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INSTRUCTIONAL PERFORMANCE OBJECTIVES FOR A COURSE IN GENERAL BIOLOGY.

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THE INSTRUCTIONAL OBJECTIVES OF A FRESHMAN COURSE IN GENERAL BIOLOGY ARE ORGANIZED FOR THE STUDENT'S EASE OF REFERENCE. THE COURSE IS OUTLINED, BY DEGREE OF COMPLEXITY, AS FOLLOWS--(1) ORIENTATION AND INTRODUCTION, (2) ORIGIN AND ORGANIZATION OF LIFE, (3) CYTOLOGY, (4) METABOLISM AND BIOCHEMISTRY, (5) PLANT LIFE (VASCULAR AND NON-VASCULAR), (6) INVERTEBRATES (PROTOZOAN AND METAZOAN), (7) VERTEBRATES AND CHORDATES, (8) PHYSIOLOGY, (9) REPRODUCTION, EMBRYOLOGY, GENETICS, (10) ECOLOGY, DIVERSITY, AND ADAPTATION. THE STUDENT WILL ALSO BE EXPECTED TO KNOW STANDARD EXPERIMENTS. AT ALL TIMES THROUGHOUT THE YEAR, THE STUDENT, BY KNOWING WHAT IS EXPECTED OF HIM AT EACH STEP, CAN BE AWARE OF HIS PROGRESS AS COMPARED WITH THE INSTRUCTOR'S PURPOSE. ALL OBJECTIVES ARE STATED IN BEHAVIORAL TERMS. (HH)

INSTRUCTIONAL PERFORMANCE OBJECTIVES for A COURSE IN GENERAL BIOLOGY

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Following is a collection of approximately one hundred and seventy instructional objectives organized in a format to be used as a supplement to a syllabus for an introductory course in biology intended for the freshman level of college.

The teacher often "realizes" and sometimes mentions to his students from time to time what he wants his students to be able to accomplish and to what extent their skills should be developed; but very seldom does the instructor state in concrete terms exactly what is expected of the student and what levels of performance the student should attain as a result of the course.

It is this instructor's objective in composing these instructional objectives to construct such an instrument that establishes as specifically as possible, precisely what the student should be expected to accomplish as a result of this course.

These objective criteria are intended to be used as a student reference to which the student may refer in order to determine for himself what will be expected of him in terms of knowledge and performance skills by his instructor. It is through this instrument that the instructor hopes to increase the import of this course for the student, thereby approaching his own prime objective: making the course as meaningful to each student as possible.

Instructional Objective Approach to Teaching College Biology. It is through this approach to teaching that the professor can present to the students guidelines which help identify exactly what the students are expected to learn. This orients the students into phase with the thinking of the professor concerning objectives and goal specifications of the course. I submit the following as an example of Instructional Objectives for College Level Biology.

TABLE OF CONTENTS

I. Orientation and Introduction

A. Lecture Procedure

Lectures will be given during three one-hour periods each week. It is expected that each student read assignments before coming to class, take adequate and legible notes in lecture, and then correlate these notes with his reading and instructional objectives.

B. Laboratory Procedure

Laboratory periods will be scheduled for one three-hour period each week. The work in the laboratory will be correlated as closely as possible with the lecture topics.

C. Testing

Examinations will be given at the break in the continuity of the lecture topic areas. The performance skills and level of performance asked for on the examinations will be originated directly from the instructional objectives.

II. The Origin and Organization of Life

Demonstrate your knowledge of Darwin's "Origin of Species" by writing out the first, second, and third generalizations on which it is based, and then conclude briefly what exactly is the conclusion of this work. To be correct your answer must include these concepts: variation, new species, inheritance, the survival of the fittest, overproduction, and the struggle for existence.

Demonstrate your understanding of the possible evolution of the cell by drawing the main possible stages and writing a brief explanation of each stage of the theory. (An example of one theory you will all be familiar with is the theory of cellular evolution by J. D. Robertson.)

Demonstrate your ability to associate biological development with geological time by writing out one important biological major group or Order which was present during each of the following geological times: archeozoic era, proterozoic era, paleozoic era, mesozoic era, and cenozoic era.

Demonstrate your understanding of the history of the science of taxonomy by explaining briefly what is meant by the two pre-Darwin concepts of creational and typological.

Demonstrate your understanding of classical taxonomy by stating the three functions of classical taxonomy and discuss in your own words briefly each function. To be correct you must include in your answer classi-

fication, nomenclature, and identification.

Demonstrate your knowledge and understanding of the type of classification system that we have today in the biological sciences by explaining briefly in writing what is meant by the statement: "--we have a natural classification system, but we will never really have a phylogenetic type."

Explain briefly three of the following four uses of a classification for any biological specimen or specimens, thereby showing your ability to realize the importance of a taxonomic classification. The four uses of a classification deal with stability, accuracy, predictive value, and heuristic value.

Demonstrate your ability to organize a specimen into the correct classification groups by classifying yourself from species up to kingdom. To be correct you must include all of the group areas (major) in the correct order beginning either with the kingdom or the species.

Demonstrate your knowledge of the importance of biochemical analysis with respect to proving certain evolutionary theories by answering briefly the following question: How do biochemical similarities and differences between species serve as evidence of the relationship of these species through evolution?

Demonstrate your understanding of evidences of evolution by explaining

briefly in what way may the difficulties in species definition and recognition be considered as evidence for evolution.

III. Cytological Aspects of Organisms

Demonstrate your ability to recognize the microstructure of a "typical" cell by labeling directly on a micrograph of a cell any ten of the following twelve structures which can be located on the micrograph: cytoplasm, endoplasmic reticulum, an invagination, a tubule, Golgi body (area), a unit membrane, a mitochondria, nuclear membrane, a granule, a ribosome, nucleus, and centrosomes.

Demonstrate your understanding of mitosis by drawing the following stages in both an animal and a plant cell: interphase, early prophase, late prophase, prometaphase, metaphase, anophase, early telophase, and late telophase. To be correct all drawings must be labelled by exact stage.

After being exposed to J. D. Robertson's "three phase system" of the cell, show your familiarity with this work by labelling the "three phases" on a simple red-blood-cell drawing.

Demonstrate your knowledge of the following terms used in the book by writing out briefly a specific fact about the term or explaining briefly what the term is: zygote, gametes, meiosis, haploid, diploid, and fertilization.

Show your understanding of the cytochemical orientation of a cell's unit membrane by briefly explaining why most unit membranes are between 75 $\mathring{A}$ and 100 $\mathring{A}$ thick. To be correct you must include one labelled sketch

of a unit membrane structure.

Demonstrate your understanding and knowledge of the length measurement often used in micrographic work by converting each of the following values:

1 Å = ____mm 1 mm = ____u 1 u = ____Å 1 cm = ____mm

Demonstrate your knowledge of the following items presented in the text by writing a brief identification of five of the six items in the list below. To be correct you must describe, relate, or identify.

(1) Study of the physiology of inheritance factors.

(2) Study of tissues.

(3) Theodore Schwann.

(4) Study of cells.

(5) Robert Hooke.

(6) "Micrographia"

IV. Metabolism and Biochemistry

Show your knowledge of the elements that are most prominent in the structure of carbohydrates, lipids, and proteins by writing after each of the items in the list below one or more of the following "qualifiers": (A) in all carbohydrates, (B) in all lipids, (C) in all proteins, and (D) in hemoglobin.

hydrogen	carbon	oxygen
sulphur	sodium	nitrogen
phosphorus	chlorine	calcium
potassium	iron	

Arrange the following steps of the oxidation of a protein in the correct order as they would occur in a cell which has just received a protein. In this way you are demonstrating your ability to identify the correct sequence of one of the most important energy yielding processes carried on by the cell.

Enters the Krebbs cycle

Deamination

Hydrolysis to form an amino acid

Yielding of ATP

In the form of simple acids or simpler amino acids

Demonstrate your ability to identify the characteristic forms of lipids, carbohydrates, and proteins by labelling the following chemical

structures as either one of the above mentioned: (Note the formulae may be of constituents of the three basic chemical divisions.)

$C_6H_{12}O_6$ $C_3H_8O_3$ $(C_6H_{10}O_5)n$

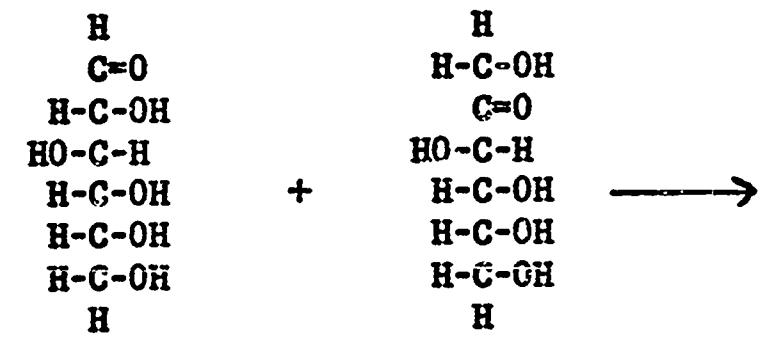
$NH_2\text{-}CH_2\text{-}COOH$ $C_{254}H_{377}N_{65}O_{75}S_6$ $C_{57}H_{104}O_6$

Demonstrate your knowledge of places where lipids, proteins, and carbohydrates occur in the cell by writing out two examples of each which are common occurances in the microstructure of the cell.

Show your knowledge of the chemical composition of protoplasm (cytoplasm) by writing out the amount (approximate) by weight which normal cytoplasm is expected to have of the following divisions: water, protein, fatty substances, other organic substances, and inorganic material.

Demonstrate your knowledge of amino acid and protein chemistry by writing out the chemical formula for glycine and labelling the amino group and the carboxyl group. Also write out another molecule of glycine and link the two together by means of a peptide linkage.

Demonstrate your knowledge of basic carbohydrate chemistry as it occurs in nature by writing the names of each of the two monosaccharides below. You must also write out the final product formed by the joining of the two and write the name of the reaction or process involved.



Demonstrate your ability to trace the mechanism of formation of proteins in the cell by arranging the following items in the correct order of occurance and describe where each is located in the cell: RNA, messenger RNA, nuclear RNA, transfer RNA, ribosomal RNA, DNA, nucleic acids, proteins, Krebbs cycle, and ATP.

Demonstrate your knowledge of the means by which biologists determine whether a sugar is levulose or dextrose by writing a simple chemical diagram of glucose and showing the difference of the possible forms. Briefly explain this method of determining the rotation of a sugar.

Demonstrate your understanding of the structure of DNA by 1) naming what DNA stands for, 2) identifying the three basic structural components of DNA, 3) identify the main function of DNA in the cell, and 4) name the form that is characteristic of the final arrangement of DNA molecules and briefly describe this form.

V. The Plant Kingdom

A. Non-vascular

Demonstrate your familiarity with the terms autotroph and heterotroph by describing briefly what each term means with relation to its application to each of the following organisms: most algae, diatoms, carnivores, saprophytes, and viruses.

Demonstrate your knowledge of the various characteristics of morphology of bacteria by writing out a brief description of each of the following forms: Vibrio comma, cocci, spirilla, and bacilli.

State briefly how bacteria movement may not be considered the same as Brownian movement. Include in your answer how and give a possible explanation why the two movements differ in appearnace. In this way you will be showing your ability to establish definite criteria for two biological observations that at first appear to be very similar.

Demonstrate your understanding of the methods involved in the prevention of many of the diseases caused by bacteria by explaining briefly why a study of the individual's allergies are important before a vaccine is administered.

State for three of the following diseases 1) the organism responsible for the disease, 2) the source of the infection, and 3) yes or no whether immunity is known as yet for this particular disease.

In this way you are demonstrating your knowledge and ability of association of many bacteria with diseases they cause.

cholera	syphilis
gonorrhea	typhoid fever
scarlet fever	tetnas
pneumonia	botulism

Demonstrate your ability to identify characteristics of algae by writing two diagnostic characteristics and one example of a particular algae of the following list of six main algae divisions: blue-green algae, green algae, golden-brown algae, luminescent algae, brown algae, red algae.

Demonstrate your ability to recognize certain economic factors about each of the following molds or fungi by characterizing them first into what type of fungi or mold they are and then writing a brief discussion of the economic importance of the growth. To be correct you are expected to be able to complete this requirement for three of the following four: corn smut, wheat rust, Penicillium notatum, yeast (any kind), and mushrooms (any one kind).

Demonstrate your understanding of the term "symbiosis" as it is demonstrated in the plant kingdom by writing a brief discussion explaining either the symbiosis of the lichens or the symbiosis of Rhizobium

as it relates to clover. To be correct you must include the part played by both members of either example.

Demonstrate your understanding and knowledge of the life cycle of the ferns by tracing the life cycle of the ferns. Write out each step or main stage and identify each with its main characteristic. To be correct your discussion should include alternation of generations, zygote, young sporophyte, group of sporangia, sperm, egg, archegonium, mature sporophyte, sporangium, young gametophyte, and the gametophyte states.

Demonstrate your knowledge of the reproduction cycles and means of reproduction of certain fungi by writing a brief discussion explaining why slime mold, Myxomycophyta, should be considered a fungi. To be correct you should include a comparison of the slime mold sporangia with the sporangia of the bread mold.

The Plant Kingdom (continued)

B. Vascular Plants

Demonstrate your familiarity and understanding of the following types of energy that can be found in various forms of life by writing out a brief discussion of each type of energy and include two examples of each type of energy and where they occur in nature: kinetic energy, heat energy, electrical energy, chemical energy, and light and radiation energy.

Demonstrate your application of your knowledge of the mechanisms implied by the following terms by devising a simple experiment to conclusively demonstrate the concept of two of the following: You will have eight minutes.

absorption	ionization
diffusion	assimilation
osmosis	anaerobic reaction

Show your ability to use a microscope, draw what you see, and label and identify what you have seen and drawn (as is often practiced in the biological research laboratory) by mounting an Elodea leaf on your slide, drawing a cell of it, and identifying your drawing by labelling the following structures: cell wall, cytoplasm a vacuole, chloroplasts, and a nucleus.

Show your understanding and your ability to prepare taxonomic keys by writing out a usable (by anyone else in the class) taxonomic key for fifteen biological specimens representing various classification areas or groups. These specimens may be given to you or you may be asked to collect them during a field trip. You will have twenty minutes to complete your key in the laboratory.

Demonstrate your understanding of evolution as a basis for classification within the plant kingdom by comparing the life cycle of the pine with the life cycle of the fern. To be correct you should include a brief discussion of the relationship of the gametophyte generation of each the fern and the pine.

Demonstrate your knowledge of various root types and their main characteristics by listing one main distinguishing characteristic of each of the following roots and name one example of each root type: tap root, fibrous root, prop root, aerial root, and dodder root (Haustoria).

Demonstrate your understanding of each of the following terms by writing a brief discussion of the differences of each of the three terms. To be correct your answer must include what happens to the root and plant each year.

annual biennial perennial (herbaceous or woody)

Demonstrate your ability to identify the parts of a plant associated with growth by identifying the following external anatomical areas or items on the drawing provided below: terminal bud, axillary bud, axil, node, and internode.

Note: the drawing will contain all of the above areas of a plant.

Demonstrate your knowledge of various parts and types of acaulescent (underground) stems by listing one main distinguishing characteristic of each of the following and name one example displaying each type of stem. To be correct you should include in your list where the leaves are and what part of the stem each is, or for each: rhizome, tuber, a corm, and bulb.

Show your ability to identify the amount of each part of the flower by using two live flowers given to you, identify all of the parts (how many in each whorl) for the two flowers by first writing out the part of the flower and then listing the number found for that particular part. The specimens to be used will be dicotyledons.

Demonstrate your understanding of the compound terms associated with flower parts by briefly identifying the three following compound terms. To be correct the answer must include the singular structures that make up the collective term: perianth, corolla, and calyx.

Demonstrate your ability to identify the constituents of a flower by identifying briefly the following flower parts. To be correct your answer must identify the number of the whorl that each main flower part composes, if any, and also the position of each structure type within the flower.

receptacle	corolla
stamens	gynoecium
sepal	ovary

Demonstrate your understanding of the origin of the parts of an Angiosperm seed and the condition of the nucleus (1n, 2n, or 3n) by filling in the following chart with the missing origins and nuclear conditions.

Seed structure	Origin	Generation	Nuclear Condition
seed coats	integument	Sporophyte I	
endosperm		Sporophyte I	
embryo		Sporophyte II	2n

Show your ability to recognize the structure of the pistal and stamen of the flowers by briefly identifying the following terms and then labelling a diagram that you draw of a pistal and stamen, with these terms on them: style, anther, ovary, filament, and stigma.

Demonstrate your understanding of the two main types of inflorescence found commonly in flowers by briefly discussing on paper the differences of determinate and indeterminate types. To be correct your answer must include which stops any further growth and why and include a simple diagram of each type using an umbel arrangement as an example.

Demonstrate your ability to characterize different types of fruit and relating examples found in flowering plants of each different fruit type by giving (written) one example and one diagnostic characteristic of seven of the following fruit types: achene, multiple fruit, drupe, berry, pome, capsule, nut, legume, and samara.

Demonstrate your understanding of the flowering plant life cycle through two generations by tracing the life cycle of the plant through two generations, gametophyte and sporophyte. To be correct you must list the correct order of the following stages and briefly write a qualifying statement about each as to the purpose of the stage. Flower, female gametophyte with egg, male gametophyte with sperm nuclei, endosperm of fertilization stage, embryo of seed with ovule forming seed, megaspore mother cell, megaspore, microspore, and sporophyte plant with the flower.

Demonstrate your understanding of the concept of convergence as it appears in botany by explaining briefly what is meant by using the fact of similarity of plant bodies of the moss gametophyte and the sporophyte of some flowering plants as an example of parallel evolution or convergence. To be correct your answer should contain a four area diagramatic list tracing the gametophyte and sporophyte generations of the following: liverwort, fern, pine, and flowering plant.

Demonstrate your ability to recognize the following types of inflorescence as they appear in botany specimens. You will be given the specimens and you are to first of all classify each of them as to whether they are a racemose inflorescence or a cymose inflorescence and then write out which of the following specific inflorescence types each is. To be correct you will need to complete three out of five choices presented to you: raceme, cyme, corymb, umbel, spike, and panicle.

Show your ability to classify the main types of seeds, dicotyledonous, monocotyledonous, and polycotyledonous, by labelling each of the following seeds as one of the above types and writing one main distinguishing characteristic about each type used: pine seed, bean seed, and Zea mays.

Demonstrate your knowledge of the distinguishing characteristics of the two main subclasses of flowering plants by writing out three ways of distinguishing Dicotyledoneae and Monocotyledoneae and give three examples of each subclass. To be correct your answer must include the number of cotyledons present, whether cambium is present or absent, the venation type of the leaves, and the number of parts and whorls of the typical flowers of each.

Demonstrate your knowledge of the following terms by writing a brief discussion of hypogynous, epigynous, and perigynous, stating the main similarities and differences as the terms refer to the ovary of the flower.

Demonstrate your ability to recognize various flower parts in their correct position within the flower by labelling the following diagram with the following terms and give the numerical configuration of this particular flower as to the number of structures in each whorl: number of locules, sepals, stamens, and petals.

Demonstrate your proficiency in using the microscope and your ability to draw and label the parts of roots by locating, drawing, and labelling the following on the roots of a grass seedling grown in water and a normal suitable plant root, after careful examination of each under the microscope: mature region of the root, embryonic region of the root, root hairs, root cap, region of cell elongation, and the region of cell differentiation.

Demonstrate your ability to identify the parts of a cross section of a root tip by locating, drawing, and labelling the following from a prepared slide of a cross section of a suitable root tip: epidermis, cortex, root hair, and the stele containing the pericycle, phloem, parenchyma, and xylem.

Demonstrate your knowledge of the functions of the various regions of a developing root by briefly identifying the main function or two main functions for four of the following six items found in a developing root of grass grown in water: mature region of the root, root hairs, root cap, region of cell elongation, embryonic region of the root, and the region of cell differentiation.

Demonstrate your knowledge of the way that growth occurs in monocots by answering the following question: Why is a palm tree uniform in size with regard to the stem from the ground to the growing point at the top? To be correct your answer must include what composition the vascular bundles are, what the growth is due to, and how the growth occurs.

Demonstrate your knowledge of the structures of monocot and dicot stems and how they differ, by placing each of the following structures under one of the two above headings and then briefly identifying the structure with regard to its main functions: vascular bundle, epidermis, parenchyme, cuticle, and pith.

Demonstrate your ability to identify the parts of the typical citrus leaf by examining the specimen given to you of a citrus leaf and then drawing the leaf and labelling it with regard to the following structures: lamina, petiole, blade at the base, venation, stipules, margin (type).

Demonstrate your knowledge of the way growth occurs as an overall view of the dicots by labelling the following structures on a simple schematic diagram of the morphology of a simple dicot stem. To be correct you must briefly explain the way in which growth occurs in the dicots, cambium, hollow cylinders, xylem, and phloem.

Demonstrate your ability to understand the concept of absorption of inorganic salts as it occurs in plants by designing an experiment to show the absorption of inorganic salts in a simple plant. You may choose your own example. To be correct you must list the seven main elements that make up the inorganic salts needed to grow plants.

Demonstrate your understanding of the interrelationships that the physiological systems of respiration and photosynthesis have in the advanced plant by writing out a brief explanation of what happens in each of the systems with regard to the following items: carbon dioxide, oxygen, energy, and carbohydrates.

Demonstrate your knowledge of the various types of tropisms that can occur in plants by stating a brief explanation of three of the following and then giving what the result is in plant growth: geotropism, phototropism, hydrotropism, and thigmotropism.

Demonstrate your understanding of the part that plant metabolism plays in the world by stating which, anabolism or catabolism, the green plants are performing overall in the world. To be correct you must give evidence to back up your answer.

Demonstrate your knowledge of transpiration as this concept occurs in plants by briefly stating what transpiration is and then designing an experiment to conclusively show how transpiration occurs in the plants.

VI. The Invertebrates

A. Protozoan

Demonstrate your skill in locating and following by drawing and labelling the following after you have found each under the microscope from your culture of Euglena agilis: cytosome, gullet, eye spot, nucleus, chloroplast, flagellum, contractile vacuole, and reservoir.

Demonstrate your knowledge of the importance of Typanosoma gambiense by explaining briefly why this organism is so economically important to man. To be correct you must include the effects from contact with this organism and where in the human, cattle, and antelope this organism does the most damage.

Show that you understand the following processes as they apply to the amoeba by writing a brief explanation of each of the following as they occur with the one-celled organism: ingestion, egestion, and assimilation.

Demonstrate your knowledge of the reproductive process of conjugation by explaining briefly the process as it occurs in paramecium. Given the opportunity you should be able to identify various definite stages of conjugation in paramecium from random slides.

Demonstrate your understanding of the life cycle and life processes of protozoa by answering briefly the following question with a proper explanation of your reasoning: Can a protozoan die of old age? To be correct your answer should include as many various things as you can think of that would determine the death of a protozoan within its own invironment.

Demonstrate your ability to write up the proper preliminary format to performing an experiment. This will also demonstrate your knowledge of the metabolism of the paramecium. You are to devise an experiment, by writing out the steps to be taken, to determine what pH range the Paramecium caudatum must have to exist over a period of normal life span.

Demonstrate your understanding of the relationship of the classification of the invertebrates and your knowledge of the representative characteristics which are the reasoning behind the certain order of classification by naming all of the main phyla and two representative Classes of each phylum with the brief explanation of the main characteristics of each Class which you list. To be correct you must list all of the phyla and two families of each for the animal kingdom up to the vertebrates.

The Invertebrates (continued)

B. Metazoan

Demonstrate your knowledge of the importance of the anopheles mosquito by tracing the life cycle of this insect as it relates to the disease that it produces in man. To be correct you should include the prevention of this disease and explain briefly why this is or is not the only way of help against this insect.

Demonstrate your knowledge of and your ability to prepare taxonomic keys by writing out a usable (by anyone else in the class) taxonomic key for 10 biological specimens representing various classification areas or groups of the animal kingdom. These specimens may be given to you or you may be asked to collect them during a field trip. You will be given a microscope to work with. You will be given thirty minutes to complete your key in the laboratory.

Show your knowledge of mitosis by identifying in the laboratory a slide of each main phase of mitosis in both an animal cell and a plant cell. (You will be given a large assortment of uncategorized slides showing animal and plant cell mitosis).

Demonstrate your knowledge of and ability to identify certain external characteristics of sponges by classifying several appropriate samples given to you in the laboratory into one of the following categories: calcareous, silicious, and horny. To be correct your answer should include a brief explanation of each type.

Demorstrate your ability to perform a scientific experiment in order to answer a basic laboratory problem. The problem might be: can a hydra bud live independent of the parent long enough to develop into an adult hydra? You will be given the materials that you need as well as samples of hydra with buds on them.

Demonstrate your knowledge of the main divisions of classification within the area of invertebrates by listing each phylum and two examples and two characteristics of each phylum within the area of the invertebrates.

Demonstrate your knowledge of the Dugesia and asexual reproduction by stating why some planaria, for example the Dugesia, reproduce asexually without a reproductive system present at the time of reproduction. To be correct you must briefly discuss in your answer the process of asexual reproduction and present conclusive evidence that the reproductive system is not needed at this time in the Dugesia.

Show your understanding for the value of the Echinoderms to the biologists by briefly discussing one example and giving evidence for their extensive use (gamete and embryo stages) in studies in experimental biology.

VII. Vertebrates and Chordates

Demonstrate your knowledge of the main divisions within the Phylum Chordata by writing out one primary characteristic and one example of each of the following Subphyla: Urochordata, Vertebrata, Cephalochordata, and Hemichordata.

Demonstrate your ability to recognize the characteristics which determine the classification of any animal within the Subphylum Vertebrata by placing eight out of ten animals presented to you in laboratory in either the proper Class if they are not of the Class Mammlia or in the proper Order if they are of the Class Mammalia. To be correct you must write out the common name or the scientific name of the animal, list the Class or Order (as per above instructions), and write out one characteristic of the animal which shows evidence of its conclusively belonging to the particular Class or Order.

Demonstrate your understanding of the reasons or possibilities of evolution by answering and giving evidence for one of the following questions: How and why does the lancelot seem inverted with respect to the earth worm in its circulatory and nervous axes? OR Why is it believed that the ancestors of the Amphibia were water breathing animals?

Demonstrate your understanding of some of the more economically important marine animals and their relationships with man by briefly discussing the economic values of the following: sharks, skates, and

rays (sting). To be correct you must include in your answer what differences and similarities there are in each within his own environment. You should also include what possible protection man has from each in the animal's own environment.

Demonstrate your knowledge of what measures man has to protect himself from death by poison from a snake-bite by briefly discussing what measures to take in case of a snake bite in this area. To be correct you must include what snakes in this area are poisonous, how antivenin is made, and how does an antivenin counteract poison from a snake-bite.

Demonstrate your understanding of vertebrate evolutionary morphology and physiology by briefly answering the following question: how does the skeleton of man compare with that of a frog with respect to skull bones, vertebrae, girdles, ribs, tail bones, and limb bones? To be correct you must compare four of the six skeletal areas mentioned.

Demonstrate your understanding of the word "chordate" by briefly tracing the form of the notocord through all of the four main groups of Chordata. To be correct you must include during what stage of life the notocord is found, where it is found, and what happens to the notocord during development for each group of Chordata.

VIII. Physiological Systems of Organisms

Show your understanding and knowledge of the circulatory system and its functioning in the crayfish by stating your hypothesis of what would happen, if anything, if the crayfish were turned upside down for a long period of time. To be correct you must briefly describe the circulatory system of the crayfish and its relationship to gravity. You may assume that all other systems are functioning adequately. You must present your reasoning and evidence, if possible, for your hypothesis.

Demonstrate your understanding that many man made devices are phenomen occuring first in nature and then adapted by man for his purposes. You must write a brief discussion of how echolocation is related to radar. To be correct you should specifically identify what takes place in the process of echolocation and what animals are known to be capable of it.

Demonstrate your knowledge of characteristics of blood by briefly identifying or discussing the occurance of four of the following terms related to blood: A-B-O blood groups in man, Rh blood groups in man, formation of antibodies, agglutination, and leukemia.

Demonstrate your understanding of and knowledge of the human endocrine system by giving for each of the following organs 1) one hormone secreted by it, 2) what the target area or organ is, and 3) the first direct effect of an excess of the hormone you named.

adrenal cortex	testis
pituitary gland	Islets of Longerhans
uterus	thyroid gland

Demonstrate your knowledge of the nervous system by relating each of the following terms to their meaning within the human nervous system: reflex, autonomic nervous system, synapse Acetylcholine-A.

IX. Reproduction-Embryology-Genetics

Demonstrate your understanding of the human fetus development by explaining how the embryos of human obtain food and oxygen during embryonic development.

Demonstrate your knowledge of developmental histology by explaining what tissues arise from the three primary germ layers. To be correct you must name eight different tissues and which of the three germ layers each originates from.

Show your knowledge of population genetics by explaining some possible reasons for the unbalance of the following: the sex ratio of human births varies with the region and race. In the white population of the United States it is about 106 males to 100 females.

From your reading, write out evidence that you have found which makes it conclusive that DNA and RNA or only one is the important substance of which genes are made. By doing this you will be showing your ability to analyze biological data and prove, with this data, a position held by most cytologists and genetists.

Demonstrate your ability to prepare a format to be followed experimentally in the laboratory by writing out the steps to be followed in order to possibly determine which came first, the histones or DNA? To be correct, your view or hypothesis is not the important thing. What is important is that you can give evidence to back up your reasoning for suggesting your format order.

X. Ecology-Diversity-Adaptations

Demonstrate your basic knowledge of ecology by briefly identifying each of the following terms: population, colony, community, ecosystem, and biosphere, microhabitat, biomes, and niche. To be correct you must explain each of the above terms in their relation to ecology.

Demonstrate your knowledge of the mechanics of luminescent organisms by writing out what chemical reaction the light production by fireflies depends on. To be correct you need only write the reaction in words and explain it.

Demonstrate your knowledge of hemiepiphytes and epiphytes by describing the adaptations which a strangling fig has as compared to a true epiphyte, the orchid. To be correct you must explain each of the terms above and compare early and late stages of both the orchid and strangling fig.

Show your understanding of the various types of ecological diversities by explaining each of the following terms: symbiosis, parasitism, commensalism, mutualism, social animals, (gregarious animals), and nastic movements in plants. To be correct you must explain the term and give two examples of each type of organism or occurance in the organism.