Biology Olympics

Inventive Thinking in Biology

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An invention is a new or original product, device, method, design, or process. Most inventions are based on applications of novel insights for new uses of, or combinations of, existing objects. They are designed to solve problems, to make work easier or more efficient, to make human life more interesting or enjoyable.

Most people associate inventions with technology and the physical sciences. Any book dealing with inventions will glowingly describe the accomplishments of Edison, Watt, and Bell, while biological inventors are almost never mentioned. In many quarters, biology continues to be viewed as a descriptive and classifactory discipline—certainly not as an inventive and imaginative art.

A good look at how scientific ideas have developed, however, will reveal that biology has had its fair share of imaginative and inventive thinkers. And, as is the case with all sciences, major advances in biology invariably require inventive thinking. Leeuwenhoek, an amateur biologist, invented a microscope and thus opened up a whole new world for biological exploration. The Watson-Crick model of DNA is an invention. So are the Fluid-Mosaic Model of cell membranes, the Protoplasmic Streaming Theory of phloem transport, and Oparin's Chemosynthesis Hypothesis. The mental processes involved in developing these biological inventions are not essentially different from those that produced the incandescent lamp, the ball-point pen, or the atomic theory.

Much of the inventive thinking used in biology is aimed at developing new methods and devices needed to discover new knowledge through field and laboratory investigations. Unique methods for measuring, counting, analyzing, and observing incredibly minute objects have been invented by biologists. Many investigators report that the key to success in research is in inventing solutions to seemingly impossible puzzles.

Biology Students as Inventors

Students will enjoy biology more if they become involved in the inventive and imaginative dimensions of the subject. It's fine to read about the discoveries and ideas invented by famous biologists; it's much more exciting to invent something yourself. Thus, this month's Biology Olympics poses challenges to the inventive instincts of both students and teachers.

For help with how to go about developing ideas for inventions, students may find the following books helpful:

KIVENSON, G. 1977. *The art and science of inventing*. New York: Van Nostrand Reinhold Company.

McCORMACK, A.J. 1981. *Inventor's workshop*. Belmont, Calif.: Pitman Learning, Inc.

MURPHY, J. 1978. *Weird and wacky inventions*. New York: Crown Publishers, Inc.

WEISS, H. 1980. *How to be an inventor*. New York: Thomas Y. Crowell Publishers.

Challenge 1—Invent a Useful Product

Many materials of biological origins are routinely discarded as useless trash. Skins, husks, and shells of various edible plants and animals might be put to better use than their usual inglorious fate in garbage landfills. If you creatively solve this challenge, you may build a reputation as the Edison of kitchen scraps!

CHALLENGE—INVENT A USEFUL PRODUCT USING ONE OF THE FOLLOWING AS A MAJOR PART OR INGREDIENT:

- ONION SKINS
- POTATO SKINS
- EGG SHELLS
- COFFEE GROUNDS
- PEANUT SHELLS
- CITRUS FRUIT SKINS

A good solution to this challenge would, of course, involve actual manufacturing and trial testing of the product. Send us a black-and-white picture of you with your product, a sample of it, and the results of your product-testing program.

Challenge 2—Invent a Way to Use Old Newspapers in Biology Classes

Old newspapers abound. In fact, many people are inundated with them. And, since the wood from a substantial forest is required daily to produce our thousands of daily papers, it seems seriously wasteful to burn or bury all this good formed and pressed cellulose (that's what newspaper is, isn't it?).

How could newspapers be recycled for use in biology classrooms? Could the material be used in construction of teaching models, learning games, or equipment for scientific investigations? Try to be as flexible and creative as you can about your notions for newspapers—intact sheets can be painted, laminated, rolled, and cut—pulp made from newspaper can be cast, sculpted, and extruded.

CHALLENGE—INVENT A WAY TO USE OLD NEWSPAPERS IN BIOLOGY CLASSROOMS. THE PAPER CAN BE ADAPTED FOR USES IN LEARNING OR TEACHING BIOLOGICAL IDEAS, OR FOR USES IN BIOLOGICAL INVESTIGATIONS.

Solutions to this challenge sent to the Editor should include black-and-white photos of the newspaper application and a brief description of how it can be used in classrooms.

Challenge 3—Invent an Insect Repeller

Though they fulfill important roles in ecosystems, insects can be downright annoying to people, right? Think about the fly on last evening's cherry pie, or the seemingly invisible mosquito that hummed you awake last July—aggravating!

Here is your chance to fight back:

CHALLENGE—INVENT A DEVICE OR SUBSTANCE THAT REPELS INSECTS. YOUR INSECT-REPELLING METHOD SHOULD BE NON-TOXIC AND ENTIRELY HARMLESS TO PEOPLE.

In attempting a solution to this challenge, you may want to concentrate on repulsion of a specific type of insect (fly, mosquito, for example) or a method that universally drives all insects away. Caution: Avoid use of toxic or otherwise potentially harmful chemicals. You may want to investigate effects of various types of sound, light, air currents, and temperatures on insect behavior. Your mission, should you decide to accept it, is to discover something that is totally disgusting and repulsive to insects while completely harmless and non-annoying to humans.

Challenge 4—Invent an Organism Attracter

Investigators of behavior have discovered that various stimuli can be very effective in causing predictable behavior of organisms from many different phyla: paramecia are attracted to light sources, hydras are repelled by sharp objects, male gypsy moths are attracted by pheromones produced by female gypsy moths.

It is sometimes desirable to be able to attract numbers of certain organisms for scientific study, aesthetic enjoyment, pest control, or for food. (The sport of fishing is, of course, a highly refined art aimed at attraction of certain aquatic species!)

CHALLENGE—INVENT A DEVICE OR METHOD THAT WILL CONSISTENTLY ATTRACT SOME TYPE OF ORGANISM. YOUR DEVICE OR METHOD SHOULD NOT BE HARMFUL IN ANY WAY TO THE ATTRACTED ORGANISM OR TO HUMANS.

Challenge 5—Invent a Cell Organelle Separater

One of the fundamental principles of biology is the idea that all living organisms are composed of discrete cellular units. And, it is common knowledge that cells are complex entities comprised of a number of different organelles which vary tremendously in size and function. How could quantities of these tiny cellular organelles be concentrated and separated from each other?

Most plant tissues and animal liver tissues are good materials to work with in attempting separation of cell parts. Cells can be ruptured by placing tissues in distilled water (or "normal" solution) and macerating them for 5-10 minutes in a kitchen blender. When this procedure is finished, you will be left with a "soup" consisting of cellular fragments and intact organelles. How could these tiny parts be separated?

CHALLENGE—INVENT A DEVICE OR METHOD THAT WILL SUCCESSFULLY SEPARATE QUANTITIES OF SOME CELLULAR ORGANELLES FROM RUPTURED CELLS. DEMONSTRATE THAT YOUR DEVICE OR METHOD ACTUALLY WORKS.

By the way, use of commercially manufactured centrifuges or like devices is not allowed. Develop and build your own device or method.

Challenge 6—Invent a Way to Measure Rate of Hyphal Growth

Mushrooms and molds are typical filamentous fungi—they consist mainly of minute tubular filaments called hyphae. When conditions are good, hyphae grow rapidly, twisting and turning, and absorb food from their environment.

Most hyphae are easily observable under a low power compound or dissecting microscope. Various types of bread mold are easily cultured and are good sources of large, easily observed hyphae. Culture some common mold in a Petri dish or a plastic sandwich bag. Then try to solve this challenge:

CHALLENGE—INVENT A METHOD OF MEASURING THE RATE OF HYPHAL GROWTH OF COMMON BREAD MOLD OR SOME OTHER COMMON FILAMENTOUS FUNGUS.

Once a dependable method has been worked out, you might want to investigate how various environmental conditions affect hyphal growth rates.

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Challenge 7—Invent a Method to Measure the Strength of Spider Web Silk Threads

Spiders are among the most accomplished engineers in the animal kingdom. Through the action of special abdominal glands they can produce strong silk threads that can be used for trapeze-style transportation, construction of webs for trapping prey, or for binding those unfortunate insects that happen to be snared by a web.

Though strands of spider silk are quite thin, they are remarkably strong. Just how strong? It's up to you to find out.

CHALLENGE—DEVISE A METHOD YOU CAN USE TO MEASURE THE STRENGTH OF STRANDS OF SPIDER SILK. TEST THE METHOD ON SILK FROM SEVERAL DIFFERENT SPECIES OF SPIDERS.

Caution: There are two spiders in the United States, the black widow and the recluse spider, whose bites can be harmful. Avoid these and use only silk from the webs of harmless spiders.

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Though I'm not advocating psychotherapy as a replacement for chemotherapy or surgery, I do think such studies direct our attention to a relatively uninvestigated part of the cancer problem and point up the fact that the constant publicity about the evils of cancer may be counterproductive. Though this publicity may frighten a person into seeing a doctor if one of the warning signs of cancer develops, it may also demoralize that same person if he/she does in fact have cancer.

Self-Helps

Recently health-care policymakers have stressed the public's responsibility in preventive medicine. Personal habits and lifestyles, for example, alcohol and drug abuse, smoking, poor nutrition, lack of exercise, failure to use seat belts, are considered major causes of mortality and morbidity. If people gave up their destructive ways, the consensus among health-care professionals is that the burden of health-care costs would be greatly eased.

In the October, 1982 issue of *The Hastings Center Report,* Howard Leichter writes that the solution may not be that simple. Some critics don't think that the evidence relating life-style to disease is convincing since age, genetic factors, and the environment are also important. There are also political implications associated with a philosophy of personal responsibility. How far can government go in getting people to change without limiting personal freedom?

Bringing about changes in personal habits doesn't necessarily mean that the government will save money, one major goal of this health-care policy. If people smoke less tobacco and drink less alcohol, tax revenues from the sale of these substances will fall. And if people stay healthier, they will probably live longer and drain ever-greater sums from the Treasury in Social Security benefits.

But Leichter says government has so promoted the idea that changing lifestyle is important to health that it can't stop now. Since it can't be coercive without restricting personal liberties, the only alternative, he feels, is more and better health education. As biology teachers, we should look upon Leichter's argument as both a challenge and an opportunity. This is obviously an area in which we can have great influence.