Ashes to Ashes, Dust to Dust, and Dirt to Dirt: Creative Biology

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INTRODUCTION

The science of biology has been built on the observations of many scientists over thousands of years. Their curiosity about the natural world has led to a body of knowledge that grows larger everyday. Science is a large body of knowledge that studies living things, or organisms, to help find out the meaning of life. Biology has enlisted the aid of other sciences, such as chemistry, physics and geology. But few have tried to approach biology using the creativity employed in the arts, for instance. How can we look at science in a more creative way?

I feel that students can receive inspiration, even in science classes, to think creatively. In my classes, students find inspiration from pictures, uplifting quotations, and interesting bibliographies that examine the lives of creative individuals in the field. I hope this unit will inspire students to see science in a new light. For example, I hope to teach students that biology encourages creative thinking through its experimental and problem solving approach. Answering questions about nature involves processes of investigation and discovery that are at the heart of the study of biology. For example, just consider some of these questions that biologist are confronted with; What is life? What does a living thing do to survive? How did life begin? And on and on.

Here is an overview of some the strategies that this unit will use in order to inspire students to start looking at the study of biology as a creative process and to help them realize that scientists can be creative thinkers as well:

- Use and Pronunciation of New Vocabulary Words (including words from *Reader's Digest* "Word Power" feature).
- Looking at a list of exciting science careers on a "Career Sheet."
- Using the newspaper to find stories on new innovations in science.
- Performing creative laboratory experiments that are not in the state-issued textbook.
- "Creating" projects, such as drawing and labeling pictures of science concepts.
- Reading bibliographies of creative scientists, such as George Washington Carver, Madame Curie, and Louis Pasteur.

Personal Narrative

My goal in writing this unit is to make my biology classes attractive to my students. To do this, enthusiasm is needed in both the teacher and the students. It is my hope that if I can exude this main ingredient – enthusiasm – that it will inspire creativity in my students.

I am a teacher of Biology I in a predominately Black school, located in the Trinity Gardens area of Houston. I myself am a native Houstonian, having been born in the Third Ward area. I attended Yates High School and Texas Southern University, both in Houston, so I feel that I can relate to students in the Houston public school system. My childhood ambition was to become a medical doctor. I worked in a hospital as an orderly, and it was my job to carry dead bodies to the morgue and to do nurses' aid work. I was also an army medic in the Korean War. Since then, I have taught biology in three different cities in Texas. It is with this background that I approach my teaching work, and with this experience that I have realize that a more creative approach to the sciences is needed.

Discussion: Looking at Biology Creatively

As you will see in the lesson plans below, I am going to use a pinch of dirt, a microscope, a plant, and a gold fish to start my students off on their "creative thinking" process. The pinch of dirt is significant in that it can help us look at natural elements in a creative way – by seeing both the big and the small picture. Here's an example of how to think "creatively" about mundane things:

The dirt itself is composed or element and compound mixtures, which in turn are composed of atoms. However, even though dirt itself is made up of tiny particles, it can be collected together and used to produce useful things. For example, bricks are made from dirt, and bricks, in turn, are used to build homes. Dirt is also made into concrete, which is, in turn, made into sidewalks, freeways, and skyscrapers. Dirt is also used for growing food, all over the world. And according to the Bible, even man came from dirt! The Bible states, "And God formed man of the dust of the ground and breathed into his nostrils the breath of life" (Genesis 2: 7).

Inspiring students to look at science as a creative field should not be too difficult in this day and age. New innovations and creative approaches are all around us, in agriculture, production, medicine and pharmaceuticals – the list goes on and on. In the biotechnology field alone, the fast few decades have seen the advent of "gene" engineering, artificial hearts, and cloning. In the twentieth century, the atomic bomb, heart transplants, and so-called miracle drugs have all astounded us. Unfortunately, however, we still do not know how creativity works, and how some great minds conceive entirely new and innovative ideas.

Exactly what is the nature of creativity? Two students from Hebrew University published as essay in a science journal that described a new algorithm, or formula, for creating advertisements. They stated that "The computer demonstrates graphically what many creative people know intuitively." They went on say that although their formula seemed to suggest the impossible—that a computer could be "creative"—they themselves weren't interested in this philosophical dilemma, but rather that they were interested in its practicality. They merely wanted to come up with better techniques for stimulating

creative thinking, rather than the hit-and-miss approach of waiting for the human mind to stumble upon the next creative idea.

Can we inspire today's students to take the time to think creatively? Today's students seem to want everything in a hurry – I have heard our young people described as "the microwave generation." Therefore, I feel that, with this mindset, the chapters presented in a science course should be as short as possible, and should be informative and interesting.

I also want my students to understand and appreciate that science is not solely a "technical" pursuit. Science evolved as a way of grappling with the big problems – What is life? Where did we come from? Why are we here? Therefore, a few lessons in the "history of science" would be helpful at the beginning of any biology course. The so-called "great conversation" – the discussion of these big questions – began well before the advent of experimental science. Yet we can say that this early pondering was indeed science. The earliest of the pre-Socratics were investigating the origins of life, and seeking to understand natural phenomena. Among them were those who used mathematical notions for this purpose. Even experimentation as we know it isn't new – it has been going on for hundreds of years. But faith in the experimental process, along with the exclusive method, is a modern manifestation. The experimental method has won such clear and convincing victories that it is now regarded in some circles as not only the best way of building up scientific knowledge, but also as the sole method of obtaining knowledge of any kind. In fact, in the modern era, we are sometimes told that any question that is not answerable by the empirical method of science is not really answerable at all. But is this really true? Can knowledge extend beyond the perimeters of the verifiable? This is the very type of dilemma that calls for more creative thinking in science.

LESSON PLANS

The textbook to be used with all of the following lesson planes is *The Web of Life*, by Scott Foresman, published by Addison Wesley, copyright 1998.

Chapter 1 – Study of Life

Objective: Explain how organisms respond and adapt to their environment.
Activities:
1. Do Vocabulary exercises for chapter (have students define words)
2. Observing Bio-diversity
3. Complete the "Checkpoint" on page 18
4. Give a Test on material covered

Chapter 2 – Chemical Basis of Life

Objective: Identify the four groups that make up most of the living things
Activities:
1. Do Vocabulary
2. Examining Isotopes, page 39
3. Teacher Demonstration, page 35
4. Test on material covered

Chapter 3 – Cell Structure and Formation

Objective: Explain the main ideas that make up cell theory
Activities:
1. Do Vocabulary
2. Do Section Review, page 60
3. Class Activity, page 60
4. Test on material covered

Chapter 4 – Photosynthesis and Cellular Respiration

Objective: Explain how energy is stored and released during the ATP cycle
Activities:
1. Complete Vocabulary
2. Do Lab Zone, "Seeing a Leaf Breathe", page 81
3. Test on material covered

Chapter 5 – Cell Division

Objective: Analyze the limits on cell size
Activities:
1. Do Vocabulary
2. Quick Activity, page 114
3. Check Point (5.3), page 117
4. Test over material covered

Chapter 6 – Fundamentals of Genetics

Objective: Distinguishing between dominant and recessive traits
Activities:
1. Do Vocabulary
2. "Find Characteristics that are Inherited", page 129
3. Test on material covered

Chapter 7 – DNA, Genes, and Chromosomes

Objective: Describe the experiments that led to the discovery of DNA as the genetic material in cells

Activities:

1. Do Vocabulary
2. Make Models of genetic material, page 157
3. Quick Activity, page 158
4. Test on material covered

AN INTRODUCTION TO BIOLOGY – SOME ACTIVITIES TO TRY

These activities may be done in succession during the first week of a biology course, or they may be inserted into your lesson plans whenever they best fit the material being covered on that day.

Activity 1 – The Vocabulary of Biology

Have students define the following words, as best they can:

1. Biology
2. Organic
3. Inorganic

Also have them answer the following questions, in their own words:

1. What is science?
2. How do we know when something is alive? What are some properties of living things?
3.

Begin your discussion by defining the word biology. This word comes from two Greek words – bios, meaning "life," and the root "ology", which means the science or study of. These two words come together to mean "the science of living things". Then explain that science is a organized study of things, in which there is observation, experimentation, hypothesizing, and reporting.

Then discuss the next two words. Organic things include plants and animals – things which have lived or are living are called organic. Things which have never lived and will never live are called inorganic. This includes things such as stones, glass, sand, iron, water, air, dirt, etcetera. Have students name things belonging to each of these two categories. You may also want to briefly discuss atoms, elements, and compounds, which are the "alphabets" of living things. Give students a brief definition of atoms, elements, and compounds.

Next move on to a discussion of living things. Have students share there ideas about what constitutes life and then discuss the following properties of living things, and give definitions: respiration, excretion, motion, sensation, reproduction.

Activity 2 – The Dirt and the Leaf

A good way to preface this activity is by the type of "big picture" thinking about small things that I explained in the introduction to this curriculum unit, above. Bring in a small plant, potted in dirt.

Have your students view a small pinch of dirt under the microscope. As them to write down a description of what they see – perhaps they can also draw a picture. Explain that they should see a group of crystal-like substances – these are particles of quartz and other materials that make up dirt. These minerals (quartz, etc.) are in turn made up of elements.

Now have your students look at the leaf of a plant. Explain the function of a leaf – it carries on respiration for the plant, so that the plant can "breathe", or carry on oxidation (the use of oxygen). Explain that the leaf and the dirt are related, because the dirt is what the plant is rooted in. And the dirt is also needed to supply the minerals needed by the plant in order to grow. Have your students look at the leaf under the microscope and draw what they see.

Activity 3 – Water

Have your students look at a drop of water. Explain that water is made up of the elements hydrogen and oxygen. These are the most used materials in the world. Water seems to be all around us, yet it often "disappears." Where does it go?

As students to think creatively about situations in which water "disappears." (For example, when you leave a glass of water on the kitchen table for a few days, or when water dries up from the streets a few hours after it stops raining). Explain that when water is heated, it changes from its liquid state to a vapor state (gas). This is called evaporation. Like air, water vapor is invisible – that is why you cannot see "dried up" water.

Also explain the process of condensation, and ask students to give examples. Explain that when large amounts of water vapor in the atmosphere are cooled, this causes condensation, turning this vapor into liquid water. This is what causes rain. Also encourage students to think about what happens to rainwater. Ask them: Where does it go? (Some of it sinks into the ground, some of it runs along the surface until it forms a brook, which combine to form streams, which form rivers, which run into the sea).

Activity 4 – The Goldfish

Now have your class look at a goldfish in order to discuss some of the functions of living things. The gold fish can be observed both in his bowl and under a slide, which must be done very carefully, handled by the instructor. Have students look particularly at the gills, under the microscope, to discuss respiration. In his bowl, the goldfish can also be observed in the processes of motion (he is swimming), excretion, and sensation (if we tap at the glass, he reacts).

Also use the goldfish as starting point from which to discuss the evolution of living things. Explain that the first signs of life probably appeared in the ocean – they were tiny algae and then strands of green plant-like sea-weeds. Millions of years later, sponges and worms appeared, and some of these creatures grew shells. Along with these came the crab-like trilobites, which "ruled the sea." Millions of years passed again and a new water creature appeared –a shark-like fish. Other kinds of fish also appeared.

Eventually, some water animals became partly adapted to living on land. They were the first amphibians. These animals could breathe air and live both in water and on land. Reptiles were the first animals to appear that could live entirely on land – these included the lizard, and later the dinosaur. Some reptiles developed wings and took to the air and began to fly. Other animals, which were covered with fur and had a stable body temperature, appeared. These were the first mammals. Finally, only about a million years ago, early "human beings" appeared. As an endeavor in creative thinking, have your students draw their own renditions of what some of these early animals might have been like.

Activity 5 – The Cell

Have students use an illustration from their textbooks to carefully draw an accurate picture of both an animal and a plant cell.

Then have them define the following words:

1. protoplasm (the primary essential substance of all plants and animals)
2. Cell (the simplest unit of a plant or animal structure. It consists of protoplasm, nucleus, and a cell wall.)
3. tissue (a group of similar cells, having a special function)
4. organ (a group of various tissues, having a special function)
5. system (a group of organs, having one or more related functions)

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