In Regard to the Safe, Ethical, and Humane Treatment of Living Organisms in the Classroom and the Natural World

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Collecting Organisms in the Field

Students will use scientific inquiry to pose questions; make observations; plan, design, and conduct experiments; collect and interpret date; communicate, draw conclusions, and develop solutions. To engage in these activities, students may use a variety of organisms both unicellular and multicellular, as well as chemicals, supplies and equipment. For the safety of the students, faculty and staff, the following are safety regulations regarding collecting and holding organisms from the field.

In Field Work Experiences

- Inform students on the nature of the ecosystem they are about to enter. Explain the features of the site and the various places life is found.
- Inform students that they will be expected to respect the natural spaces they are collecting from if collection is a goal of the experience.
- Inform students to avoid getting between an adult organism and its young. This presents a hazardous situation where the adult is likely to become aggressive.

Regarding Marine and Freshwater Animals

- Students should be cautioned against tasting or eating any organism collected in the field.
- Students should be warned of the hazards involved in the collection and handling of specimen with claws, spines, or poisonous secretions such as crayfish, sea urchins, and jelly fish.
- Some students may be hypersensitive to stings by aquatic organisms and proper precautions should be taken to ensure appropriate protective gear is worn at all times.
- Proper footgear (boots, or sneakers) should be worn when collecting specimen.
- Proper hand-cover (gloves) should be worn to protect the specimen and the student or teacher from contact with each other.
- Where possible, students and teachers should use other measures to collect specimen to avoid skin contact.
- Dead or decaying organisms should be discarded.
- Specimen which will be used for more than one day should be preserved, refrigerated or humanely kept with adequate food and water.

Regarding Land Animals

- Parent permission should be required before students are allowed to handle live animals.
- Student should only be allowed to handle animals when supervised.
- If students experience an allergic reaction to an animal or the dust from their cage in a classroom, the animal should be removed immediately.

- Potentially dangerous animals including poisonous snakes, reptiles and insects should never be allowed in the classroom.
- All animals brought into the classroom should be healthy and free of transmissible disease or any other problems which may endanger student health.
- Teachers will provide instruction on the collection, care and handling of all animals that are kept in school or might be encountered on a field trip or field experience.
- Students will be cautioned against touching certain animals because of diseases they may harbor or injury they may inflict with teeth, tails, or claws.
- Teachers will inform students not to treat animals in a manner which may lead to injury or death of the animal. Teasing and abuse will be strictly prohibited.
- Cages will be cleaned, disinfected, and checked for hazards (frayed wires, sharp edges) regularly.
- When caring for rodents, pick up their cages by its handles, not by the mesh, the animal can often bite through the mesh.
- Students should be instructed not to insert their fingers or other objects into cages.
- When collecting, or handling animals, and when cleansing cages, wear appropriate, thickly padded gloves.
- Students will wash their hands prior to and after handling all animals.
- All animal bites, or scratches should be reported immediately for appropriate medical attention.
- Advise that animals are to not be handled during their first few days in the classroom in order to give them time to adjust to their new surroundings.

Regarding Plants

- Caution students against tasting or eating any plant material that has been collected or used in a lab exercise.
- Many common house and garden plants are toxic: azalea, crocus, daffodil, dieffenbachia, foxglove, mistletoe, poinsettia, etc. Teachers should make students aware of this if they are to be handling any of these plants.
- Before a field trip, students will be instructed on the identification and avoidance of poison ivy, poison oak, poison sumac, nettles, burrs and thorns if there is a possibility they will be encountered.
- On all field trips that include visits to fields and woods, students will be required to dress to prevent scratches and tick bites.
- This includes wearing caps or hats and dressing in light colored long sleeved shirts and pants which can be tucked in at the bottom to the top of students' footgear.
- Students with long hair will be advised to pull it back.
- In lessons on flowers and molds, care will be taken to prevent the excessive distribution of pollen or spores.
- Teacher will take care to learn any specific allergies that students may have to prevent exposure during field or lab work.

Rules and Regulations for Conducting Experiments

The American Association for Laboratory Animal Science (AALAS) recognizes that the appropriate and humane use of animals in elementary and secondary school classrooms can provide significant educational benefits to these students, including positive interactions between the students and animals that both enhance scientific learning and provide an avenue to promote a sense of responsibility and respect for all living things. The following are 10 principals and approaches to ensure the ethical and humane treatment of animals in the classroom during experiments.

- **Principal 1: Observational and natural history studies that are not intrusive (that is, do not interfere with an animal's health or well-being or cause it discomfort) are encouraged for all classes of organisms.** When an intrusive study of a living organism is deemed appropriate, consideration should be given first to using plants (including lower plants such as yeast and fungi) and invertebrates without or with primitive nervous systems, including protozoa, planaria, and insects. Intrusive studies of invertebrates with advanced nervous systems (e.g., octopi) and of vertebrates should be used only when lower invertebrates are not suitable, and only under the conditions stated in Principle 10.

- **Principle 2: Supervision shall be provided by individuals who are knowledgeable about and experienced with the health, husbandry, care, and handling of the animal species used and who understand applicable laws, regulations, and policies.** AALAS recommends that educators seek the advice of a veterinarian with demonstrable expertise in laboratory animal medicine before introducing animals in the classroom. The advisor should have formal training in laboratory animal medicine and preferably be a Diplomate of the American College of Laboratory Animal Medicine (ACLAM, http://www.aclam.org) or a member of the American Society of Laboratory Animal Practitioners (ASLAP, http://www. aslap.org). These professionals are often associated with biomedical institutions. They can provide sound advice on animal husbandry, veterinary care, and regulatory guidelines pertaining to animals in an academic environment.

- **Principle 3: Appropriate care for animals must be provided daily, including weekends, holidays, and other times when school is not in session.** This care must include nutritious food and clean, fresh water; clean housing with space and enrichment suitable for normal species behaviors; and temperature and lighting appropriate for the species.

- **Principle 4: Animals should be healthy and free of diseases that can be transmitted to humans or to other animals. Veterinary care must be provided as needed.** Specific information about commonly used species, such as amphibians, reptiles, mice, rats, hamsters, guinea pigs, and rabbits, can be found on the AALAS website. This information includes physiological data, housing, feeding, handling requirements, and diseases of the species. Links to other websites that may be useful to the teacher or student are also available. Regardless of the animal species used in the classroom, animal records should be maintained by the students

and overseen by the teacher. These records should include the animal's identification, the people responsible for the animals, and a log that describes the date and time of feeding, water changes, and cage cleaning. A brief description of the animal's general health should also be included. Initials of the person who records this information should accompany each entry. AALAS distributes a guideline called Establishing an Animal Care Committee that describes how to plan, care for, and use animals in the classroom. This document is available from the AALAS website.

- **Principle 5: Students and teachers should report immediately to the school health authority all scratches, bites, other injuries, allergies, or illnesses.** AALAS recommends that educators contact their administration and health care professionals prior to using animals in the classroom to discuss any relevant issues, such as possible student or staff allergies and diseases that can be transmitted from animals to humans and humans to animals. Recommended publications regarding these issues are "Laboratory Animal Allergy," Volume 42, number 1, 2001, from the Institute of Laboratory Animal Research, National Research Council, available at <http://dels.nas.edu/ ilar_n/ilarjournal/42_1>, and the Caring for Animals sheets "Animals in the Classroom: Allergy and Asthma Considerations" and "Signs of Common Diseases in Classroom Animals" available at <http://www.kids4research.org>.

- **Principle 6: Prior to obtaining animals for educational purposes, it is imperative that the school develop a plan for the procurement and ultimate disposition of the animals.** Animals must not be captured from or released into the wild without the approval of all appropriate wildlife and public health officials. When euthanasia is necessary, it should be performed in accordance with the most recent recommendations of the American Veterinary Medical Association (AVMA) Guidelines on Euthanasia, and only by someone trained in the appropriate technique. The AVMA Panel on Euthanasia report is available at <http://www.avma.org/issues/animal_welfare/euthanasia.pdf>. AALAS strongly recommends that euthanasia be performed with the counsel and advice of a veterinarian.

- **Principle 7: Students shall not conduct experimental procedures on animals that may cause pain, discomfort, or any disruption of an animal's health or well-being, including causing nutritional deficiencies or the buildup of toxins and exposure to microorganisms, ionizing radiation, cancer-producing agents, or any other harmful drugs or chemicals capable of causing disease, injury, or birth defects in humans or animals. In general, procedures that cause pain in humans are considered to cause pain in other vertebrates.** AALAS strongly encourages the use of animals in educational experimentation that does not cause them pain and distress, and that does not expose animals or students to harmful infectious, physical, or chemical agents. Suggested sources for information on detecting signs of pain and distress in laboratory animals are "Signs of Pain and Distress in Classroom Animals," available from <http://www.kids4research.org>, and the advice and guidance of a veterinarian.

- **Principle 8: Experiments on avian embryos that might result in abnormal chicks or in chicks that might experience pain or discomfort shall be terminated 72 hours prior to the expected date of hatching. The eggs shall be destroyed to prevent inadvertent hatching.**

- **Principle 9: Behavioral conditioning studies shall not involve aversive stimuli. In studies using positive reinforcement, animals should not be deprived of water; food deprivation intervals should be appropriate for the species but should not continue longer than 24 hours.**

- **Principle 10: A plan for conducting an experiment with living animals must be prepared in writing and approved prior to initiating the experiment or obtaining the animals.** Developing a proper experimental design that promotes animal welfare is an important scientific learning experience and contributes to establishing a responsible and respectful attitude towards animals. The plan shall be reviewed by a committee composed of individuals who have the knowledge to evaluate it and who have the authority to approve or disapprove it. The written plan should include the following components: a statement of the specific hypotheses or principles to be tested, illustrated, or taught; a summary of what is known about the subject under study, including references; a justification for the use of the species selected and consideration of why a lower vertebrate or invertebrate cannot be used; and, a detailed description of the methods and procedures to be used, including experimental design, data analysis, and all aspects of animal procurement, care, housing, use and disposal. AALAS recommends the following three references for information about the composition and function of an animal care and use committee:
    1. Guide for the Care and Use of Laboratory Animals, National Academy Press, Institute for Laboratory Animal Research at <http://dels.nas.edu/ilar_n/ilarhome/guide.shtml>
    2. The Institutional Animal Care and Use Committee Handbook, Office of Laboratory Animal Welfare, NIH, which can be found at <http://grants1.nih.gov/grants/olaw/GuideBook.pdf>
    3. "Establishing an Animal Care Committee (ACC)" and the complementary "Classroom Animal Care Plan" created by NJABR and the AALAS Foundation, available at <http://www.aalas.org>.

References

National Academy of Sciences. 2004. Principles and Guidelines for the Use of Animals in Precollege Education. <http://www.nabt.org/websites/institution/File/Principles%20and%20Guidelines%20for%20the%20Use%20of%20Animals%20in%20Precollege%20Education.pdf>

Regarding Microorganisms

Microorganisms can serve to enhance many biology lessons. There are many important points to take in to account when planning a lesson involving microorganisms to ensure student and teacher safety. A summary of these points is below. In many cases it may be helpful to provide students with a safety review and contract for lab behavior prior to conducting lessons with microorganisms.

- **Only culture microorganisms that are obtained from known sources**. The only microorganisms that should be used in the classroom are those that have been obtained from a known source such as a biological supply house or university laboratory. Organisms should be identified with their genus and species name. Students should never culture microorganisms from their own bodies, from surfaces around the building or any other locations/sites, as it is impossible to know whether or not these organisms are pathogenic.

- **Treat all microorganisms as potential pathogens**. All microorganisms, especially unknown cultures should be treated as if they are pathogens. The majority of microorganisms that will be used in the science laboratory are not pathogenic and have never been shown to cause disease in humans (James, 2008); but it is always possible for a microorganism to exhibit pathogenic properties. Students with compromised immune systems, or those who have recently been ill should consult with their teacher, the school nurse, or their physician before participating in any microbiology laboratory. When transferring bacterial colonies, lift the Petri dish cover at a 45o angle to avoid exposing the entire container to the air.

- **Personal Protective Equipment & Personal Hygiene**. Students should use gloves, chemical splash safety goggles, and aprons. Students should not wear open toed shoes (sandals or flip flops), long hair should be tied back, and hands should be kept away from the face at all times.

- **Wash your hands**. Hands should be washed before and after performing any experiment in the laboratory using disinfectant soap. Non-disinfectant soap can be used if it is the only soap available. Gloves can be worn for added protection. Wash hands with soap and water after removing gloves.
  - What is the right way to wash your hands?
    - Wet your hands with clean, running water (warm or cold) and apply soap.
    - Rub your hands together to make a lather and scrub them well; be sure to scrub the backs of your hands, between your fingers, and under your nails.
    - Continue rubbing your hands for at least 20 seconds. Need a timer? Hum the "Happy Birthday" song from beginning to end twice.
    - Rinse your hands well under running water.
    - Dry your hands using a clean towel or air dry them.

- **How to Remove Gloves Safely.** Teachers should demonstrate for students how to properly remove gloves. As you remove the gloves, avoid allowing the outside surface of the gloves to

come in contact with your skin, because the outer surface may have become contaminated. Avoid letting gloves snap, as this may cause contaminants to fly into your eyes or mouth or onto your skin or other people in the area. Remove used gloves before touching anything. Counter tops, faucets, pens and pencils are often contaminated because workers wearing gloves touch them.

- The following is one way to safely removing gloves.
  - With right hand, pinch palm of glove on left hand and pull left glove down and off fingers. Form left glove into a ball and hold in fist of right hand.
  - Insert one or two fingers of left ungloved hand under inside rim of right glove on palm side; push glove inside out and down onto fingers and over balled left glove.
  - Grasp gloves, which are now together and inside out, with left hand and remove from right hand.
  - Discard gloves in autoclave biohazard bag. Step 5. Wash hands thoroughly with soap and water.

- **Disinfect work areas before and after use**. Benches and work areas should be wiped down before and after working with bacteria. First apply a green cleaner to the surface. Then apply a solution of 70% ethanol or 10% bleach. A contact time of approximately 10 to 15 minutes should be effected (follow manufacturer's recommended application time). Alcohol should not be used around Bunsen burners, and paper towels that are used to wipe counters should not be disposed of with the regular trash to prevent the fumes from catching fire. Bleach, if spilled, will stain clothing. Both ethanol and bleach are dangerous to the eyes; students should know the location of the eye wash station before they begin the experiment. Note: 70% alcohol is the optimum concentration that should be used because higher concentrations evaporate too quickly and do not expose microbes to the alcohol for a long enough time to kill them.

- **Sterilize equipment**. All equipment that is used in the culturing of bacteria should be sterilized by autoclaving. If an autoclave is unavailable, use pre-sterilized products.

- **Never pipette by mouth**. Liquid cultures should be transferred using a pipette bulb or pipetting device.

- **Do not eat or drink in the laboratory or store food in a refrigerator where microorganisms are being stored**. Food and beverages should not be consumed in any laboratory environment. Cuts, broken skin or wounds on the hands should be covered by a bandage. Gloves can be worn for extra protection. Food or beverages for human consumption should never be stored in a refrigerator with bacterial cultures to prevent the possibility of cross contamination. Refrigerators must be labeled relative to allowable contents – e.g., Food for human consumption only; Lab biological/chemicals only!

- **Label everything clearly**. All cultures, media, chemicals and disinfectant should be clearly labeled with their names and the date. Hazardous substances should be labeled as such with their hazard information clearly marked.

- **Autoclave or disinfect all waste material**. All items to be discarded after class should be placed in an auto-claveable biohazard bag. Such materials include culture tubes, culture plates, swabs, toothpicks, plastic pipettes, and plastic gloves. The bag should be autoclaved at 121°C at 20 pounds of pressure for 30 to 40 minutes. If an autoclave is not available, cultures should be covered in bleach for 1-2 hours before being discarded.

- **Clean up spills with care**. Cover any broken or spilled culture tubes with 70% ethanol or 10% bleach and let sit for approximately 10 to 15 minutes. Clean up the spill with paper towels and throw all waste into the biohazard bag. Wash area with disinfectant. Clean up glass spills with a broom and dustpan. Keep in mind that we are responsible for the safety of everyone who may come in contact with materials that are being disposed of, including the custodial staff.
  - NOTE: Teachers should always do a run through of any experiment they plan to perform with their students. This will ensure that all needed equipment for running the lab and cleaning up are available. Teachers should make students and parents aware of potential health and safety hazards in working in the laboratory with bacteria using a Safety Acknowledgement Form. Students should be encouraged under strict confidentiality to let the teacher know their status so an alternative assignment can be made if appropriate.

- **Sterilization Techniques**: Beyond the measures mentioned above, the following are additional sterilization techniques that can be used:
  - Safer and successful microbiology lab activities require proper sterilization of materials before and after each activity. Sterilization is defined as the death of all living things, including spores, in or on an object. It is almost impossible to guarantee total sterility. For practical purposes in secondary education labs, sterilization can generally be achieved using dry heat, filtration, chemicals, or autoclaving.
  - Dry heat in a preheated laboratory oven at 160 °C for at least two hours may be used to sterilize glass and metal lab equipment. Inoculating loops and the mouths of culture or test tubes should be sterilized by heating in a Bunsen burner flame.
  - Microbiological membrane filters provide a useful way of cold-sterilizing materials such as enzyme or vitamin solutions, antibiotics, and cell culture media components that would be damaged by high temperatures or chemical treatment. The filters contain pores small enough to prevent passage of microbes but large enough to allow organism-free fluid to flow through. The sterile liquid is collected in a sterile container.
  - Materials that are potentially contaminated with microorganisms must be sterilized before disposal. Examples of microbiological waste include bacterial cultures and culture tubes, disposable loops, Petri dishes, biological culture media, and disposable gloves used when handling living materials. Biological culture media are specifically designed to promote the growth of microorganisms. These organisms will continue to grow even after disposal unless they are destroyed. There are two methods for sterilizing biological waste prior to disposal— autoclaving and chemical sterilization. Objects to be autoclaved should be placed into an autoclaveable biohazard bag (do not place any sharp objects into the bag,

however). The biohazard bag should be placed in an autoclave or pressure cooker if an autoclave is not available. Recommended sterilization conditions are 30 minutes at 121 °C and 15 psi pressure. The requirement for length of autoclaving and temperature increases at higher altitudes. Autoclaves and pressure cookers present hazards of high temperature and pressure—carefully follow manufacturers' directions and safety instructions.

- **Aseptic Technique**
  - Wear gloves and indirectly vented chemicals splash goggles while working with the cultures. It is important to sterilize metal inoculating loops between "dips" to control cross-contamination, even when working with the same bacterial strain. Bacteria from the air may contaminate stock cultures. After opening a culture, briefly sweep the mouth of the tube through a burner flame 2–3 times. This creates airflow outward from the tube, preventing contamination. Place the inoculating loop in the flame until it glows red and then allow it to cool. After finishing work with bacterial cultures, label the tubes, sterilize the work area with 10% bleach solution, and wash hands thoroughly with soap and water. Remember to sterilize any areas that may have been touched with your glove. Further information on aseptic technique can be found from the following resources: Recombinant DNA and Biotechnology (Kreuzer & Massey); American Association for Microbiology, 1996; and DNA Science (Micklos & Freyer); Cold Spring Harbor Press, 2003.

Listed below are bacteria considered safer for advanced high school level science laboratory course activities following appropriate legal safety standards and professional best practices (American Society for Microbiology). Culturing and use of live bacteria is not recommended and should not be done at the elementary/middle schools and introductory level high school science courses.

BACTERIA: Acetobacter aceti (vinegar), Bacillus cereus (cocoa, tofu), Bac. licheniformis (cocoa), Bac. megaterium (cocoa), Bac. pumilus (cocoa), Bac. subtilis (cocoa, rice natto), Erwinia dissolvens (coffee), Lactobacillus acidophilus (acidophilus milk; yogurt), Lact. bulgaricus (yogurt), Lact. casei (many cheeses), Lact. delbrückii (pickles, soy sauce), Lact. helveticus (many cheeses), Lact. lactis (most cheeses), Leuconostoc (many cheeses), Leucon. mesenteroides (pickles; sauerkraut), Pediococcus (sauerkraut, ensilages, pickles), Propionibacterium acidipropionici (Emmenthaler cheese), Prop. freundenreichii (Swiss cheese), Prop. jensenii (buttermilk), Prop. shermanii (Emmental and Swiss cheeses), Prop. technicum (Edam cheese), Prop. thoenii (Emmenthaler cheese), Streptococcus cremoris (many cheeses), Strep. diacetilactis (sour cream, and butter products), Strep. faecalis (pickles), Strep. lactis (many cheeses, sour milk), Strep. thermophilus (yogurt and many cheeses).

BACTERIA AND ASSOCIATED NATURAL PLASMIDS AND LYSOGENIZED NATURAL PHAGES: Aerococcus, Agrobacterium radiobacter, Alcaligenes eutrophus (degrades 2,4D), Alcal. faecalis, Alcal. viscolactis, Alicyclobacillus acidocaldarius, Ali. acidoterrestris, Ali. cycloheptanicus, Aquaspirillum itersonii, Aquaspirillum polymorphum, Aquaspirillum serpens, Aquaspirillum sinuosum, Arthobacter globiformis, Azotobacter

chrooccum, Az. vinelandii, Bacillus apiarius (bee symbiont), Bac. azotofixans (N-cycle), Bac. brevis, Bac. circulans (rumen), Bac. coagulans, Bac. laterosporus (rumen), Bac. macerans (rumen), Bac. marinus, Bac. pasteurii, Bac. polymyxa (N-cycle), Bac. pulvifaciens (insect symbiont), Bac. schlegelii, Bac. sphaericus (mosquito control), Bac. stearothermophilus, Bac. thiaminolyticus (insect symbiont), Bac. thuringiensis, Bac. tusciae, Beggiatoa (S-cycle), Brevibacterium linens, Butyrivibrio (rumen), Caulobacter, Cellumonas, Corynebacterium pseudo-diphtheriticum, C. xerosis, Epulopiscium spp., Escherichia coli (only classic strains of K-12, 1776, B and C, and with their indiginous plasmids and phages), Kurtha zopfi, Lucibacterium spp., Metabacterium polyspora, Micrococcus luteus, Micro. roseus, Neisseria flava, Neis. sicca, Photobacterium, Pseudomonas fragi, Rhizobium, Rhodococcus rhodochrous, Rhodospirillum rubrum, Ruminococcus (rumen), Sarcina aurantiaca, Sarc. flava, Sarc. lutea, Selenomonas (rumen), Serratia liquefaciens, Spirillum serpens, Spir. volutans, Sporosarcina ureae, Staphylococcus epidermidis, Staph. saprophyticus, M. mutans, M. salivarius, M. stereothermophilus, Streptomyces albus, Strep. antibioticus, Strep. venezuelae, Succinomonas (rumen), Sulfolobus (S-cycle), Thermoplasma, Thiobacillus thioparus, Vibrio anguillarum, Vib. fischeri, and Zymomonas

References

James, D. (2008). Nine safe practices for the microbiology laboratory. Carolina Biological Supply, Burlington, NC.

Ewald, H., Brashears, J., Huynh, C., Freeman, E., Corvini, M., Davis, M., Femenia, E., Hart, B.,and Vermeulen, C. (1997). Micro-Organisms for Education. Presented at the general meeting of the American Society for Microbiology, Miami, FL.

Science Department Safety Notes – Microbiology Safety. (2011). Flinn Scientific, Inc. Putting It On, Taking It Off - www.ab.ust.hk/hseo/sftywise/200303/page3.htm

Center for Disease Control & Prevention – Handwashing: Clean hands Save Lives: <http://www.cdc.gov/handwashing/>

On Dissection

Classroom dissection of nonhuman vertebrate animals is a useful adjunct to the biology curriculum if done with well-defined educational objectives appropriate for the grade level and maturity of the students.The animal used should represent the lowest phylogenic species that will satisfy educational objectives.

Prior to the dissection instructor will go over safety procedure with students and distribute contracts to be taken home to parents to alert them that students are completing a dissection in the class. The policy for handling and disposal of dissection materials is no different than that required for any other biological or chemical material. Common sense, knowledge of the material, and a familiarity with local disposal regulations and procedures must prevail. Careful and clearly written directions are critical for safe and meaningful dissection work. Professionally illustrated dissection guides add an important degree of authenticity to classroom dissection work. Many software programs are available to prepare students to carry out dissection activities. However, nothing can replace the actual experience of dissection.

The dissection activity must be well supervised to ensure that:

- Students maximize the value of the animals being used.
- The animal specimen is treated respectfully.
- The procedure is done safely and students practice care while handling dissection utensils.

Alternatives to animal dissection should be used whenever they would adequately serve as substitutes. Students' views on dissection should be openly discussed and respected, with non-dissection alternatives made available when feasible and the student allowed to opt out of the dissection if no alternative is possible.

Guidelines for Dissection

- Be sensitive to any students who may be put under physical stress when using preserved materials.
- Monitor students for any signs of illness during dissection.
- Wear chemical splash goggles and chemical-resistant gloves and apron.
- Properly mount dissection specimens to the dissecting pan or tray. Do not dissect a specimen while holding it.
- Handle scalpels, razor blades, and other sharp instruments with care.
- Cut away from the body and away from other students.
- Do not use excessive force when working with sharp instruments. Use scissors instead of scalpels wherever possible.
- Students should be cautioned to never ingest specimen parts.
- Students should not be allowed to remove specimens or specimen parts from the classroom.
- All dissection parts should remain within the dissecting pan.
- Properly dispose of dissected materials.
- Store specimens in accordance with directions and chemical storage safety rules.

Scalpel Safety Reminders:

- Hold a scalpel as you would a pencil.
- Cut with a downward motion but never push down very hard to make a cut. (If extreme pressure is required, you have a dull scalpel or require a different instrument.)
- Watch the placement of your specimen-holding hand. Do not cut toward your holding hand.
- Scalpels are not appropriate for bone or cartilage tissue work.

Equipment Considerations:

Protective gloves, chemical-resistant aprons, and protective eyewear are dissection necessities. Quality dissection tools that are sharp and free of rust should be provided. Routine procedures for inspecting dissection tools should be instituted. (Dull and dirty scissors, scalpels, or blades are much more dangerous than sharp, clean ones!) Student laboratory directions should include the proper techniques for using specific dissection instruments, as well as how to dispose of sharps. Appropriate dissection pans and table protection should be provided at each workstation. Commonsense rules relative to jewelry, nails, hair length, etc. should be reviewed in terms of student personal safety during dissection work.

Preservatives and Ventilation:

Preserved materials are often fixed in formaldehyde or other toxic chemicals. After the fixing process, the excess fixative is removed and replaced with safer preservatives. A certain degree of preservative odor is likely to linger, and thus good ventilation of the work area (classroom) is critical. Good ventilation will provide fresh air and will not "announce" to the entire school that it is dissection time. Rinsing procedures are often specified for specimens. Follow any such directions carefully, especially if the preserved materials will be used over an extended period of time. With the extremely low levels of preservative in most specimens, odors are minimal but the expected shelf life of a preserved specimen is also shortened.

Cleanup and Disposal of Preserved Materials:

Proper cleanup and disposal of dissected materials is critical. Be sure to read the Flinn Scientific "Biological Waste Disposal" instructions in the *Flinn Scientific Catalog/ Reference Manual* and note especially the section on the disposal of Type III Biological Materials. Local conditions (septic systems, sewers, etc.) and local regulations may influence the proper disposal procedures of your biological materials. It is critical to know your local regulations and guide- lines for such materials. Plenty of soap and water should be provided after all dissection work and adequate time should be provided for the proper cleanup of materials and students.

References

Flinn Scientific, Inc. 2010. Dissection Safety Tips. <http://www.flinnsci.com/media/396301/dissectionsafety.pdf>.

National Academy of Sciences. 2004. Principles and Guidelines for the Use of Animals in Precollege Education. <http://www.nabt.org/websites/institution/File/Principles%20and%20Guidelines%20for%20the%20Use%20of%20Animals%20in%20Precollege%20Education.pdf>

Regarding Protected and Endangered Species

All wildlife species, including reptiles and amphibians are regulated in Indiana by the Indiana Department of Natural Resources (DNR) through rules in the Administrative Code.

For a complete list of regulations, visit <www.IN.gov/legislative/iac/title312.html> and look for Article 9, Rule 5.

Summary of regulations regarding the collection of protected and endangered species in Indiana

- Collection of endangered species, box turtles, and eggs of reptiles and amphibians is prohibited.
- For all nongame species where collection is allowed, there is a daily bag limit of two and a possession limit of four for each species.
- The common snapping turtle, smooth soft-shell turtle, spiny soft-shell turtle, bullfrog and green frog are regulated as game animals with specified methods of take, bag limit and seasons. Game turtles may be taken anytime. Game frogs may be taken anytime except between April 30 and June 15.
- Releasing of any reptile or amphibian collected from Indiana unless it has been held for less than 30 days, has not been housed with other animals, and is released at the original site of capture is prohibited.
- Teachers may collect up to four of any non-endangered species of tadpole with a fishing and hunting license. However you cannot release them back into the wild. You should be prepared to permanently take care of anything you collect.

The Role of Parks and Reserves

Parks and reserves can serve as spaces where students can see and interact with a variety of organisms which they do not normally have the opportunity observe. Students need to be informed of the respectful practices and approaches for interacting with the natural world in parks or reserve areas.

A visit to an informal science center is most effective when advanced preparation is thorough. Planning for field work, site visits, or other outdoor experiences teachers must take time to remember the 4 P's: Prepare, Plan, Prevent and Protect (Texley et al., 161). Teachers need to consider a diversity of student needs in all lab and field experience. From restroom needs, to special considerations for students with IEP's, teachers must accommodate all students in learning environments outside of the classroom.

Prior to planning a visit, the instructor should always preview the site and consider any hazards. Then the teacher can complete their plans including safety preparations, chaperone training, permission slip modification, clothing and gear requirement, and schedules of work, travel and site cleanup (Texley et al., 119). A detailed permission slip should be provided to each student and their guardian and a signature from both should be required to attend the field experience.

Instructors should also have the appropriate documentation to be at their site and to do what they plan to do while they are there. This may require getting the necessary permits if there are plans to remove wild animals or plants from the space. Under no circumstances, should teachers or students remove endangered species from a site (Texley et al., 123).

The best visits are achieved when the focus is narrow and well-connected to classroom work. By having an organized activity for students to complete while they are engaged with a field site ensures there will be fewer chances for students to get into hazardous situations. If used effectively and with planning, parks and reserves can be places where students have many meaningful learning experiences outside of the more traditional classroom structure.

When planning outdoor learning experiences reference:

Texley, J., T. Kwan, and J. Summers. (2004) Investigating Safety a Guide For High School Teachers. NSTA Press. Arlington, VA.