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Teaching Spiritual Concepts in the Microbiology Classroom: An Illustrative Approach

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Introduction

Today, every field of study is developing rapidly, and the bioscience field is developing much more rapidly than the others. Moreover, microbiology is one of the fastest growing fields. Therefore, the microbiology major student should be aware of the latest news concerning microbiology and understanding the different characteristics.

Microorganisms are better known in the public as "germs". Are microorganisms friend or foe? Some people even think it would be great if scientists could wipe out all the microbial bugs! Should we do it, and why or why not? As a microbe sleuth, I get a lot of requests to track down the nasty bugs that are making people sick. It's true that some microbes cause health problems such as streptococci throat, chickenpox and the common cold. Unfortunately, because a small number of microbes cause disease, all microbes have got a bad rap. It seems only a few bad microbes get almost all the press. You just don't hear as much about all the many good things microbes do everyday. Let us think about some of the good things done by these "bugs".

Why did the good Creator make bacteria? The short answer is: life on planet earth would be impossible without microorganisms. The most vital role they play is the conversion of nitrogen gas in the air to useful nitrates in the soil, without which plants could not grow (1). In addition, some bacteria participate in the capture of solar energy through photosynthesis and others implement the biodegradation of dead organic matter (2). While some microbes cause disease, most are harmless and many are helpful.

Of one of the wisest men, this was written:

> Solomon took a special interest in natural history, but his research was not confined to any one branch of learning. Through a diligent study of all created things, both animate and inanimate, he gained a clear conception of the Creator. In the forces of nature, in the mineral and the animal world, and in every tree and shrub and flower, he saw a revelation of God's wisdom, and as he sought

to learn more and more, his knowledge of God and his love for Him constantly increased (3).

Psalm 119:18 "Open my eyes that I may see wonderful things in your law."

In this essay I will review a few basic concepts of microbiology and view them from the perspective of the Biblical revelation. Finally I will relate it to the above issue by bringing out its nature through selected illustrations.

What are some of the microbe-made things we use everyday?

We've been using microbes for thousands of years to make products we need and enjoy. For example, you can thank fungi for the cheese on your cheeseburger and yeast for your bun. Cheese and bread are two microbe-made foods people have been enjoying since civilization began, only unlike our ancestors; we know that microbes are what makes bread rise and milk curdle into cheese.

Over the past 50 years, we've begun harnessing microbes to do all_kinds of new work for us. Here are some examples of microbes at work in pollution control, medicine and industry.

Researchers are using bacteria that eat methane gas to clean up hazardous waste dumps and landfills. These methane-munching bacteria or methanotrophs, make an enzyme that can break down more than 250 nasty pollutants into harmless molecules (4). By piping methane into the soil, we can increase the growth of the methanotrophs that normally live in the polluted soil. More methanotrophs means faster pollution break up.

We are using bacteria, as one of the tools to clean up oil spills. These bacteria feed on the oil, turning it into carbon dioxide and other harmless by – products (5).

Genesis 1:25 "God made the wild animals according to their kinds, and all the creatures that move along the ground according to their kinds. And God saw that it was good."

Microbes make compounds called enzymes that we use in making hundreds of products. We grow billions of bacteria in

giant fermenting tanks. We then break apart the bacteria to get their enzymes to make soy sauce, soda, cheese, infant formula, chewing gum, leather goods, paper and laundry detergent (6). Therefore, the microbial community not only plays essential role biogeochemical cycling, but it also plays many vital roles in environment, many different areas in bioengineering such as sewage and waste water treatment, and decomposition of non-biodegradable chemicals, degradation of crude oil, and elimination of toxic heavy metals. It also produces antibiotics and different enzymes and it is used to make medicines and in the food industry as well. Therefore, it's very beneficial to our life. Microbes can help fight disease and disasters such as oil spills.

Helpful bacteria help clean up toxic groundwater.

Western Australian scientists are set to put to work a toxin munching bacterium they discovered earlier last year (1999). Their first task is to attempt the clean up of pesticide-contaminated groundwater beneath a Perth suburb, making it safe for drinking or domestic use. They select the microbes that are best at breaking down the pollutant from the actual site and then create the circumstances in which their population will flourish at the point where you want to intercept the polluted groundwater. The team has devised a practical method for using the bacteria to strip the pesticide out of following ground water. They have designed a system of boreholes referred to as a curtain, which is placed at the front of the underground plume of atrazine. The boreholes that contain permeable matting allow oxygen into the some providing the right conditions for the microbes to flourish. By introducing the toxin-eating bacteria into the boreholes the aim is to allow the water but not the atrazine, to flow through.

They said that the lab system was low maintenance and, if trials were successful, could prove to be much cheaper in the long term than conventional methods that pump the water above ground for treatment with activated carbon.

The bacterial treatment is also much faster. The half-life of atrazine in groundwater is up to eight years, but with the bacterium present the half-life is reduced to five and a half hours.

The bacterium is a special strain of Pseudomonas that evolves over a number of years in soil contaminated with

atrazine. It uses the nitrogen in the herbicide as a food source and breaks down the toxin into carbon dioxide and water (7).

Revelation 4:11 "You are worthy, our Lord and God, to receive glory and honor and power, for you created all things, and by your will they were created and have their being."

The research has implications for the worldwide problem of underground water contamination by leaks, spills and discharges of toxic industrial solvents, pesticides, oils, and industrial chemicals. They said that the "curtain" system could be applied to the remediation of other contaminated sites, as long as the correct bacteria were used for the job.

Microorganisms are good or bad, or even dangerous.

Microbes cause the flu, chicken pox, measles, pneumonia, athlete's foot and the common cold. Certain pathogens can indeed make you suffer, but they should not give every microorganism a bad name. Thanks to planes, trains, and automobiles, people now travel often and in droves to virgin tropical forests and other remote places where humans seldom visited and so there were infrequent opportunities for pathogens. Today, strange and dangerous pathogens encounter novel carriers. Within a matter of hours human travelers can become infected. They can taxi such pathogens far away, and back home. The deadly, emerging pathogens may have been around for quite a long time and only now are taking advantage of the increased presence of novel hosts. Maybe some are newly mutated strains of existing species.

For example, it appears that Ebola, an RNA virus, may have coevolved with monkeys in African tropical forests. It is 70-90 percent lethal, and there are no treatments or vaccines. High fever flu-like aches mark the onset of the disease. Within a few days nausea, vomiting, and diarrhea begin. Cells making up the lining of blood vessels are destroyed (8). Blood seeps into the surrounding tissues and out through the body's orifices. Organs may turn to mush. Patients often become deranged and die of circulatory shock. During recent epidemics, government agencies around the world were mobilized. Only the fast implementation of quarantine procedures limited the spread of the disease.

We are enjoying our advanced civilization, but fatal diseases threaten us because our environment is polluted.

1 Corinthians 12:26 "If one part suffers, every part suffers with it; if one part is honored, every part rejoices with it."

Microbes aren't trying to make you sick. They are just trying to survive.

There is a world out there that we cannot see with our naked eye. No one knew that before being discovered by microscope, there existed a microbiological world that effects mankind greatly in many ways. After the discovery of these wonderful microorganisms under the microscope, Leeuwenhock made a report of his discoveries at the request of England's Royal Scientific Society in 1676 AD (9).

Psalm 147:4 "He determines the number of stars and calls them each by name."

On one square-inch of our bodies, there are as many as 10,000 bacteria (9). Although it is well established that our normal flora is, for the most part, beneficial, considerable evidence is accumulating that suggests a more insidious role. Let us look at the facts and then the circumstantial evidence of colon cancer.

Large bowel cancer is a major disease in Western countries but is uncommon in Asia, Africa, and South America. Moreover, people who emigrate from low-incidence parts of the world to Western countries become equally susceptible, indicating that the tendency to colon cancer is not genetically controlled. There is, however, a positive correlation between the consumption of beef, total fat, animal fat, total calories, and animal protein and the incidence of colon cancer. It has been proposed that such a diet leads to the formation of pro-carcinogens, which are converted by our intestinal flora to carcinogens (cancer-causing agents).

Data supporting this proposal was first published in 1990(11), when it was reported that a naturally occurring beta-glucoside of methyl azoxymethanol would cause large bowel cancers when fed to normal rats but was completely innocuous in germ-free animals. Subsequent experiments showed that the bacteria in

the intestine hydrolyzed the beta-glucoside, leaving methylazoxymethanol, the true carcinogen.

Because most carcinogens are mutagens (i.e., increase the rate of mutations), one can obtain circumstantial evidence for the presence of carcinogens by the Ames test, which measures the rate of mutation in several special strains of Salmonella. Using this test, only 2 percent of fecal samples obtained from low-risk Blacks in South Africa contained mutagens as compared with 15 percent from high-risk Whites in Johannesburg. Similar results were obtained in comparing the presence of mutagens in fecal specimens of New York city residents and Seventh-Day Adventists (12). Lastly, when antibiotics were given to beef-fed rats that were challenged with the procarcinogen dimethylhdrazine, tumors developed in only 20 percent as compared with 74 percent of controls that did not receive antibiotics.

These data, along with many other studies, strongly support the conclusion that a high-beef, high-fat diet may be metabolized to yield procarcinogens, which can then be converted by our normal intestinal flora to true carcinogen.

Psalm 139:14 "I praise you because I am fearfully and wonderfully made."

In another example, it appears that an outbreak of Legionnaires' disease originated in a grocery store. In October 1989, two physicians reported an outbreak of serious lung infections to the Louisiana Department of Health and Hospitals. An investigation showed the outbreak to be Legionnaires' disease involving 33 patients. A control group was then selected-people from the same general area who did not become ill, who were matched with the patients according to age, physician, and the presence of conditions (such as chronic bronchitis) that might predispose the person to Legionnaires' disease. When the patient and control groups were compared, it become apparent that all the Legionnaires' disease patients had visited a certain grocery store within two weeks of the start of their illness, whereas only about half of the control group had done so. Moreover, the Legionnaires' disease patients were more likely to have spent a long time in the store and to have selected foods located close to a mist machine used to keep the produce fresh. The mist machine was shown to produce water droplets less than 5μm in diameter, tiny enough to be inhaled,

and that contained Legionella pneumophila, the cause of Legionnaires' disease. Further study showed that this strain of L. pneumophila was the same serotype as the one that infected the patients. No further cases of the disease occurred after use of the mist machine was discontinued.

The mist machine used in this grocery store contained a reservoir of relatively stagnant water, and it was well-suited to colonization of Legionella species. Since this episode occurred, The Food and Drug Administration and Consumer Product Safety Commission has publicized measures to help ensure that all grocery store mist machines remain free of Legionella.

John 1:3 "Through Him all things were made, without Him nothing was made that has been made."

Today, many diseases are transmitted through contaminated food.

Today, there is still controversy about the consumption of milk and cheese, but many research results are revealing that these foods are not as safe as they once were. Adventists were advised that there would come a time when it would no longer be safe to use eggs, milk, cream or butter because disease in animals would increase (13). More and more titles in the field of scientific literature and press reports show outbreaks of sickness and sometimes death from the consumption of these products. Contamination with disease causing organisms such as Salmonella, Campylobacter, Escherichia coli, and Listeria appear in these scientific and press reports. The use of non-sterilized milk or milk products has caused many cases of infections (14).

Psalm 139:16 "Your eyes saw my unformed body. All the days ordained for me were written in your book before one of them came to be."

On June 13, 1985, California health officials announced that they had linked more than 80 illnesses and 28 deaths to eating soft Mexican-style cheese prepared commercially in a Southern California factory. The responsible organism was Listeria monocytogenes, which often causes stillbirths, but can also cause meningitis and other serious illnesses in children and

adults. The company immediately closed its factory and recalled thousands of pounds of cheese, which was then buried in landfill. Although most of the cheese was sold in California, about 20% was shipped elsewhere, necessitating the recall and destruction of cheese in an additional 14 states.

Widely scattered cases of listeriosis would probably have escaped the attention of public health officials because although the organism is commonplace, it usually attacks only people with cancer, AIDS, or other immunological impairments. However, the California incident attracted attention because the cases of listeriosis were concentrated among Hispanic people and suggested the spread of disease from a single source. Fondness for the implicated cheese caused the cases to be concentrated in the Hispanic community, a connection discovered when infectious disease sleuths analyzed the dietary habit of the Listeria victims. Further investigations uncovered another factory producing contaminated cheese, and the discovery of additional cases of illness and death from listeriosis doubled the original figures.

Contamination of the cheese occurs because of the presence of Listeria monocytogenes in many samples of unpasteurized cows' milk. Seemingly healthy cows can shed large numbers of the organisms in their milk for months. Then these organisms can contaminate the hands of workers and the work area where milk is being processed. Thus, although pasteurizing milk kills Listeria monocytogenes by pasteurizing milk it can contaminate cheese at some other step in cheese production. Contamination can also occur as the result of faulty pasteurization producers. The high moisture content of soft cheese provides a suitable growth medium, and L. monocytogenes is one of the few bacterial pathogens that multiply well at refrigerator temperature. Therefore, a person eating contaminated cheese may ingest large numbers of the pathogen, making it more likely that infection and serious disease will occur than if only a few organisms were present. Stricter regulation of cheese factories has made the production of soft cheese safe, however, pregnant woman and people with immune deficiencies should consider abstaining from such cheese.

Again the advise given to Adventists, one hundred years ago is that ripened cheese was wholly unfit for food. Today, these microorganisms that are not destroyed in the curing process, are causing listeriosis (15). So far we have looked at diet in terms of the type of diet recommended to promote optimal health. Today,

there is still controversy about the benefits of breastfeeding versus bottle-feeding, but more and more research results are they once were. Breast-fed infants tend to be healthier than those given formula. The reason is that human milk and colostrum (the milk produced a few days before and after childbirth before production of normal human milk) contains IgA and macrophages that help defend against infection. Over 80% of cells in colostrum are macrophage that can phagocytize pathogenic microorganisms. Because a breast-feeding woman is exposed to many of the same antigens as the infant, she is likely to make immunoglobulins that specifically protect the infant. The gastrointestinal tract of the infant is especially prone to infection because the normal microbiota have not yet established a stable and protective community. Immunoglobulin A helps protect the surface of the gastrointestinal tract of the infant against infection. Bacterial and viral infections that cause infant diarrhea are prevented by the immunoglobulin A in colostrum.

Genesis 9:3 "Everything that lives and moves will be food for you. Just as I gave you the green plants, I now give you everything."

Mutations are directly involved in Health and Disease.

The immunity protects our body from bacterial infection, viral infection and cancer. When the immunity is weakened, our body is likely to be infected with different kinds of infectious disease and cancer. Then, why is the host's immunity weakened? There are several reasons which cause immunity to be weakened, such as, environmental pollution, bad diet habits, stress, alcoholism, drug addiction, and heavy smoking. However, according to a recent study, cancer is becoming a big problem for modern people resulting from the gene mutation of the host. Cancers grow in an invasive manner and are almost invariably life threatening. Among the many causes of cancer are viruses that carry oncogenes. For example, the Rous Sarcoma virus, which includes the formation of cancer in chickens, contains four genes. Three of these genes are essential for virus replications, whereas the fourth gene, an oncogene, induces tumor formation. What is the origin of the fourth gene (v-src: "v" for virus "src" for sarcoma), and how does it function? Michael Bishop and Harold Varmus in 1976 lead to the remarkable discovery that infected

chicken cells contain a gene, c-src ("c" for cellular), that is homologous to v-src and that is highly conserved in a wide variety of eukaryotes, suggesting that it is an essential cellular gene. Apparently, v-src is under no such control and hence its presence maintains the host cell in a proliferating state. Since cells are not killed by an RSV infection, this presumably enhances the viral replication rate. Other oncogenes have been similarity linked to processes that regulate cell growth.

Cancer is the result of the uncontrolled growth of malignant cells. These cells reproduce more rapidly than normal cells, form abnormal shapes, and fail to stop growing when they contact other cells. They lose their adhesiveness so that they may break off and move to other body sites where new malignant growths than form. Malignant cells also invade connective tissues and various organs of the body. The formation of malignant tumors disrupts body functions and will cause death. Numerous treatments are used in an attempt to control malignant growths, including surgical removal, chemical inhibition (chemotherapy), exposure to radiation (radiation therapy), and administration of various cytokines (immuno therapy). In some cases, when the cancer spreads throughout the body, such as in cases of leukemia (malignant growth of white blood cells) massive doses of chemotherapy and/or radiation therapy can be employed to kill the malignant cells. Such treatment also damages healthy body cells and tissues. If the lymphocytes of the immune system are eliminated along with the malignant leucocytes, the individual could not survive due to a lack of an immune response system. To prevent this, bone marrow is sometimes surgically removed. This bone marrow, which contains the cells that give rise to the body's blood cells, including lymphocytes, is frozen. After chemotherapy and/or radiation therapy, the bone marrow cells are thawed and re-injected into the body. This therapy can be tried as long as the malignant cells have not invaded the bone marrow. If possible, a compatible donor can be used as a source of bone marrow cells. The donor must have the same or nearly the some antigens on his or her blood cells as the patient. Otherwise, as the immune function is restored, the donor bone marrow cells will be attacked and rejected.

In many developed countries, the major cancers associated with dietary habits involve the postmenopausal breast, distal colon, prostate, pancreas, ovary, and endometrium. Current evidence suggests that the toxic carcinogens for these diseases from the traditional intake of foods such as meats. These foods

contain a class of powerful mutagens, which are carcinogenic to the target organs in animal models (16).

Education p.99-100 "The same power that upholds nature, is working also in man. The same great laws that guide alike the star and the atom control human life. The laws that govern the heart's action, regulating the flow of the current of life to the body, are the laws of the mighty Intelligence that has the jurisdiction of the soul. From Him all life proceeds. Only in harmony with Him can be found its true sphere of action. For all the objects of His creation the condition is the same-a life sustained by receiving the life of God, a life exercised in harmony with the Creator's ill. To transgress His law, physical, mental, or moral, is to place one's self out of harmony with the universe, to introduce discord, anarchy, ruin."

We have to obey the heavenly order!

American scientist S. Prusiner received the Nobel Prize for the discovery of prion, which has been found to cause some toxic human diseases such as kuru and various degenerative nerve disorders. Scientists believe that prion caused "mad cow disease" in England (17). And so the person who eats infected beef is also infected with Creutz-Feldt Jakob disease. The cows are infected with prion because they were fed with meat protein instead of dry grass.

Therefore, we have to obey the heavenly order. God has created all living beings with "order". We have to keep that "order" in order to live without disastrous diseases.

Another example, AIDS is caused by the HIV(Human Immunodeficiency Virus). AIDS is the final and most serious stage of HIV disease. Signs and symptoms of severe immune deficiency characterize this disease. This virus attacks the immune system and leaves the body vulnerable to a variety of life-threatening illnesses. Common bacteria, yeast, and viruses that ordinarily do not cause disease often cause these diseases. HIV has been found in blood, semen, saliva, tears, nervous system tissue, breast milk and female genital tract secretions; however, only blood, semen, female genital tract secretions, and breast milk have been proven to transmit infection to others. Transmission of the virus occurs through sexual contact including oral, vaginal, and anal sex; via blood through

transfusions or needle sharing; and from a pregnant woman to the fetus or a nursing mother to her baby. Other transmission methods are rare and include accidental needle injury, artificial insemination through donated semen. High risk groups include homosexual or bisexual men, intravenous drug users who share needles, the sexual partners of those in high risk groups, infants born to mothers with HIV, and persons who received blood transfusions or clotting products between 1977 and 1985.

The people who have inappropriate sexual practices spread the AIDS virus and also people who share needles. God didn't intend His creation to be that way. The AIDS virus is a good example of our need to follow God's order.

Romans 1:27 "In the same way the men also abandoned natural relations with women and were inflamed with lust for one another. Men committed indecent acts with other men, and received in themselves in due penalty for their perversion."

The mutagen that causes mutation in the cell becomes a carcinogen that causes cancer. A cell becomes a cancer cell when it does not obey the law and order of their respective system. Therefore, we could conclude by saying that cancer is a result of these abnormal cells abusing their host body.

Jeremiah 13:15 "Hear and pay attention, do not be arrogant, for the Lord has spoken."

According to recent immunology studies, the scientists are beginning to find out that our body has a great defense mechanism against the outside attacks. It has a natural resistance that defends the body from pathogens like bacteria, toxic poisons, and other harmful things.

The organs and systems that are related to Immune response are called Lymphoid system. In humans, the bone marrow, thymus gland, and Peyer's patches are primary lymphoid tissue. These are the sites of lymphoid maturation. Some lymphocytes migrate though the circulatory or lymphatic systems to the secondary lymphoid tissues (spleen, mucosal lymphoid tissue, lymph nodes, tonsils and appendix), where they produce lymphocyte colonies.

The fact that tonsils and the appendix have important roles in the human body as immune systems is beginning to be acknowledged by many scientists. Although the specific role of

tonsils and the appendix has not been fully discovered yet, it is obvious that they are related to immune systems. The tonsils and the appendix may not be crucial immune systems that would cause death in case of malfunction, but they sure have some important roles in the human body, since God created them. The Bible states that Hebrew men were circumcised but there is no other mention about any other organs that should be eliminated from the human body.

Genesis 1:1 " In the beginning God created the heavens and the earth"

Summary and Conclusion

God created all kinds of organisms with a purpose, even the very small microorganisms. They are surely wonderful creatures. All existing organisms were generated by supernatural power a few thousand years ago. Our Creator created many stars in the universe, but we can see His greatness through His creation of microorganisms.

Without microbes there would be no life on earth. Most microorganisms not only control our environment by using their specific activities, but also maintain the balance between living things and chemicals that have a great effect on human life.

For example, microorganisms of the sea, lakes and rivers are the basis for the food chain. The microorganisms from the soil degrade not only different kinds of wastes but also a process called nitrification is done to contribute to biogeochemical cycling. Some bacteria and algae supply essential organic compounds and oxygen to living things by photosynthesis. Microorganisms are often used commercially. Microorganisms are not only used to manufacture acetone, enzyme, alcohol, organic acids, and medicine, but it is used to manufacture cheese, yogurt, bread, vinegar, and etc.

Even though, microorganisms are good to us in many different ways, most of the time we think of them as causing disease spoiling food and AIDS causing organisms. We think this way, because of its bad history with human beings. Microorganisms are the basis for maintaining the ecosystem. Hence it is easier to believe in a planned creation and the Creator rather than in an alternate view because we trust in God, in His word and in His creative powers. We also have faith in His love and His plan

of salvation and His restoration of us to the pristine holy status.

Job 28:28 "And to man He said, Behold, the fear of the Lord, that is wisdom, and to depart from evil is understanding"

God created all the living creatures from microorganisms to human beings. Although some creatures like pathogenic microorganisms have negative effects on human beings, they are still God's creation. If we had followed God's rules and obeyed the heavenly order, most times all the living creatures would be a blessing to human beings instead of causing diseases or other negative effects. Throughout the development of the microbiology class, it is possible to lead the student to recognize God as his creator and redeemer.

This study will demonstrate that inspiration or revelation, which dictated and directed these beliefs and practices are superior to the test tube and microscope. We have to thank and praise God for giving us this wonderful life.

Education p.101 "'I know the thoughts that I think toward you, says the Lord, thoughts of peace, and not of evil.' Jeremiah 29:11. This is the message that, in the light from the cross, may be read upon all the face of nature. The heavens declare His glory, and the earth is full of His riches."

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