c. Rr x rr

b. Rr x Rr d. rr x rr

24. Given the following genotypes, Gg x Gg, what will be the phenotypic ratio of the offspring?

a. 1:2:1 c. 3:1

b. 2:2 d. 4:1

25. What are the genotypes of the parents if in the F1 generation all pea plants has a genotype of heterozygous talland heterozygous round? (Note: T- tall, t- short, R-round, r- wrinkled)

a. TtRR x TtRR c. TTRR x ttrr

b. TTRr x TtRR d. TtRR x ttrr

26. For item 26, please refer to question number 25, for the genotype of parent 1, after crossing the parent 1 in number 25, which phenotype has a percentage of 0 % of occurrence among pea plants?

a. round and tall c. wrinkled and tall

b. round and short d. both b and

27. Which among the following situations show the concept of Law of Segregation?

a. Tall is dominant over short, that is why when a tall man marries a short woman, there is a greater

probability that they will have tall children.

b. Traits can be a dominant or recessive and it is controlled by a pair of genes which has a specific location in the chromosome.

c. During meiosis, pairs of alleles separate during gamete formation or meiosis, that is why a sex cell receives

a single allele for a particular trait.

d. In a cross between round and wrinkled, 100 percent of the f1 generation have round seeds, it shows that wrinkled is recessive.

28. Which among the following statements CORRECTLY describes Law of Independent Assortment?

a. Each sex cells receive a single allele for a trait because during meiosis, pair of alleles segregate or separate.

b. Each traits are controlled by genes which has a specific location in the chromosome

c. During inheritance there is a total masking of a trait, wherein the occurrence of a weak trait is being masked by a stronger trait.

d. Traits are inherited independently from one another, such as the inheritance of the trait for height has nothing to do for the inheritance of the color of the eyes.

29. Law of Segregation can explain by showing the diagram of;

a. Separation of homologous chromosomes during meiosis.

b. Formation of chromosomes during meiosis.

c. Location of genes in the chromosomes.

d. Position of chromosomes during meiosis.

30. Which among the following statements follow Law of Dominance? (Note: Y- yellow, y-green)

a. A cross between yellow seeds and green seeds will have green seeds in the F1 generation.

b. A cross between yellow seeds and green seeds will have yellow seeds in the F1 generation.

c. A cross between both yellow seeds will have green seeds in the F1 generation.

d. A cross between both green seeds will have yellow seeds in the F 1 generation

APPENDIX R
GAIN SCORE OF POSTTEST AND PRETEST

	EXPERIMENTAL		GAIN SCORE		CONTROL		GAIN SCORE
	POST TEST	PRETEST			POST TEST	PRETEST	
E1	25	9	16	C1	24	8	16
E2	27	10	17	C2	14	9	5
E3	24	6	18	C3	25	14	11
E4	28	7	21	C4	18	16	2
E5	23	10	13	C5	15	11	4
E6	28	10	18	C6	17	9	8
E7	21	11	10	C7	10	6	4
E8	24	11	13	C8	20	9	11
E9	26	9	17	C9	17	10	7
E10	29	11	18	C10	22	7	15
E11	26	8	18	C11	11	6	5
E12	24	7	17	C12	22	12	10
E13	27	7	20	C13	12	7	5
E14	26	12	14	C14	24	9	15
E15	27	13	14	C15	16	7	9
E16	27	9	18	C16	19	12	7
E17	27	12	15	C17	23	7	16
E18	29	12	17	C18	17	9	8
E19	28	5	23	C19	23	4	19
E20	27	7	20	C20	17	9	8
E21	23	9	14	C21	24	8	16
E22	19	12	7	C22	24	4	20
E23	21	7	14	C23	16	7	9
E24	24	10	14	C24	12	8	4
E25	22	7	15	C25	15	11	4
E26	19	4	15	C26	15	7	8
E27	28	6	22	C27	17	10	7
E28	22	10	12	C28	23	6	17
E29	23	10	13	C29	26	11	15
E30	27	11	16	C30	14	5	9
AVERAGE			15.97				9.80

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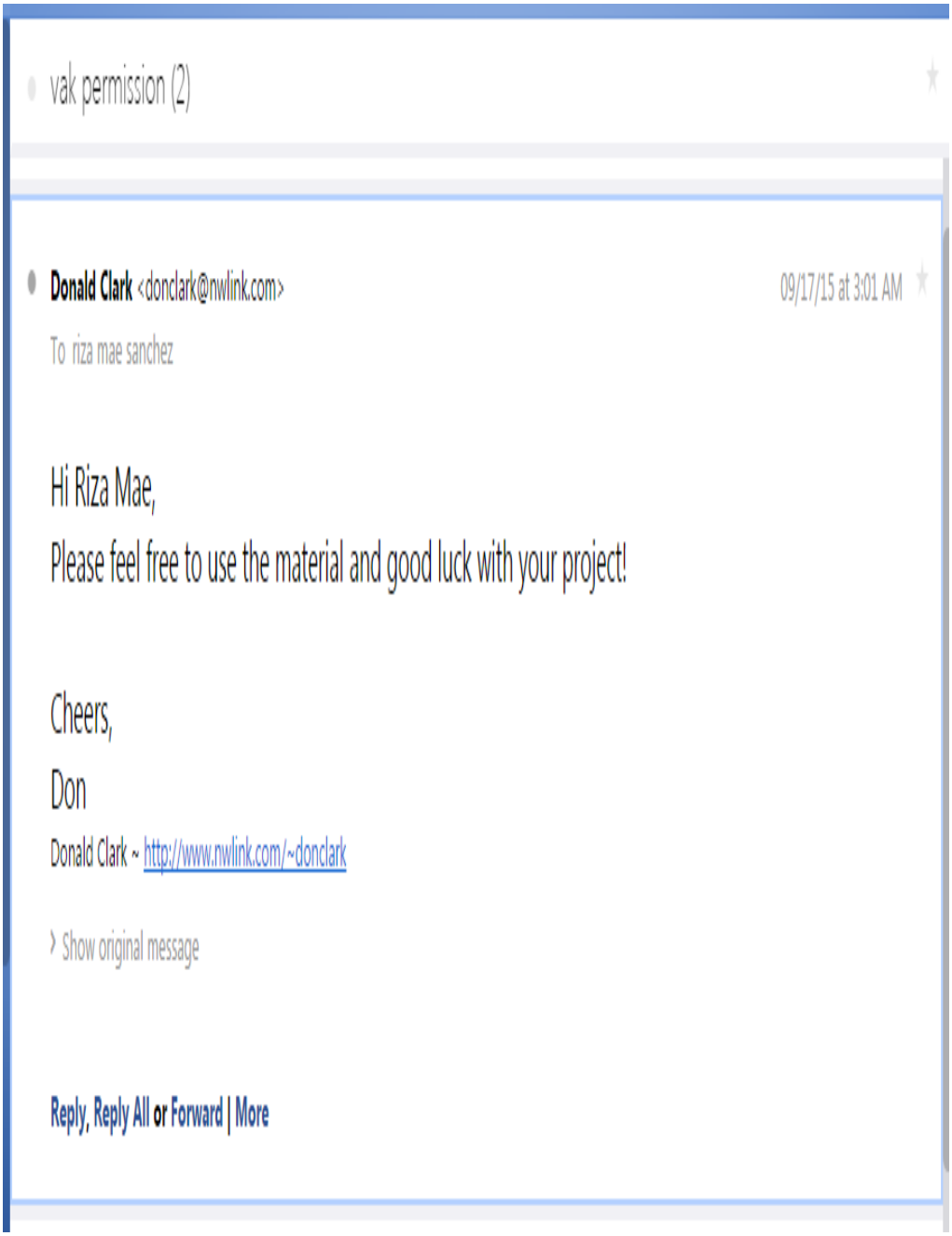
APPENDIX S

Permission Letter to Adapt the Learning Style Inventory



vak permission (2)

Donald Clark <donclark@nwlink.com> 09/17/15 at 3:01 AM

To riza mae sanchez

Hi Riza Mae,

Please feel free to use the material and good luck with your project!

Cheers,

Don

Donald Clark ~ http://www.nwlink.com/~donclark

› Show original message

Reply, Reply All or Forward | More

APPENDIX T
Permission Letter to Adapt the Differentiated Evaluation Instrument

Ms. Sanchez,
Any documents available on the GaDOE Teacher and Leader Effectiveness website is public information and may be used as long as appropriately cited.

Thanks!
Cindy

Cindy E. Saxon
Associate Superintendent of Teacher and Leader Effectiveness
Georgia Department of Education
205 Jesse Hill Jr. Drive
1854 Twin Towers East
Atlanta, Georgia 30334
404.803.3419
csaxon@doe.k12.ga.us
http://gadoe.org

From: Avis King
Sent: Thursday, May 19, 2016 5:37 PM
To: Cynthia.Saxon
Subject: Fwd: REQUEST
FYI. A
Sent from my iPhone

Begin forwarded message:

From: Matt Cardoza <MCardoza@doe.k12.ga.us>
Date: May 19, 2016 at 4:21:43 PM EDT
To: Stacey Suber-Drake <SDrake@doe.k12.ga.us>
Cc: Avis King <AKing@doe.k12.ga.us>
Subject: FW: REQUEST
Stacey,
Is this something you or Avis need to handle?

Matt Cardoza
Chief Communications Officer
Georgia Department of Education
2062 Twin Towers East
205 Jesse Hill Jr. Drive SE
Atlanta, GA 30334
(404) 651-7358
mcardoza@doe.k12.ga.us
http://www.gadoe.org

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From: riza mae sanchez [mailto:rizamaesanchez03@yahoo.com]
Sent: Thursday

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APPENDIX U

Table of Specification s 30-Item Pretest

PHILIPPINE NORMAL UNIVERSITY

Taft Avenue, Manila

TABLE OF SPECIFICATIONS 30 ITEM ACHIEVEMENT TEST

TOPIC/OBJECTIVES	NO. OF DAYS TAUGHT	%	NO. OF ITEMS	ITEM PLACEMENT		
				K	P	U
A. Digestive System						
1. Demonstrates understanding about the different organs and functions of the digestive system.	2	8	2	1,2		
2. Identify the different organs and enzymes involve in digestion.	3	12	4	3,4,6		5
3. Recognize the importance of different food nutrients in our body.	2	8	2	7,8		
4. Trace the pathway of food.	2	8	2	10		9
B. Cellular Division						
1. Identify the different events that take place during cell cycle.	2	8	2	11	12	
2. Explain the different stages and importance of mitosis.	2	8	3	13	15	14
3. Discuss the different stages of meiosis.	2	8	2			17-18
4. Identify the different human disorders caused by abnormalities	1	8	2	19,20		
in chromosomes.						
C. Genetics						
1. Identify the phenotype and genotype of an organism.	1	8	2			21,22
2. Infer the genotype and phenotype of an offspring using a monohybrid cross.	2	8	2		23,24	
3. Calculate the phenotype and genotype of an offspring using	2	8	2		25,26	
a dihybrid cross.						
4.Recognize Mendel's law of inheritance.	3	12	4	28		27,29,30
TOTAL NUMBER OF DAYS	**25**					
TOTAL NUMBER OF ITEMS	**30**					

APPENDIX V
Experts who Validated the Instruments
Expert's Profile

A. Experts who Validated the 50 Item Achievement Test

Expert 1	Expert 2	Expert 3
Doctor in Philosophy Major in Botany at University of the Philippines	Complete Academic Requirements for Doctoral Degree at De La Salle University	Presently pursuing Doctoral's Degree at Philippine Normal University
Master of Science in Biology at University of Santo Tomas	Master of Arts in Science Major in Biology at De La Salle University	Master of Arts in Science Education Major in Biological Science at Pamantasan ng Lunsod ng Maynila
17 years of teaching experience at Philippine Normal University	Elementary and Secondary teacher for 5years, Head Teacher, Science Department for 4yrs, Academic for Coordinator 3yrs	15 years of teaching experience
Presently the Chief Curator of National Museum Botany Division	Presently a full time faculty member of Field of Science, Technology, Engineering and Mathematics at Philippine Normal University	Presently a full time faculty member of Field of Science, Technology, Engineering and Mathematics at Philippine Normal University

B. Experts who Validated the Lesson Plans and Activities that were used in the Study.

Expert 1	**Expert 2**	**Expert 3**
Doctor of Philosophy in Engineering-biotechnology Program	Presently pursuing Doctoral's Degree at Philippine Normal University	Master of Science in Biology at University of Santo Tomas
Master in Science Biological Science	Master of Arts in Science Education Major in Biological Science at Pamantasan ng Lungsod ngMaynila	Bachelor of Secondary Education for Teachers at Philippine Normal University
Teaching for seven years at Philippine Normal University	15 years of teaching experience	Part Time Faculty at Philippine Normal University (2014-2016) Full time Senior High School Faculty at University of Santo Tomas.
Senior Researcher at the Department of Science & Technology for 2 years- present	Presently a full time faculty member of Field of Science, Technology, Engineering and Mathematics at Philippine Normal University	

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APPENDIX W

Differentiated Lesson Plan Matrix

Content	Process			Product		
	Visual	**Auditory**	**Kinesthetic**	**Visual**	**Auditory**	**Kinesthetic**
Cell Cycle	**Strategies: Cooperative Learning, Anchoring Activities, Learning Centers** Students will perform the Act. ” Pair Me Dood”, wherein they will be asked read an article about cell cycle. Then they will complete the graphic organizer about cell cycle and identify the stages of the cell cycle through diagrams.	**Strategies: Cooperative Learning, Anchoring Activities, Learning Centers** Students will perform the Act. “Share It”, they will be asked to form 4 groups and read an article about cell cycle and discuss it in their group. Then one representative from each group will go to the other group and share what they’ve learned to the other group. They will take turns, until they return to their home group. Then they will summarize what they’ve learned.	**Strategies: Cooperative Learning, Anchoring Activities, Learning Centers** Students will perform the Act. “Wheel of Life”, they will be asked to read an article about cell cycle. Guided by the article, they will construct a model of cell cycle.	**Graphic organizer about cell cycle**	**Tabular presentation of stages of cell cycle.**	**Cell Cycle Model**

Content	Process			Product		
	Visual	**Auditory**	**Kinesthetic**	**Visual**	**Auditory**	**Kinesthetic**
Mitosis	**Strategies: Cooperative Learning, Anchoring Activities, Learning Centers** Students will perform the Act. "Describe Mitosis" ,wherein they will be given graphic organizer as their guide in answering the activity. Then they will be asked to draw the stages of mi	**Strategies: Cooperative Learning, Anchoring Activities, Learning Centers** Students will perform the Act."Grab a Bucket" wherein they will be asked to draw a word from the bucket, then they will make a sentence which uses the word in relation with mitosis. They will take turns, and they will write the sentences on their worksheet. They will discuss it with their groupmates.	**Strategies: Cooperative Learning, Anchoring Activities, Learning Centers** Students will perform the Act. "Mitosis Model", wherein they will be given an article about mitosis, They will make models of the different stages of mitosis using clay, yarn, buttons, and paper plates.	**Diagrams of the different stages of mitosis.**	**Summary of the different stages of mitosis.**	**Models of the different stages of mitosis.**

Content	Process			Product		
	Visual	**Auditory**	**Kinesthetic**	**Visual**	**Auditory**	**Kinesthetic**
Meiosis	**Strategies: Cooperative Learning, Anchoring Activities, Learning Centers** Students will perform the Act." Show Meiosis", wherein they will read an article about meiosis. Then they will be asked to paste the corresponding pictures of the respective mitosis stage. They will also describe each stages of meiosis.	**Strategies: Cooperative Learning, Anchoring Activities, Learning Centers** Students will perform the Act. "Describe Meiosis", wherein they will listen to a recorder which discuss the different stages of meiosis. It will be played repeatedly. They will write the important events of meiosis on their metacards and present it in class.	**Strategies: Cooperative Learning, Anchoring Activities, Learning Centers** Students will perform the Act. "Meiosis in Action". wherein they will demonstrate each stage of mitosis. They will be guided by the article and the illustrations	**Diagrams of the different stages of mitosis**	**Metacards which contain the description of the stage of meiosis Presentation**	**Simulation through body movements Presentation**

Content	Process			Product		
	Visual	Auditory	Kinesthetic	Visual	Auditory	Kinesthetic
Comparison of Mitosis and Meiosis	**Strategies: Cooperative Learning, Anchoring Activities, Learning Centers** Students will perform the Act. "Gallery Walk" wherein they will be given diagrams of mitosis and meiosis posted on the wall, These will be their guide in comparing mitosis from meiosis through checklist and venn diagram.	**Strategies: Cooperative Learning, Anchoring Activities, Learning Centers** Students will perform the Act. "Raise Your Banners", wherein they will have a game. One member will be asked to draw a piece of paper (written on the paper are the stages of mitosis or meiosis) from the bag. She will describe the stages, then let her groupmates to guess if the event is mitosis or meiosis by raising the placard. The group who will score high for 5 minutes will be the winner. Then they will complete Table A. which is comparison of mitosis	.**Strategies: Cooperative Learning, Anchoring Activities, Learning Centers** Students will perform the Act. "Charade", wherein they will have a game. One member will be asked to draw a piece of paper (written on the paper are the stages of mitosis or meiosis) from the bag. Four members will simulate the stages of mitosis or meiosis. Their groupmates will guess if the event is mitosis or meiosis by raising the metacards. The group who will score high for 5 minutes will be the winner. Then they will complete Table A. which is comparison of mitosis and meiosis	**Venn Diagram and Tabular Comparison of Mitosis and Meiosis**	**Tabular presentation of the Comparison of Mitosis and Meiosis**	**Tabular presentation of the Comparison of Mitosis and Meiosis**

Content	Process			Product		
	Visual	Auditory	Kinesthetic	Visual	Auditory	Kinesthetic
Law of Segregation and Independent Assortment	. **Strategies: Cooperative Learning, Anchoring Activities** Students will perform the Act." Genetics Stix",wherein each group will have a representative of visual, auditory and kinesthetic having different roles in their group. The visual learners will interpret the alleles, and decode the traits.	**Strategies: Cooperative Learning, Anchoring Activities** Students will perform the Act." Genetics Stix",wherein each group will have a representative of visual, auditory and kinesthetic having different roles in their group. The auditory learners will discuss and present their output	**Strategies: Cooperative Learning, Anchoring Activities** Students will perform the Act." Genetics Stix",wherein each group will have a representative of visual, auditory and kinesthetic having different roles in their group. The kinesthetic learners will draw the facial features	**Data Sheet of the genotypes and phenotypes of the parent.**	**Data Sheet of the genotypes and phenotypes of the parent.**	**Illustration of phenotypes and genotypes.**

Content	Process			Product		
	Visual	**Auditory**	**Kinesthetic**	**Visual**	**Auditory**	**Kinesthetic**
Law of Dominance	**Strategies: Cooperative Learning, Anchoring Activities, Learning Centers** Students will perform the Act. "Traits of a Dragon" wherein they will be given pictures of dragons, they will complete the table by observing the characteristics of dragons.	**Strategies: Cooperative Learning, Anchoring Activities, Learning Centers** Students will create a radio program which discuss Law of Dominance.	**Strategies: Cooperative Learning, Anchoring Activities, Learning Centers** . Students will perform the Act. "Show Me a Dragon", wherein they will cross the traits of the dragons, then they will draw the phenotypes of the dragons.	**Tabular Data of the observable traits of a Dragon.**	**Radio Program**	**Illustrations of the Phenotypes of the Dragons**
Parts and Functions of the Digestive System	**Strategies: Cooperative Learning, Learning Centers, Anchoring Activities** Students will perform the Act. "Select and Connect", wherein they will be given pictures of the different body organs. They will be asked to cut and paste the pictures of organs of the digestive system and identify the functions.	**Strategies: Cooperative Learning, Learning Centers, Anchoring Activities** Students will perform the Act.'Listen To Me", wherein they will listen to a recorder which discuss the parts and functions of the digestive system. They will identify the parts and functions of the digestive system.	**Strategies: Cooperative Learning, Learning Centers, Anchoring Activities** Students will perform the Act. "Digestive Puzzle", wherein they will be asked to assemble a puzzle of the digestive system. Then they will identify the organs and functions of the digestive system.	**Pictures of the Organs of the Digestive System and Functions of each organs were presented in tabular form**	**Tabular presentation of the Organs of the Digestive System and Functions of each organs.**	**Digestive Puzzle and tabular presentation of the Organs of the Digestive System and Functions of each organs.**

Content	Process			Product		
	Visual	**Auditory**	**Kinesthetic**	**Visual**	**Auditory**	**Kinesthetic**
Proper Caring of the Digestive System	**Strategies: RAFT (Role, Audience, Format, Topic)** Students will perform the Act. "RAFT", wherein their role is an artist, They will draw 2 pictures of themselves showing the positive and negative side in terms of their health. The second drawing should illustrate how they would like to appear. They will identify the steps they will take in like the food they will eat. *RAFT was given two days before	**Strategies: RAFT (Role, Audience, Format, Topic)** Students will perform the Act."RAFT", wherein they will have a talk show about the proper caring of the digestive system. *RAFT was given two days before	**Strategies: RAFT (Role, Audience, Format, Topic)** Students will perform the Act. "RAFT", wherein they will have a role playing which focus on the proper caring of the digestive system. *RAFT was given two days before	**Illustrations of their present and future selves.**	**Talk Show Program about Proper Caring of the Digestive System**	**Role Playing about Proper Caring of the Digestive System**

APPENDIX X
Traditional Lesson Plan Matrix

Topic	Lesson Strategy	Output
Cell Cycle	**Strategy/ies: Discussion, Picture Analysis** The students will watch a video clip about cell cycle. Based on the video clip, they will answer the activity entitled "Cell Goes on a Cycle".	Student's Activity Cell Goes on a Cycle
Mitosis	**Strategy/ies: Discussion, Picture Analysis** The students will be given sets of pictures of the different stages of mitosis. Let them write their observations on their activity entitled "Observing Mitosis"	Student's Activity Observing Mitosis
Meiosis	**Strategy/ies: Discussion, Picture Analysis** The students will be given pictures of the different stages of meiosis. Let them write their observations on a manila paper and present it in class. Then let them answer the activity entitled "Describe Meiosis".	Student's Activity Describe Meiosis
Comparison of Mitosis and Meiosis	**Strategy/ies: Discussion, Game** The class will simulate the game entitled "Deal or No Deal", wherein they will identify if the statement refer to mitosis, meiosis or both. Then they will perform the activity entitled "Comparison of Mitosis and Meiosis.	Student's Activity Comparison of Mitosis and Meiosis

Law of Segregation and Independent Assortment	**Strategy/ies: Discussion** Let the students perform an activity entitled "Our Baby", wherein they will work in pairs and identify the genotypes and phenotypes of their future baby.	Student's Activity Our Baby

Topic	Lesson Strategy	Output
Law of Dominance	**Strategy/ies: Discussion** The teacher will discuss the concepts of Law of Dominance and demonstrate on how to perform a monohybrid cross	Student's Response on Problem Solving
Parts and Functions of the Digestive System	**Strategy/ies: Discussion, Game** The students will play a game entitled 4 Pics One Word, wherein they will identify the organs of the digestive system. Then the teacher will discuss the functions of these organs.	Student's Response
Digestive Enzymes	**Strategy/ies:Discussion, Discovery Learning** The students will perform an activity/experiment entitled Chemical vs. Mechanical Digestion	Student's Response on Activity
Proper Caring of the Digestive System	**Strategy/ies: Discussion, Picture Analysis** The teacher will present different samples of food. Let the students identify which among the food samples is good for the body and which is not. Then let them explain their answers.	Student's Response

Philippine Normal University
National Center for Teacher Education

Curriculum Vitae

RIZA MAE O. SALINAS

307 Ilang-ilang St. Buenavista II, Gen. Trias Cavite
Cell:0930-3426-197
Email: rizamaesanchez03@yahoo.com

EDUCATIONAL BACKGROUND

- **Master of Arts in Science Education with Specialization in Biology (Candidate)**, Philippine Normal University , Taft Avenue, Manila

- **Bachelor of Secondary Education Major in Biology,** Philippine Normal University,
  June 2001- March, 2005, Cum laude

- **Graduate**, Governor Ferrer Memorial National High School, Gen. Trias, Cavite,
  June 1997- March 2001, Class Salutatorian

- **Graduate,** Buenavista Elementary School, Gen. Trias, Cavite
  June 1991 – March 1997, Third Honors

TEACHING EXPERIENCE

ACADEMIC /TEACHING EXPERIENCE

- **Science Teacher** , General Emilio Aguinaldo National High School, Palico IV,
  Imus City, Cavite, July 2007- Present, Teaching Science 8

- **Science Teacher** , Academy of Saint John La Salle Green Hills Supervised, Sta. Clara, Gen. Trias, Cavite, June 2005- March 2007, Taught Science 4, 5, and 6

.

HIGHLIGHTS OF PROFESSIONAL EXPERIENCE

AWARDS RECEIVED

- **Winning Coach**, 1st Place, Science 8 Quiz Bee sponsored by School's Division Office Imus City (Science Fair 2015)
- **1st Place,** Action Research (Teacher's Category) sponsored by School's Division Office Imus City (Science Fair 2015)
- **Winning Coach**, 1st Place, Science 8 Quiz Bee sponsored by School's Division Office Imus City (Science Fair 2014)
- **Winning Coach**, 1st Place, Technoquiz National Level sponsored by Association of Science Educators (ASEP 2013)
- **Winning Coach**, 1st Place, Technoquiz Regional Level sponsored by Association of Science Educators (ASEP 2013)
- **Winning Coach**, 5th Place, Science 8 Quiz Bee Regional Level sponsored by Association of Science Educators (ASEP 2013).
- **Winning Coach,** 1st Place, Science 8 Quiz Bee Division Level sponsored by School's Division Office Imus City (Science Fair 2013)
- **Winning Coach**, 1st Place, Science Investigatory Project Division Level sponsored by School's Division Office Imus City (Science Fair 2013)
- **Winning Coach,** 1st Place, Sci- Damath Competition, Division Level sponsored by School's Division Office Cavite (Science Fair 2009)
- **Demonstration Teacher Regional Level 2016**
- **Demonstration Teacher Division Level 2015**
- **Member** of the Division Research Advocators Enthusiasts and Mentors, (DREAM TEAM) 2015 to present
- **Grade 8 Key Teacher**, 2013-2014, 2014-2015

.

SEMINARS ATTENDED

- **Regional Mass Training for Grade 11 Teachers on the K to12 Curriculum, May 23 – June 9, 2016 held at De la Salle University, Dasmarinas, Cavite**
- **International Conference on Action Research, Action Learning, 2016, May 3 – May 5, 2016 held at De la Salle University, Taft Avenue, Manila**
- **Seminar on Capability Building in Planning and Writing Action Research for Science Teachers, held at Philippine Normal University, Taft Avenue, Manila**
  December 11 - December 12, 2015

- **Division Seminar Workshop in Science held at Malagasang I, Imus City October 27- October 30, 2015**

- **1st Biological Teacher's Association Convention held at Philippine Normal University, Taft, Manila, October 4, 2015**
- **International Conference Bridging the Gaps on Education held at Saint Paul University, Tuguegarao City, August 20 – August 22, 2015**
- **International Mind Educator Seminar, held at Imus, City Dec 12-16, 2014**
- **Regional Mass Training for Grade 8 Teachers on the K to12 Curriculum, May 23 – June 3, 2013 held at De la Salle University, Dasmarinas, Cavite**

PERSONAL INFORMATION

- **Age:** **31 years old**
- **Birthday:** **December 7, 1984**
- **Birthplace:** **Trece Martirez City, Cavite**
- **Height:** **5'6**
- **Weight:** **58 kg**
- **Religion:** **Iglesia ni Cristo**
- **Citizenship:** **Filipino**

CHARACTER REFERENCES

- **Rochelle S. Balete**, Department Head of Science Department of Gen. Emilio Aguinaldo National High School , Palico IV, Imus City Cavite (09435147470)
- **Melinda A. Tapawan,** School Head of Gov. Ferrer Memorial National High School, Buenavista II, Gen. Trias, Cavite (09472617821)
- **Marilyn A. Dimapilis**, Master Teacher I of of Gov. Ferrer Memorial National High School, Buenavista II, Gen. Trias, Cavite (09234263186)

Philippine Normal University
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Philippine Normal University
College of Graduate Studies and Teacher Education Research
PUBLICATION OFFICE

AUTHENTICITY RESULT

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Author(s): Riza Mae O. Salinas

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Rio Anne R. Maño
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Director, Publications Office