NEWSLETTER

Kansas Association of Biology Teachers

Volume 39 Number 4 - November 1998

Calendar & Activities

Please mail, e-mail or phone meeting dates and other items of interest to biology teachers to John Wachholz, 2311 Applewood Lane, Salina, Kansas 67401-

Date	Event
May 15, 1999	Spring Field Trip - Canoe Trip on KS River or Stream
May 21-23, 1999	Kansas Herpetological Society Spring Field Trip, Kanopolis
September 18, 1999	Fall Meeting – Great Plains Nature Center, Wichita
October 1-3, 1999	Kansas Herpetological Society Fall Field Trip, Cherokee County, Kansas
October 27-30, 1999	NABT National Convention - Fort Worth, Texas
March 25–28, 1999	NSTA National Convention - Boston
September 16, 2000	Sternberg Museum and Wildcat Canyon – Hays
May 13, 2000	Morton County Field Trip
Spring 2001	Northeast KS Field Trip

Your membership **expiration date** can be found on your mailing label. All dues are now payable on September 1st of each year. If an envelope was enclosed with your newsletter your membership has expired. Please use the envelope to mail your dues and the other information requested. The membership list was last updated on **November 25, 1998**. If you sent dues in after this date they were not recorded before the mailing list was printed.

KABT Web Site
http://www.midkan.com/kabt
Send comments to:
jwachholz@midkan.net

NABT Web Site
http://www.nabt.org

Publishing Dates For Newsletter

The newsletter is published during the months of September, November, February and April. Manuscripts must reach the editor by the 15th day of the previous month. The KABT Newsletter includes abbreviated minutes of the official meetings, announcements of future activities, brief news notes, and other brief items of interest to biology teachers. Send your contributions to John Wachholz, Editor, 2311 Applewood Lane, Salina, KS 67401 785-825-7742. You may send you information to jwachholz@midkan.net.

Newsletter & Journal Articles

Articles are needed for the newsletter and journal. Send them via e-mail to jwachholz@midkan.net or on a disk. If you send it on a disk, any format is acceptable. Your help is appreciated.

Articles for the Kansas Biology Teacher should be sent to John Richard Schrock, editor KBT, Division of Biology, Box 50, Emporia State University, Emporia, KS 66801-5087.

Please remember to keep your dues up to date so you will continue to receive KABT publications.

Outstanding Biology Student Certificates

These are available for students who you feel have completed a biology course under you and have shown outstanding achievement. We have just updated our supply. Send your name and address to KABT Student Certificates, 2311 Applewood Lane, Salina, KS 67401-3707.

Please use these certificates as valuable awards for outstanding students.

NABT Contact Information

Address: ..... 11250 Roger Bacon Drive #19
Reston, VA 22090-5202

Web Site:..... http://www.nabt.org

Phones: 703-471-1134; 800-406-0775

Fax: 703-435-5582

E-mail: ..... NABTer@aol.com

AP Biology Summer Workshop

Th AP Biology workshop at the University of Northern Colorado is scheduled for June 14-18, 1999. Some preliminary information has been put up on the AP web site at http://www.unco.edu/ap/ap99.html. I was involved in this workshop last summer and found it extremely beneficial.

If you have further questions contact:

Dr. Warren R. Buss
Department of Biological Sciences
University of Northern Colorado
Greeley, CO 80639
(970) 351-2555,
Fax: (970) 351-2335

From Your President

Greetings to the members of Kansas Association of Biology Teachers.

As your new KABT president, I'd like to welcome our new members and share a few thoughts on KABT and the teaching of biology. I'm very honored to accept the job of presidency for an organization that I find to be a valuable asset to my classroom teaching. I think that KABT provides a fellowship amongst biology teachers across the state that is outstanding. The spring field trips and the fall meetings and field trips have been an excellent meeting of the minds -- what a wonderful to learn about various aspects of biology -- from our own resource of members and guests alike!

We have, in recent years, learned about the unique habitats in the Gyp Hills around the town of Belvedere with Stan Roth. We toured the Z-Bar Ranch, learning of it's interesting history and observing the flora and fauna in the Flint Hills. Last fall, along with KESTA members, we investigated the Niobrara Chalk beds of western Kansas around Castle Rock where I discovered a fossil of five fossilized vertebrae from a mosasaur. I treasure my find! Last spring, Brad Williamson, John Wachholz, and Ernie Brown organized a trip through the unique ecosystems of the Kanopolis Reservoir area. The native plant life was so interesting. What unique landscapes, flora, and fauna there is to observe and learn about in Kansas.

We have also had outstanding fall conferences at Kansas University, Emporia State University, and Fort Hays State University (Niobrara chalk beds). Our fall conference held on September 19, 1998 at Olathe East High School was also a great success. We spent the day learning from advocate biologists--experts in their fields. Most teachers brought two students to share this knowledge with; it was a great day for teacher and student alike.

Kansas Association of Biology Teachers' mission is to encourage continued education in biology for both the "new" and "old" biology teacher, to help generate new ideas and creative ways to change or improve on current techniques and strategies. It must be a combined effort from each member to participate in and contribute to our great organization in order to keep it current and useful. We are truly lucky to have several very active and diligent members that have been willing to donate their knowledge and time to bring the benefits of our organization to its members through field trips, conferences, and especially our newsletters and journal. Our newsletter reaches out to many Kansas biology teachers, informing them of current happenings in our field. It is particularly valuable for each of our members to consider contributing articles to our editor, John Wachholz. New labs and activities as well as "old" labs and techniques are welcome additions to our newsletters. The next deadline for articles is January 15, 1999. Let's send John more than he can read!!

I'm excited to take KABT into the next century. It seems as though new discoveries and advanced technologies are occurring exponentially, which is almost overwhelming to keep up with! The more we participate in our state and national organizations, the quicker that information and experience can be at our fingertips and in our classrooms! Get involved--and you too can reap the benefits of KABT!

DOOR PRIZE WINNERS

Congratulations to the winners of the door prizes at the KABT Fall Conference on September 19, 1998.

Swift Microscope donated by Frey Scientific
Shawn Johns, Iola, KS

$50 Gift Certificates donated by Fisher Scientific
Amy Albers, Emporia State Univ.
Stephanie Strycker, Kansas Univ.

Advanced Owl Pellet Kit donated by Nasco
Larry Bice, Leavenworth, KS

Seven Specimen Survey Kit donated by Nasco
Jeanna Antonellis, Emporia State

Biology Teacher Survival Guide donated by Flinn
Paula Donham, Olathe, KS

Rain Forest Poster donated by Carolina Biological
Kevin Edwards, Olathe, KS

Protozoan Posters donated by Ward's
Keith Smith, Salina, KS

Protozoan Demoslides donated by Connecticut Valley
Bevery Ring, Olathe, KS
Susie Hebry, Kansas City, MO
Donna Cooper, Hays, KS
Ken Highfill, Lawrence, KS

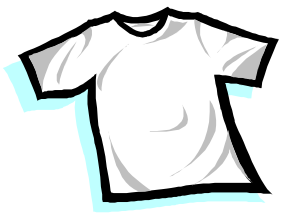
KABT T-shirt - Latex Exam Gloves - Artery Pens donated by Lisa Volland
Jill Fischer, Sheryl McCoy, Kimberly Benkman

Microscope slides were also donated by MedVenture of Topeka, KS.

KABT T-SHIRTS AVAILABLE

KABT has available for order an ash gray T-shirt (50/50) that bears the KABT logo (forest green) in the front upper left portion of the shirt. Adult S, M, L, and XL t-shirts can be ordered for $11.00 and XXL, XXXL t-shirts for $13.00. Some sizes are available now, other orders will be batched together to save on screening fees. Please send check or money order to Lisa Volland, Topeka West High School, 2001 SW Fairlawn, Topeka, KS 66604.

I also have an original design available on about any specified color T-shirt. It is a design that spells out the word "CELLS" using specific cells of a kingdom for each letter! Screens are printed in black, white or any specified color. T-shirts in blue, purple, and burgundy (white print) or ash gray, sage, and light tab (black print) are available for $13.00 (sizes up to XL) and $15.00 (XXL). Specialized orders-please add $5.00 for screening fees.



Adapting to the New, Updating the Old

It's a struggle to keep up with the whirlwind of technology in the science classroom. All too often, it must just be left out, due to the expense, the difficulty, the inexperience of the experiment/equipment.

TAPESTRY GRANTS

Give it a try. What have you got to lose?

Most teachers I know have an innovative idea or two that would really impact their student's science education. These ideas often are not implemented due to a lack of local funding. These ideas might involve some risk in that they are not proven ideas. I'm willing to bet that you have such an idea that only needs to be funded so that you can provide new opportunities for your students. Now's the time to look into the Toyota TAPESTRY program.

In the spring of 1991 five Kansas teachers (Ernie Brown, Steve Case, Donna Cooper, John Wachholz and Brad Williamson) were awarded a $10,000 TAPESTRY grant from Toyota and NSTA to help establish the Kansas Environmental Monitoring Network (KEMNET). Though KEMNET is not currently active it provided the foundation seed for a number of other collaborative research projects involving thousands of Kansas students and teachers. Those projects include the NSF-funded, KU Monarch Watch, the KDHE Water Monitoring network, and the DOE-funded KanCrn project. Originally the TAPESTRY program funded 21 projects like KEMNET around the nation and was targeted only to secondary teachers. Today the program has grown to include elementary teachers and funding for 50 projects per year. The grants are awarded to projects that provide innovation for environmental science or physical science education. No other program makes so much money available to the everyday classroom teacher. Program details and applications are available at:

http://www.nsta.org/programs/toyota.htm

Deadline for entering this years competition is January 15th.

The purpose of this article is to encourage you to apply for this grant. The program was set up to encourage innovative teaching so that all of science education can benefit. Let me emphasize that I don't consider this to be an award although it is very prestigious. It is a grant and if your are awarded the grant, you will be expected to make every effort to carry out your proposal. It's a tremendous opportunity to make a difference.

I've been asked to serve as NSTA's representative for TAPESTRY in our state. I do this gladly. I have a number of application packets that are ready to send out on request. I'm not sure why but I'm often asked for advice about proposal preparation. I usually say that the most significant factor for success is simply-- a "good idea". For those of you that would like some suggestions or encouragement from me, feel free to contact me at my email address below. One final point: Don't be reticent about putting effort into a proposal that you worry won't be funded. Most people find that the exercise of articulating their ideas into the grant format is a very valuable exercise in and of itself. Even if not funded on the first try, several uent proposals. The only way to find out is to begin.

Good luck.

Brad Williamson, bwilliam@sound.net

DRAFT KANSAS STATE EDUCATION STANDARDS UP FOR PUBLIC REVIEW

The first draft of the State Science Education Standards have been distributed for first review and comment. The Grade 9-12 Life Science sections **only** are reprinted here for careful scrutiny by Kansas biology teachers. Comments, revisions, etc. should be forwarded to:
Greg Schell, KSDE Science Education Consultant, 120 SE 10th, Topeka, KS 66612, ... or e-mailed to: gschell@ksbe.state.ks.us **by December 4, 1998.** This draft will be revised in December, and second draft will be distributed in January, 1999. Public hearings will be held across the state that month. Further revisions will be made in February, an external review will occur in March, and the Kansas State Board of Education will act upon the final copy in April, 1999.

It is not the intent of the standards to dictate curriculum; however the standards are the basis for the science content assessment mandated by the QPA legislation. Biology teacher preparation programs across the state will undoubtedly align their programs with the standards; inservice workshops and teacher education grants will be restricted to these standards. In addition, publishers will likely align future textbooks with the concepts addressed in most state standards.

Without doubt, there will be careful attention addressed to incoming comments relating to issues both within the life science standards and in the rest of the document:

-evolution [included in all other state standards to this point in time]

-promoting metric or non-metric measurement

-keeping chemistry and physics distinct rather than uniting them in a physical science certification

Benchmarks 1 through 6 are revised [often heavily] from the *National Science Education Standards*, NAS, 1996. Members of the secondary level standards writing committee [who could provide further details and background] include a heavy biology component: Ken Bingman, Steve Case, Letha Gillaspie, Jay Nicholson, John Richard Schrock, Ben Starburg, David Steinmetz, Pat Wakeman, and Brad Williamson. -JRS

STANDARD 3: LIFE SCIENCES
As a result of their activities in grades 9-12, all students should develop an understanding of the cell, molecular basis of heredity, biological evolution, interdpendence of organisms, matter, energy, and organization in living systems, and the behavior of organisms.

Benchmark 1. Student will demonstrate an understanding of the structure and function of the cell.
Indicators:

1. Cells are composed of a variety of specialized structures that carry out specific functions.

Examples:

- Every cell is surrounded by a membrane that separates it from the outside environment and controls flow of materials into and out of the cell.
- Specialized bodies, including organelles, serve specific life functions of the cell.

2. Most cell functions involve specific chemical reactions.

Example:

- Food molecules taken into cells provide the chemicals needed to synthesize other molecules. Both breakdown and synthesis in the cell are catalyzed by enzymes.

3: Cells function and replicate as a result of information stored in DNA and RNA molecules.

Example:

- Cell functions are regulated by proteins and gene expression. This regulation allows cells to respond to their environment and to control and coordinate cell division.

4. Plant cells contain chloroplasts which is the site of photosynthesis.

Example:

- The process of photosynthesis provides a vital connection between the sun and the energy needs of living systems.

5. Cells can differentiate enabling complex multicellular organisms to form.

Example:

- In development of most multicellular organisms, a fertilized cell forms an embryo that differentiates into an adult. Differentiation is regulated through expression of different genes and leads to the formation of specialized cells, tissues, and organs.

Benchmark 2. Student will demonstrate an understanding of the molecular basis of heredity.
Indicators: The students will under stand that:

1. Experiments have shown that all known living organisms contain DNA or RNA as their genetic material.

Examples:

- Frederick Griffith's work with bacteria demonstrated DNA changed properties of cells.
- Hershey and Chase's work demonstrated that viral DNA contained the genetic code for new virus production in bacterial cells.

2. DNA specifies the characteristics of most organisms.

Examples:

- Five major nucleotides (adenine, thymine, guanine, cytosine and uracil) make up DNA and RNA molecules.
- Sequences of nucleotides that either determine or contribute to a genetic trait are called genes.
- DNA is replicated by using a template process which usually results in identical copies.

3. Organisms usually have a characteristic numbers of chromosomes; one pair of these may determine the sex of individuals.

Example:

- Most cells in humans contain 23 pairs of chromosomes; the 23rd pair contains the XX for female or XY for male.

4. Sex cells carry the genetic information to the next generation.

Examples:

- Sex cells contain only one representative from each chromosome pair.
- Sex cells unite to form a new individual in most organisms.
- Many possible combinations of genes explain features of heredity such as how traits can be hidden for several generations.

5. Mutations occur in DNA at very low rates.

Examples:

- Some changes make no difference to the organism or to future generations.
- Many changes are harmful; a few mutations enable organisms to survive changes in their environment.
- Some favorable mutations are passed on to offspring.
- Only mutations in the germ cells are passed on to offspring and therefore can bring about beneficial or harmful changes in future generations.

Benchmark 3. Students will understand* major concepts of biological evolution

Indicators: The students will understand:

1. That the earth's present day biodiversity developed as a result of biological evolution over the last 3. 8 billion years.

2. The mechanisms for evolution recognized by biologists.

Example:

- 1) Heritable variation exists in every species; 2) some heritable traits are more advantageous to reproduction and/or survival than are others; 3) there is a finite supply of resources required for life; not all progeny survive; 4) individuals with advantageous traits generally survive to reproduce to leave more young; and 5) the proportion of individuals with advantageous traits will increase.

3. The sources and value of variation.

Examples:

- Variation of organisms within and among species increases the likelihood that some members will survive under changed environmental conditions.
- New heritable traits result from new combinations or mutations of genes in reproductive cells; changes in other cells of a sexual organism are not passed to the next generation.
- Evolution builds on what exists; the more variety present, the more variety possible in the future; evolution does not necessitate long-term progress in some set direction.

4. Understand evolution by natural selection is a broad unifying principle in biology.

Examples:

- Evolution provides the context to ask research questions and yields valuable applied answers, especially in agriculture and medicine.
- Degree of kinship between organisms or species is estimated from similarity of DNA
- DNA sequences, which often closely matches classification based on anatomical similarities; molecular evidence substantiates anatomical evidence for evolution and provides additional detail about the various lines of descent.
- Organisms are classified into a hierarchy of groups; these classifications or family trees follow rules of nomenclature and reflect evolutionary relationships; scientific names have unique definitions and value.
- Natural selection and its evolutionary consequences provide a detailed scientific explanation for an ever-increasing amount of the fossil record and correlates with radio-isotope dating results; distribution of fossil and modern organisms is related to

geological and ecological changes (i. e. plate tectonics, migration).

***Understand:** "Understand" does not mandate "belief. "While students may be required to understand some concepts that researchers use to conduct research and solve practical problems, they are never required to hold belief in a science concept. This applies particularly where students' and/or parents' religion denies the science. See *Teaching About Evolution and the Nature of Science*, 1998, page 59.

Benchmark 4. Students will understand the interdependence of organisms and their interaction with the physical environment.

Indicators: The students will understand that:

1. Atoms and molecules on the earth cycle among the living and nonliving components of the biosphere.

Example:

- The chemical elements, including all the essential elements of life, circulate in the biosphere in characteristic paths known as biogeochemical cycles. [ex: nitrogen, carbon, phosphorus, etc. cycles]

2. Energy flows through ecosystems in one direction.

Examples:

- Organisms, ecosystems, and the biosphere possess thermodynamic characteristics that exhibit a high state of internal order, low entropy.
- Radiant energy that enters the earth's surface is balanced by the energy that leaves the earth's surface.
- Transfer of energy through a series of organisms in an ecosystem is called the food chain; at each transfer as much as 90% of the potential energy is lost as heat.

3. Organisms both cooperate and compete in ecosystems.

Examples:

- The interrelationships and interdependence of these organisms may generate stable ecosystems.
- The stable community in ecological succession is the climax community.
- The climax community is self-perpetuating because it is in equilibrium within itself and with the physical habitat.

4. Living organisms have the capacity to produce populations of infinite size, but environments and resources are finite. This fundamental tension has profound effects on the interactions between organisms.

Example:

- The presence and success of an organism, or a group of organisms, depends upon a large number of environmental factors. Any factor that approaches or exceeds the limits of tolerance is limiting.

5. Human beings live within and impact ecosystems.

Example:

- Humans modify ecosystems as a result of population growth, technology,and consumption. Human modification of habitats through direct harvesting, pollution, atmospheric changes, and other factors affects ecosystem stability.

Benchmark 5. Students should develop an understanding of matter, energy, and organization in living systems.

Indicators: The students will develop an understanding of:

1. Living systems require a continuous input of energy to maintain their chemical and physical organizations.

Examples:

- All matter tends toward more disorganized states.
- With death, and the cessation of energy in take, living systems rapidly disintegrate.

2. The energy for life primarily derives from the sun through the process of photosynthesis.

Examples:

- Plants capture energy by absorbing light and using it to form molecules.
- These molecules can be used to assemble larger molecules with biological activity (including proteins, DNA, sugars, and fats).
- The energy stored in bonds between the atoms (chemical energy) can be used as sources of energy for life processes.

3. The chemical bonds of food molecules contain energy. This energy is made available by cellular respiration.

Examples:

- Energy is released when the bonds of food molecules are broken and new compounds with lower energy bonds are formed.
- Cells usually store this energy temporarily in phosphate bonds of a small high energy compound called ATP.

4. The structure and function of an organism serves to acquire, transform, transport, release, and eliminate the matter and energy used to sustain the organism.

5. The distribution and abundance of organisms and populations in ecosystems are limited by the availability of matter and energy

and the ability of the ecosystem to recycle materials.

6. As matter and energy flow through different levels of organization of living systems-cells, organs, organisms, communities--and between living systems and the physical environment, chemical elements are recombined in different ways. Each recombination results in the storage of energy and a dissipation of energy into the environment as heat.

Benchmark 6. Students will understand the behavior of animals.

Indicators: The students will understand that:

1. Animals have behavioral responses to internal changes and to external stimuli.

Example:

- Responses to external stimuli can result from interactions with the organism's own species and others, as well as environmental changes. These responsescan be innate and/or learned. Animals often live in unpredictable environments, and so their behavior must be flexible enough to deal with uncertainty and change.

2. Most multicellular animals have nervous systems that underlie behavior.

Examples:

- Nervous systems are formed from specialized cells that conduct signals rapidly through the long cell extensions that make up nerves.
- The nerve cells communicate with each other by secreting specific excitatory and inhibitory molecules. In sense organs, specialized cells detect light, sound, and specific chemicals and enable animals to monitor what is going on in the world around them.

3. Like other aspects of an organism's biology, behaviors have evolved through natural selection.

Examples:

- Behaviors are often adaptive when viewed in terms of survival and reproductive success.
- Behavioral biology has implications for humans, as it provides links to psychology, sociology, and anthropology.

Benchmark 7. Students will demonstrate an understanding of structure, function and diversity of organisms.

Indicators: The students will understand:

1. The diversity, basic biology, ecology and medical effects of microbiological agents including viruses, bacteria, and protists.

Examples:

- Viruses vary from bacteria; because of these differences, vaccines are effective but antibiotics are not.
- Bacteria vary from eukaryotes; because of these differences, bacteria are important decomposers and unique disease agents and some ancient forms are in a separate kingdom or domain.
- Protists are unspecialized eukaryotes whose ancestors gave rise to other major kingdoms; some are disease agents (e. g. malaria, amoebic dysentery) and may require an animal vector.
- Understanding of this basic biology underlies effective sanitation and hygiene.

2. The diversity, basic biology, ecology and medical effects fungi.

Example:

- Fungi are vital decomposers and important commercial and medical agents.

3. The diversity, basic biology, ecology and human relationships of plants.

Examples:

- Plant structures vary from primitive to derived; this variation is important in understanding the function of plants in farming, pharmaceutical products, etc.
- Photosynthesis is the basis for nearly all food chains and our food production.
- Understanding biology of plants underlies a science understanding of ecology.

4. The diversity, basic biology anatomy, ecology and medical effects of major animal groups.

Examples:

- Animals vary from primitive to derived; this variation is important in understanding the function of animals in farming, medical research, etc.
- Understanding biology of animals underlies a science understanding of ecology.

5. Humans as complex soft machinery that requires many systems operate properly.

Examples:

- Organ systems have specific structures and functions; they interact with each other.
- Infections, developmental problems, trauma and aging result in specific diseases and disorders.

6. The structures and processes of development and reproduction.

Examples:

- Reproduction is essential to all ongoing life and is accomplished with wide variation in life cycles and anatomy.

- Understanding of basic mechanisms of development, as well and changes of aging, is critical to leading a healthy life, parenting, and making civil decisions.
- Environmental factors (e. g. radiation, chemicals) can cause both gene mutations and directly alter development; changes to nonreproductive cell lines are not passed on.

Bird Cake Recipe

Here is a "Bird Cake" recipe given to me by a friend a couple of years ago, to pass on to others. As for a guarantee that it will be eaten..., you'll have to take that one through the "avian court" system!

Ingredients:
1 cup lard
1 cup peanut butter [plain or crunchy?]
2 cups cornmeal
2 cups quick oats
1 cup white flour
1/2 cup sugar.

Melt the lard and peanut butter over low heat or in a microwave oven. Then stir in the remaining ingredients. Pour the mixture into a pan about 1-1/2 inches deep. Allow to cool. Cut into bricks that will fit into your suet feeder. Wrap bricks in air tight plastic and store in freezer until ready for use. [If you want to get fancy, pour the hot mixture into cupcake papers, over a strong cord, which can be used to hang the cake from a limb, etc.]

Lard can be rendered from suet strips, or, ground suet (included entirely) [probably best choice], by putting in a 350 degree oven. Also, other seeds (sunflower chips, millet, etc.) and fruit (raisins, apples, nuts, etc.) can be added to mixture.

[It appears that the secret is the proper amount of melted suet to bind it all together. Any bird food item 'should' be usable, including chopped corn, chopped acorns, etc. However, to save a lot of trouble, go to the butcher shop (as we do) and ask for some free suet and package to fit suet cage, and freeze. You may arrange to have it ground, for use in compressed raw suet patties, or, in suet cakes.]

Robert J. Mangile

FDA PROPOSES HEALTH CLAIM FOR SOY PROTEIN

The Food and Drug Administration (FDA) has proposed allowing health claims about the role soy protein may have in reducing the risk of coronary heart disease (CHD) on the labels and labeling of foods containing soy protein. This proposal is based on the agency's determination that soy protein, as part of a diet low in saturated fat and cholesterol, may reduce the risk of CHD.

CHD is the most common, most frequently reported, and most serious form of cardiovascular disease, and is the number one cause of death in the United States. Despite the decline in deaths from CHD over the past 30 years, this disease still causes more than 500,000 deaths annually, and contributes to another 250,000 deaths. High blood total cholesterol and high low-density lipoprotein (LDL) cholesterol levels are proven risk factors for CHD.

In proposing this health claim, FDA concluded that foods containing protein from the soybean as part of a diet low in saturated fat and cholesterol may reduce the risk of heart disease by lowering blood total cholesterol and LDL-cholesterol. The amino acid content in soy protein is different from animal and most other vegetable proteins, and appears to alter the synthesis and metabolism of cholesterol in the liver.

Foods containing soy protein include soy milk, tofu, meat substitutes (such as vegetable burgers) and baked goods made with soy flour. Because soy protein occurs in or can be added to a wide variety of foods and beverages, it is possible to eat soy protein-containing products as many as 4 times a day (3 meals and a snack), according to the FDA.

Studies show 25 grams of soy protein per day have a cholesterol-lowering effect. Therefore, for a food to qualify for the health claim, each serving of the food must contain at least 6.25 grams of soy protein, or one-fourth of the 25-gram amount shown to have a cholesterol-lowering effect.

The FDA is soliciting comments on this proposed regulation. Written comments will be received until January 25, 1999, and may be addressed to: Dockets Management Branch (HFA-305) Food and Drug Administration 5630 Fishers Lane, Room 1061 Rockville, MD 20852

<http://www.fda.gov/>

Soyfoods USA, Vol. 3, No. 10
November 16, 1998

A Simple Method to Explore Enzyme Activity

Brad Williamson

Background:

Enzymes are essential in nearly all life processes. By catalyzing (speeding up a chemical reaction) various chemical reactions in the cell enzymes make energy and nutrients available to living systems. Each enzyme only catalyzes one kind of chemical reaction so there is a lot of enzymes in a typical cell. As the human genome project uncovers the genes in the human population it is important to realize that the majority of genes code for enzymes. A basic understanding of enzyme properties then is an essential, first step, to understanding living systems.

Enzyme studies are easily studied by students. For this investigation we will work with an enzyme that begins the breakdown of starch into sugar. It's called amylase (enzyme) since it breaks down starch (the substrate) which is known as amylose. Scientists use the term substrate to describe the chemical that an enzyme catalyzes. Starch is an energy-storing compound present in many plant foods such as potatoes, corn and bread. Amylase is a component of saliva where it starts the digestion of starch as you chew your food. It's also a valuable commercial enzyme. The starch in grains such as sorghum are digested with amylase in large reaction vessels to break the starch down to sugar which is then used to produce a number of products. Quite a bit of research that is done by various agricultural product companies attempts to find more efficient forms of enzymes such as amylase. Any organism that might consume starch (including plants) probably relies on some form of this enzyme. And each organism might have just a slightly different form of the enzyme that might be more efficient than others. You might find such an organism and find a valuable enzyme product.

Most of the time biochemists (scientists that study enzymes) work with enzymes in a liquid environment. Such techniques require careful control of a number of variables. A simpler method to study enzymes involves a gel-like substance known as agar. The substrate (starch in this case) is dissolved in this gel and various suspected enzyme-containing substances are added to small holes (wells) in the gel. The suspected enzyme diffuses out through the gel. If it can actively digest starch it will create a starchless area around the well. Iodine stain can be used to cause starch to turn a dark purple. Clear zones that are not purple are areas that the enzyme has digested the starch to sugar. This technique makes it simple to test many samples for activity or to determine the amount of activity a specific enzyme might have. In addition, it is easily modified to test various variables that might affect enzyme activity.

Methods

Materials:

Petri plates (90 mm x 15 mm)	amylase: saliva, enzyme wallpaper remover, plant extracts, and germinating seeds
agar	
soluble starch	5 test tubes (13 x 75 mm) and rack
drinking straw	dropping pipette (graduated)
iodine solution	ruler

Procedure:

Preparation of starch-agar plates:

1. To prepare about 20 starch-agar petri plates mix 2.5 grams of starch with 10 grams of agar. Add 500 ml of water. Stir to mix thoroughly. Slowly bring to a boil in a large, loosely covered container (at least 1500 ml). (Covering can be aluminum foil if heating is done on a hot plate or on the stove.) This step is critical since it is easy to scorch the agar or to have it boil over. Several researchers today melt their agar in a microwave. You'll need to experiment with the settings on your microwave. Make sure to not use aluminum foil in the microwave. You may want to experiment with smaller quantities until you develop the skills to melt agar. Make sure the proportions are the same: 0.5 parts of starch, 2 parts agar, and 100 parts water.
2. When the agar has melted and then cooled to just under 85_C pour the agar into the bottom petri plates till the plate bottom surface is just covered to a depth of 5 mm. Cover the plate so that the agar can cool and solidify.
3. Store the plates in the refrigerator in plastic bags until needed. Plates should be used within 3 days or they may develop fungal contamination.

Enzyme preparation (Serial Dilution):

4. An excellent source of amylase is enzyme-based wallpaper stripper. To prepare a stock solution or a starting concentration of wallpaper stripper enzyme mix a small amount in the quantity ratios indicated on the label of the container. For "DIF Wallpaper Stripper" from the Zinsser company a one part wallpaper stripper to 12 parts water is a good starting enzyme solution. You

(Continued on page 10)

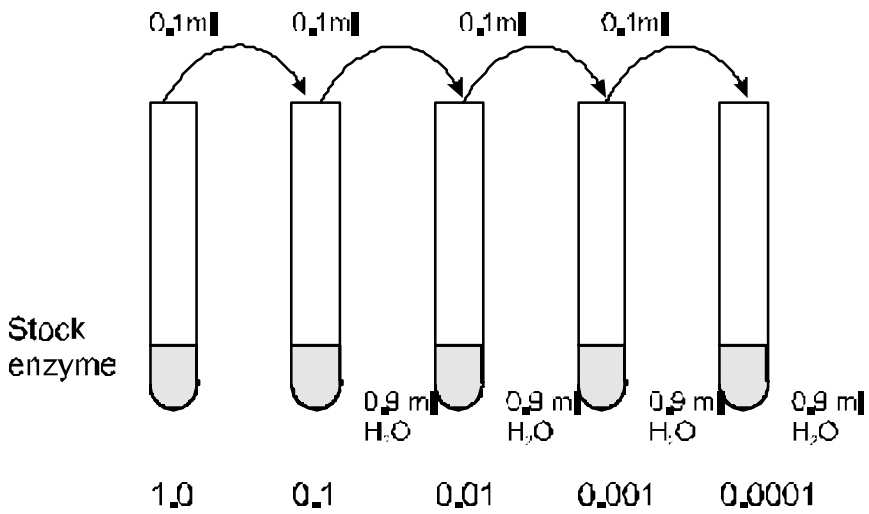


Figure 1

won't need more than 100 ml of solutions for an entire class so 10 ml of wallpaper stripper diluted with 120 ml of water is plenty. Follow the safety precautions listed on the label of the container. If proper precautions are taken saliva can also serve as a stock enzyme solution. Refer to NABT position paper.

5. Set up five 13 x 75 mm test tubes. Label the tubes 1, 0.1, 0.01, 0.001, and 0.0001 with a glass marking pen (Sharpie®). In the first tube place 1 ml of stock enzyme solution. Into each of the other tubes place 0.9 ml of water. From tube #1, the stock solution remove 0.1 ml of enzyme and place in tube #2, labeled 0.1. This will bring tube #2 to a volume of 1 ml of 10% or 0.1 enzyme. After this tube is mixed remove 0.1 ml and place into tube #3. This will dilute the enzyme by another factor of 10. Tube #3 will have a 1% or 0.01 enzyme solution. Follow the same procedure for the remaining two tubes. Refer to the following illustration:
6. Using a plastic drinking straw remove 5 agar plugs to make "wells" in the starch-agar plate. Holding your finger over the top of the straw gently lower the end of the straw down into the agar. If you are lucky the plug will stay in the straw. Don't remove it since it will help to make the next plug. Sometimes this is a bit tricky but if you have a toothpick you can easily remove any agar plugs that stay in the wells. When you are done your starch-agar plate should look something like figure 2.
7. Label the wells with the enzyme dilutions that you created in step 5. It is best to do this by writing on the bottom of the petri dish with a waterproof ink pen (Sharpie®). Into each of the wells add two or three drops of the appropriate enzyme dilution being very careful not to overflow the well. If you overflow the well the enzyme will run over the surface of the agar confusing the results. The idea is for the enzyme to diffuse through the agar, digesting starch as it goes. Allow the starch-agar plate with enzyme dilutions to incubate 8 to 24 hours.
8. Since starch-agar is slightly turbid you should see zones of clear agar around each well if your enzyme is active. The size of the zone will be proportional to the enzyme's activity. To help visualize these zones better a very dilute (looks like a medium tea) iodine solution can be poured over the surface of the plate. It will react with the starch to produce purple. Where the starch has been digested by the enzyme the agar will be mostly clear instead of purple. The results should look something like figure 3. Measure the diameter of each clear zone in millimeters and enter the measurement in Table 1. To determine the amount of starch digested by a given enzyme dilution it is necessary to determine the volume of the starch-agar clear zone. Since the height or thickness of the agar is uniform throughout the plate a calculation of the area of each circle will provide an adequate picture of the relationship between enzyme concentration and the amount of starch digested–in other words the enzyme activity. Complete the rest of Table 1.
9. After completing the data table graph the Area of the clear zone versus the enzyme dilution using the graph paper provided. There are two kinds of graph paper provided. Use the normal graph paper for your first graph. This will not be an easy graph to make. Scale the x-axis so that 1.0 is at the far right and 0 is at the origin. Start the y-axis plot 0.1 or 0.2. The second kind of graph paper is called log-log paper and you'll probably need your science or math teacher's help to graph using this paper.

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Table 1

Enzyme dilution	Diameter of clear zone (mm)	Diameter/2 = radius	radius x radius = r^2 (mm^2)	Π x r^2 = Area 3.14 x r^2 = Area (mm^2)
0.0001				
0.001				
0.01				
0.1				
1.0				

10. This technique presents many possibilities for further exploration of enzyme activity. For instance you could study the effects of temperature on enzyme activity by placing three identically prepared plates in 3 temperature environments such as a refrigerator, an incubator and at room temperature. You could explore various substances for amylase activity by placing suspected amylase into wells on your starch-agar plate or for something like a germinating seeds placing the seed directly into a small slot cut in the agar.

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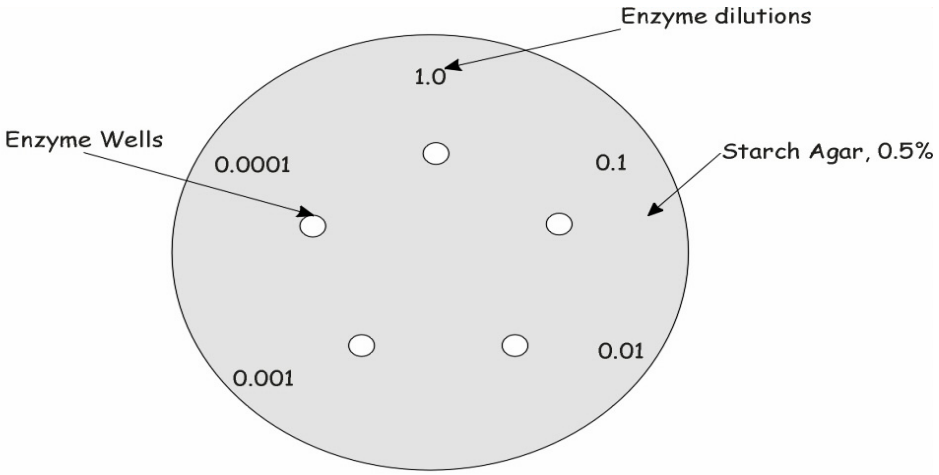
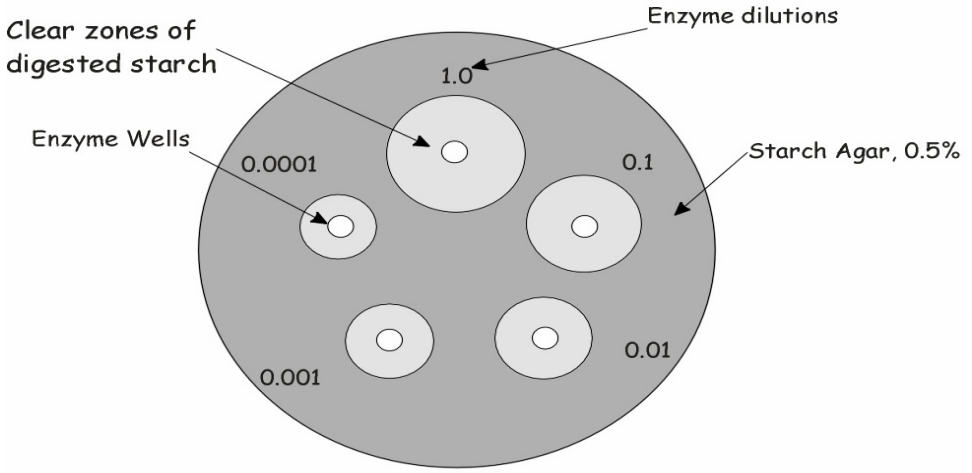
Davis, Bill D. 1977. Determining Enzyme Activity by Radial Diffusion. The American Biology Teacher. April, 1977. 217-226.

Snyder, John A. and Donald Fritsch. Two Reliable and Inexpensive Lysozyme Assays for Teaching Enzymology and Microbiology. Proceedings of the Third Workshop/Conference of The Association for Biology Laboratory Education. Kendall Hunt. 1984. 167-179.



Prepared Starch Agar Plate, Fig. 2



Developed Plate after Enzyme Digestion, Fig. 3

Exploring Seed Germination

By Brad Williamson

Background:

Seeds are very remarkable. Laying dormant inside the seed is an embryo plant. Packed with the embryo is enough stored chemical energy to power the young seedling until it can capture its own energy from the sun by the process of photosynthesis. The timing of germination or the breaking of the dormancy is important to the success of the young seedling. For instance, milkweed seeds that are produced in late summer and fall are carried on the wind, away from the parent plant. They fall to earth in all sorts of environments. If the seed goes ahead and germinates immediately, the young milkweed plant will not be able to produce flowers and seeds before the onset of frosts and winter (at least in the northern U.S.) Milkweed seeds actually don't germinate until they have experienced long periods of low temperatures. In the spring when the soil is moist and the soil temperature is warm enough a new generation of milkweed to begin. The seed has to somehow respond to signals in its environment in order to germinate at appropriate times.

Many environmental factors can affect seed germination. Light intensity, day length, night length, light color, water, water quality, gravity, crowding, temperature, nearby plants (by chemical agents), genetics, oxygen availability, seed condition, seed age, seed coat condition, seed size and other environmental conditions can have measurable effects on seed germination. Gardeners, worldwide, have a number of ideas of other environmental factors that may influence germination such as the phases of the moon, tidal effects, and planting with companion seeds. Seed germination is a good topic for scientific exploration since it is easy to observe and there are so many obvious and not so obvious environmental factors that can affect the germination.

In order to germinate and break dormancy a seed has to absorb quite a bit of water. In nature seeds absorb this water from the soil. Planting seeds in pots of soil is certainly one way to study their germination and a lot can be learned with controlled experiments. However, observation of soil germinated seeds is not easy–one can only observe the top half of the newly emerged plant. The newly developing roots are equally important when studying seed germination. The method described here involves germinating seeds on a moist filter paper that has a constant source of water. By germinating seeds on a moist paper the root growth can be observed and measured more easily. Also, large numbers of seeds can be tested in a small amount of space in a short period of time.

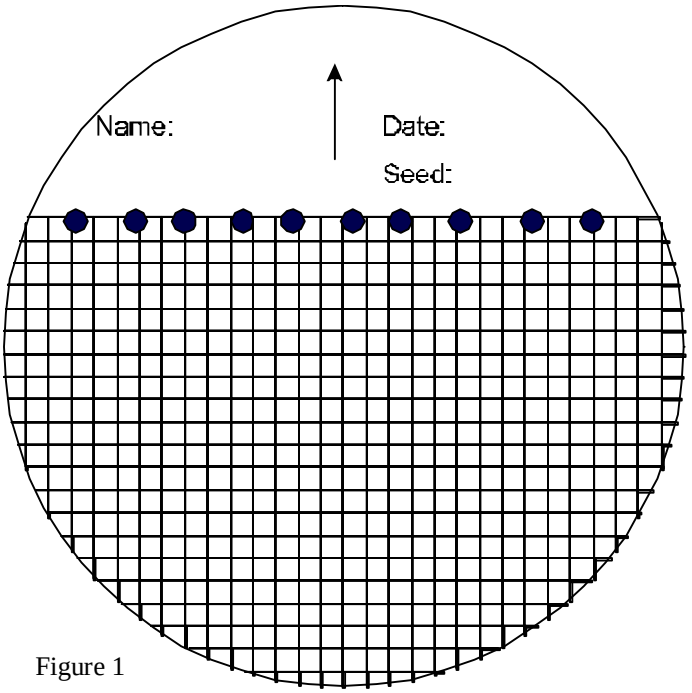
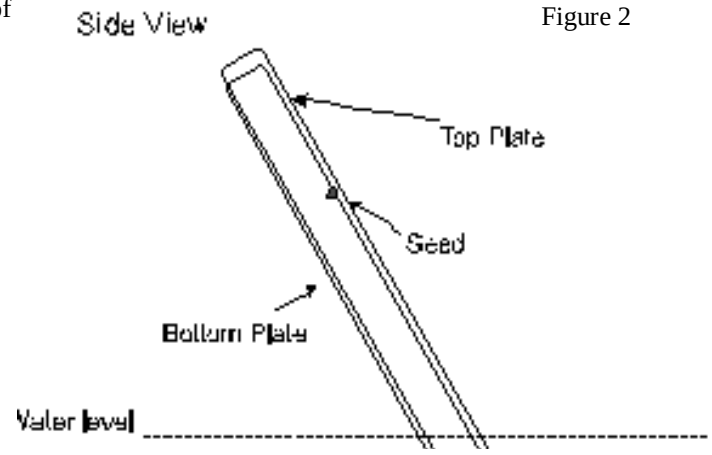


Figure 1

Figure 2



A method for exploring seed germination:

Materials:

- 9 cm Petri dish
- 10 seeds per chamber (small seeds such as radish, alfalfa, lettuce, weed seeds, etc.)
- 9 cm filter paper disk
- plastic acetate grid
- water reservoir (plastic shoe box, the bottom of a two-liter bottle, etc.)
- magnifier
- forceps

Procedure:

1. Construct a seed germination chamber by first placing the plastic acetate grid on the top petri plate. Secure it in place with a drop of water. Write your name, date and seed type near the top edge of the filter paper disc with a pencil or waterproof ink.

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Place the filter paper disc over the top of the plastic acetate grid. You may have to trim the paper to fit flat in the petri dish. Wet the paper to hold it in place. It will become transparent so that you will be able to see the grid lines underneath.

2. With the arrow on the grid pointed up, add ten seeds evenly spaced across the line that is the top of the grid. Refer to figure 1. The seeds will usually stick to the wet surface of the filter paper. If seeds fall off during the study simply place them back on the moist filter paper. Make sure that you orient the seeds so that the micropyle is facing down. The root will usually emerge from this area since it is the weakest point in the seed coat. Place the bottom of the petri over the assembly to complete the germination chamber.

3. Place the chambers leaning on edge in a water reservoir. Maintain about two or three centimeters of water in the water reservoir throughout the experiment. The water in the reservoir will wick onto the surface of the filter paper, keeping the filter paper wet and providing an ideal environment for seed germination.

Collecting Data:

Data is information that is collected with a purpose. It can be *qualitative* data–data such as color, appearance, relative size, etc. or it can be *quantitative* data–data that is measured and assigned numerical values. Generally, quantitative data is more reproducible than qualitative data. For example, when your description of how green (qualitative data) a leaf is will probably differ from your neighbor's description–even when you are describing the same leaf. However, if you were to both measure the length of the leaf in millimeters (quantitative data), your measurements would probably be in close agreement. The above procedure is good for collecting both kinds of data.

Carry out an Investigation:

1. Using the background as a guide decide on an environmental factor that might affect the germination of seeds. A sample question might be: "Does light affect seed germination in lettuce seeds?"
2. Develop a hypothesis that will help you to design an experiment using the method described above. A sample hypothesis might be: "If light is necessary for radish seeds to germinate then lettuce seeds germinated under room light should have a higher germination rate and faster germination than radish seeds germinated without light." You might add another hypothesis about root growth rates or other factors. A single experiment can measure more than one outcome. It's important, though, to keep the number of tested variables (light) to one when you are just starting out learning to do science.

Qualitative	Quantitative
Color of seeds. Seeds come in all kinds of colors. Trying to categorize colors can be difficult just ask anyone who has tried to match house paint. Often by selecting a specific color closest to your seed and describing that color by the shade you'll	Number of seeds germinated per day. Seed germination can be measured and communicated by counting the number of seeds that have germinated in a given time period. For instance if 6 seeds germinate the first day of your investigation and 3 the next out of a total of 10 seeds then you could communicate that the germination rate was 60% after one day and 90% after two days.
Color of cotyledons. Refer to the above.	Length of root of each seedling in mm. This procedure was actually designed to make it easy to measure the length of germinating roots. Since the seeds are placed on a grid. You can simply count the number of times that a particular root crosses or intersects a grid line (vertical or horizontal). Plug that number into the following formula to calculate root length. Root length (mm) = number of intersections x (0.7857 x the size of the grid in mm) For example, if a root crosses a 3 mm grid 24 times: Root length = 24 x 2.3571mm Root length = 56.6 mm
Appearance of seed. Describe the shape and texture	Size of seed in mm. Measure the size in millimeters.
Color of hypocotyl. This is the stem of the new plant. Its color can vary	Length of hypocotyl. Measure with a ruler or use a different background grid. Measure daily.

(Continued on page 14)

3. Design your experiment to control your variables. A sample experiment might be: "Set up two identical petri plates with 10 seeds of lettuce each as describe in the above procedure. Keep both at room temperature but cover one with aluminum foil to block out all light. Keep both plates under a fluorescent light. Grow the plates for 4 days, taking data for seed germination, root length, and cotyledon color for each day "
4. Design and construct data tables for data collection. Collect the data over 4 days.
5. Present your data. Develop and present your conclusions based on your data.

Teacher notes:

1. The student procedure purposely leaves out description of terms needed for understanding. You may introduce the terms as needed or as the student attempts to communicate use the opportunity to introduce the importance of scientific terminology. Vocabulary needed for this procedure: cotyledon, hypocotyl, radicle, root, micropyle, hilum, seed coat, seed, germination, embryo.
2. The background has a number of environmental factors listed that affect seed germination. The idea of this investigation is to have students develop or design their own lab to investigate one or more of these factors. This method is particularly good for quantifying root growth. Some students may want to compare this method to germination experiments that involve soil. This lab is also applicable as a performance assessment to determine students abilities to design and carry out a laboratory investigations. A related assessment can be found at:

   http://www.gene.com/ae/AE/SH/NSTA_NOR/morris_seeds.html

3. Seeds of all kinds can be used but they should be small to fit onto the petri plates. Suggested seeds include: Wisconsin Fast Plants, radish seeds, lettuce, alfalfa, clover, seeds from various weeds such as mustards, plantain and dandelion.
4. Different sizes of grids can be designed for this investigation. The 3-5 mm size is easiest for students to count but a 1 mm grid may provide more precise measurements.
5. There is no particular reason for 10 seeds to be tested on each plate. The number can be higher or lower. What is important is that the students realize that the seeds represent a population and by have a reasonable sample variation in the population is considered.
6. This is a good lab to utilize stem and leaf diagrams as well as box and whisker plots for comparing data sets. Diagrams, data tables, and graphing templates are not provided so that the student will be encouraged to develop their own diagrams, tables and graphs as part of their laboratory work.
7. This lab also is a good take-home lab since there are minimal safety precautions.

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Wisconsin Fast Plants Manual. Carolina Biological Supply. 1989.

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2609 SW Morningside Dr
Topeka, KS 66614
(785) 273-1810
Topeka West High School
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(785) 456-7924
Wamego High School
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FAX (785) 456-8125

Treasurer and Newsletter Editor
John Wachholz
2311 Applewood Lane
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(785) 825-7742
Salina High School Central
650 E. Crawford Street
Salina, KS 67401-5119
(785) 826-4751
FAX (785) 826-4740
jwachholz@midkan.net

Secretary and KACEE Representative
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24549 Sandusky Rd.
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(913) 845-3208
Tonganoxie High School
Box 179 24-40 Highway
Tonganoxie, KS 66086
(913 845-2654
FAX (913) 845-3716
pwakeman@nehub.nekesc.k12.ks.us

Region 1 Representative
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WaKeeney, KS 67672
(785) 743-2972
Trego Community High School
1200 Russell Avenue
WaKeeney, KS 67672
(785) 743-2061
FAX (785) 743-2449
ebrown@ruraltel.net

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(405) 487-3547
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Journal Editor
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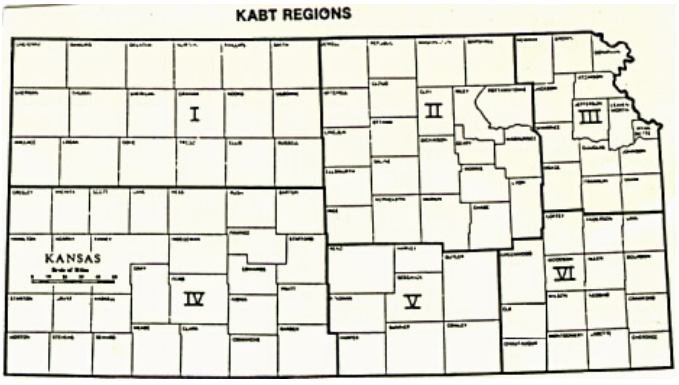
1101 W. 18th Avenue
Emporia, KS 66801
(316) 342-3879
Emporia State University
Division of Biology
Box 4050
Emporia, Ks 66801
(316) 341-5614
FAX (316) 341-5997
ksnaturl@esumail.emporia.edu

NABT Representative
Brad Williamson
Olathe East High School
14545 W. 127th Street
Olathe, KS 66062
(913) 780-7120
(913) 780-7137 FAX
bwilliam@sound.net

KABT Historian
Stan Roth
532 Oklahoma St.
Lawrence, KS 66046
(785) 843-4764
Lawrence Free State H.S.
4700 Overland Dr.
Lawrence, KS 66049
(785) 832-6050 X7218
(785-832-6099 FAX
jroth@ukans.edu



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