

# How to Reduce the Level of Formaldehyde in the Zoology Lab

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## Introduction

Chemicals used to fix specimens that are purchased for dissection are notorious for the dangers they pose to human health. Formalin and phenol are toxic, irritating constituents of most fixatives and embalming solutions. However, these chemicals continue to be used because of the superior results they yield. Commercial suppliers of biological specimens have recognized the hazards involved when students dissect fixed material. They have attempted to reduce the concentration of formaldehyde vapors by storing and shipping their products in a variety of less toxic holding or preservative fluids. As soon as the specimens arrive in the lab and students start their dissections, problems may still arise.

Dissections that are carried out over a period of months lead to conditions that promote desiccation and degeneration of the specimens. Sharks and cats often become moldy and must be replaced. Therefore, there is a need for a storage fluid that will retard the growth of mold and preserve the quality of the specimen, but not add to the hazards in the lab. Unfortunately, most storage/wetting fluids are diluted embalming fluids; they contain formalin and phenol. These hazardous components that the suppliers try to decrease are thus introduced directly into the student lab at concentrations that may be above acceptable levels.

The problem of students working with important but potentially harmful materials is not a new one. Similar situations exist in the dissection labs of medical schools and other student labs where many hours are spent dissecting fixed material (Wineski and English, 1989). Steps to improve conditions in the anatomy lab have been given recent impetus as a result of our concern about quality of the work/study environment (Rosenberg, 1992). The steps outlined in the present paper are followed in the student laboratory of the comparative vertebrate morphology course at the University of Calgary.

## Holding Fluid

The attempt by commercial suppliers to reduce the concentration of formaldehyde vapors involves the use of a non-toxic holding/shipping fluid that is not identified. Other attempts to decrease hazards involve the use of freeze-dried preparations. However, this report will not evaluate such preparations.

It is our experience that careful use of a 2% aqueous solution of 2-phenoxyethanol for holding specimens during a one semester course results in a marked improvement in work

conditions in the dissection lab. Furthermore, this solution maintains the quality of the specimens at a high level.

Phenoxyethanol has a potentially confusing array of generic and commercial names. It may be listed as 2-phenoxyethanol or ethylene glycol (mono)phenyl ether or 1-hydroxy-2-phenoxyethane or phenyl cellosolve. It is available from Eastman Kodak Co. or Dow Chemical Co. (Dowanol EPh<sup>®</sup> or glycol ether EPh). It is possible to purchase 20 liter containers of concentrated 2-phenoxyethanol, although it normally is supplied in 45 gallon drums. The *concentrate* must be handled with care in well ventilated areas, with the use of lab gloves, lab coat, and tight fitting goggles according to the supplier's suggestions. A 2% working solution is made with hot tap water and adequate stirring; it has proven to be non-irritating to students.

Safety sheets supplied with 2-phenoxyethanol indicate that it is a relatively safe, non-toxic liquid with a mild odor. It contains both aromatic and aliphatic components that give it a high boiling point, high organic solubility and low aqueous solubility. The value of using a phenoxyethanol holding solution lies in its ability to prevent fungal growth and to keep tissues pliable. It plays little role in extracting formalin from fixed specimens (Rumph and Williams, 1988).

### **Neutralizing Formaldehyde**

Formaldehyde contained in the specimens must be neutralized by the students as they do their dissections. The most effective method is to spray the specimen with a diluted (20% aqueous) solution of Infutrace<sup>™</sup>. This product is produced by the S & S Company of Georgia, Inc. [827 Pine Avenue, Albany, Georgia 31701; phone (912) 435-8394]. If there is a particularly strong odor of formaldehyde, it may be necessary to submerge the entire specimen in 10% Infutrace<sup>™</sup> and resort to the spray as needed.

### **Preservation of Sharks in the Teaching Lab**

Sharks are best preserved by total submergence in 2% phenoxyethanol. Two types of containers may be used to hold the solution and the specimens. Clean 45 gallon drums (new or recycled) are fitted with heavy duty (6 ml) plastic garbage bags (36"x65") that serve as liners. These are held in place by stainless steel bolts that also serve as binding posts to which the sharks are anchored. The bolts are held securely by rubber washers and lock nuts. The preferred type of container is a clean, hard plastic drum (new or recycled) that does not require a liner but does have the binding posts. Each container can be mounted on a small dolly constructed of plywood and casters for ease of movement. In addition, containers must have tightly fitting lids to decrease evaporation.

Newly arrived sharks should be thoroughly rinsed in cold, running water by students who are required to use gloves, lab coats, and goggles. Shipping bags should also be rinsed and then discarded. Spines on the dorsal surface of the shark are clipped off close to their base by instructors wielding bone shears (or an equivalent tool) as the students study the external features of their specimen. Students should spray their specimens with Infutrace<sup>™</sup> as required. This will certainly be necessary once the celomic cavity of the shark is opened.

A retrieval line of cotton twine having a numbered aluminum disk is secured to the shark's body. This is done by punching a hole through the shark's body with an awl and drawing the twine through with a hemostat. The numbered end of the line is formed into a loop that is placed over the binding post of the barrel for easy retrieval of the specimen. Each barrel holds 20-25 sharks. Students and teaching assistants must be encouraged to make sure that sharks are submerged below the surface of the phenoxyethanol solution and that the barrels are tightly closed.

Not a single shark had to be replaced because of mold after the proposed method of storage was initiated. In previous years, when sharks were wrapped in cheesecloth moistened with dilute embalming fluid and stored in plastic bags, 25% of the specimens had to be replaced and the remainder were in a less than desirable state.

### **Preservation of Cats in the Teaching Lab**

Rinse preserved cats in cold, running water and study external anatomy. Students should skin their cats, discard the skin, and spray their specimens with Infutrace™ before starting dissection. The shipping bag should be rinsed and discarded. Cats should be wrapped in old cotton towels soaked with 2% phenoxyethanol and stored in new, closed plastic bags. The towels are held in place by several rubber bands. The quality of most dissected cats was maintained at a high level for the duration of a one semester course. The few cats that become moldy should be treated with household bleach (50% aqueous solution) and soaked in a bath consisting of 25 parts methanol and 75 parts of 2% phenoxyethanol.

### **Related Procedures and Lab Modifications**

The following practices and alteration of the dissection lab helped improve the work environment:

1. Work closely with your campus safety officers. Have them check the concentration of formaldehyde (while classroom conditions prevail) before and after your modifications. Have them compare their results with existing exposure limits and react accordingly.
2. Require all students, graduate teaching assistants, and instructors to wear gloves, lab coats, and goggles during dissections. Students should not wear contact lenses but should change to their glasses while dissecting.
3. All tissues that students remove during dissection and remaining carcasses should be kept in closed containers prior to disposal.
4. Storage cabinets used for cats should be vented to an exhaust system. Barrels used for sharks must be kept in a well ventilated area; eg. install hood vents over the barrels.
5. Install louvered, exhaust fans in windows to improve ventilation of the dissection lab. Ideally the lab should be under slight negative pressure to enhance the flow of fresh air into the lab. This will lower the concentration of toxic vapors, decrease the diffusion of vapors into adjacent hallways, and generally improve work conditions.

### **Conclusions**

We are obligated to provide students and staff with safe work conditions. The use of a formaldehyde neutralizing spray each time students work on their specimens, disposal of the cat's skin, and use of 2% phenoxyethanol results in greatly improved air quality in the dissection

laboratory. The improved work conditions will allow students to concentrate on their dissections and the fascinating anatomical configurations that form the core of any course in comparative vertebrate anatomy. We cannot remove hazardous substances from the dissection lab entirely, but we can reduce them sufficiently to lessen the risks to health.

### Literature Cited

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**Reprinted From:** Rosenberg, H. and W. Fitch. 1998. How to reduce the level of formaldehyde in the zoology lab. Page 357-360, *in* Tested studies for laboratory teaching, Volume 19 (S. J. Karcher, Editor). Proceedings of the 19<sup>th</sup> Workshop/Conference of the Association for Biology Laboratory Education (ABLE), 365 pages.

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