ENVR 1301 - 001 INTRODUCTION TO ENVIRONMENTAL SCIENCE
Spring 2017, 01/19/2017 - 05/013/2017

*Approximately 15 weeks – 3 credit course

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Office Hours: TBD
Section Information: ENVR 1301-001
Texas Common Core Number: ENVR 1301 Environmental Science I (lecture)
Time and Place of Class Meetings: TBD

Description of Course Content: This course provides an introduction to the basic principles of environmental science. Environmental science, as a discipline, along with key chemical, physical, geological and biological science aspects and relevant societal issues will be examined.

Course Purpose Statement: This course satisfies the UT Arlington core curriculum requirement in life and physical science.

Student Learning Outcomes: The purpose of this course is to provide an introduction to environmental science. The students will develop an understanding for the global issues that are currently facing the environment. Students will become familiar with the functioning of earth’s system and how they are affected by anthropogenic activities. Students will use critical thinking to analyze problems and find solutions to environmental problems. Learning outcomes will be measured by exams and lab exercises.

Core Objectives (see below) will be assessed in a signature assignment.

Core Objectives: A signature assignment involving toxicity testing by exposing brine shrimp (Artemia salina) to several potentially toxic substances will address specific core objectives to be met be the assignment. These core objectives are: (i) critical thinking skills, (ii) communication, (iii) empirical and quantitative skills, and (iv) teamwork.

Signature Assignment (and core objectives): The purpose of the signature assignment is to determine the LD₅₀ (concentration at which 50% of the test animals (here brine shrimp) die) for several kinds of common household materials. Upon completion of the assignment the student will be able to measure the effect of various toxic materials on brine shrimp, and determine the LD₅₀ for a variety of toxic materials. The students will prepare a stock solution for each toxic substance (e.g., copper sulfate solution (CuO₄), peroxide, bleach, vinegar, coffee, nicotine) and serially dilute the solution so that the brine shrimp can be administered various doses and well as a blank control (advancing critical thinking skills). For each level of dose a petri dish containing brine shrimp and the toxic material is examined at 24 hours and again at 48 hours and in each case a record is made of the number of brine shrimp that have died (coordinating these activities promoting communication among students). Data collected on the percentage of brine shrimp deaths at each dose are graphed and LD₅₀ values are determined (developing empirical and quantitative skills). As a communal assignment, project phases of (a) experimentation, (b) data collection, synthesis and analysis, (c) group presentation and report writing require team building (teamwork).

**Descriptions of major assignments and examinations:** There will be 5 exams during the course (as marked on the syllabus), the results from the four exams with the highest grades will be used to calculate 75% of the student’s final grade. In addition, 25% of the final grade will be determined from efforts in the Labs.

**Attendance:** As the instructor of this section I allow students to attend class at their own discretion. However, I have established following attendance policy: attendance will be taken and if a student attends all lectures they will be eligible for a half letter grade extra credit.

**Other Requirements:** Lab attendance is expected. Please remember 25% of the final grade comes from your efforts in the lab class.

**Grading:** A final letter grade will be assigned to each student in the following manner based on the cumulative percentage score from the class exams plus the score from the Lab exercises. A Grade => 90%, B Grade 80-89%, C Grade 70-79%, D Grade 60-69%, F grade <60%. Students are expected to keep track of their performance throughout the semester and seek guidance from available sources (including the instructor) if their performance drops below satisfactory levels.

**Expectations for Out-of-Class Study:** Beyond the time required to attend each class meeting, students enrolled in this course (which is highly condensed) should expect to spend at least an additional twelve hours per week of their own time in course related activities, including reading required materials, completing assignments, preparing for exams, and preparing for lab.

**Make-up Exams:** These are discouraged unless the need is critical.

**Grade Grievances:** Any appeal of a grade in this course must follow the procedures and deadlines for grade-related grievances as published in the current undergraduate catalog. See: [http://wweb.uta.edu/catalog/content/general/academic_regulations.aspx#10](http://wweb.uta.edu/catalog/content/general/academic_regulations.aspx#10);

**Drop Policy:** Students may drop or swap (adding and dropping a class concurrently) classes through self-service in MyMav from the beginning of the registration period through the late registration period. After the late registration period, students must see their academic advisor to drop a class or withdraw. Undeclared students must see an advisor in the University Advising Center. Drops can continue through a point two-thirds of the way through the term or session. It is the student’s responsibility to officially withdraw if they do not plan to attend after registering. Students will not be automatically dropped for non-attendance. Repayment of certain types of financial aid administered through the University may be required as the result of dropping classes or withdrawing. For more information, contact the Office of Financial Aid and Scholarships ([http://wweb.uta.edu/ses/fao](http://wweb.uta.edu/ses/fao)).

**Americans with Disabilities Act:** The University of Texas at Arlington is on record as being committed to both the spirit and letter of all federal equal opportunity legislation, including the Americans with Disabilities Act (ADA), The Americans with Disabilities Amendments Act (ADAAA), and Section 504 of the Rehabilitation Act. All instructors at UT Arlington are required by law to provide "reasonable accommodations" to students with disabilities, so as not to discriminate on the basis of that disability. Any student requiring an accommodation for this course must provide the instructor with official
documentation in the form of a letter certified by the staff in the Office for Students with Disabilities, University Hall 102. Only those students who have officially documented a need for an accommodation will have their request honored. Students experiencing a range of conditions (Physical, Learning, Chronic Health, Mental Health, and Sensory) that may cause diminished academic performance or other barriers to learning may seek services and/or accommodations by contacting: The Office for Students with Disabilities, (OSD) www.uta.edu/disability Information regarding diagnostic criteria and policies for obtaining disability-based academic accommodations can be found at www.uta.edu/disability or by calling the Office for Students with Disabilities at (817) 272-3364.

Counseling and Psychological Services, (CAPS): www.uta.edu/caps/ or calling 817-272-3671 is also available to all students to help increase their understanding of personal issues, address mental and behavioral health problems and make positive changes in their lives.

Non-Discrimination Policy: The University of Texas at Arlington does not discriminate on the basis of race, color, national origin, religion, age, gender, sexual orientation, disabilities, genetic information, and/or veteran status in its educational programs or activities it operates. For more information, visit uta.edu/eos.

Title IX Policy: The University of Texas at Arlington (“University”) is committed to maintaining a learning and working environment that is free from discrimination based on sex in accordance with Title IX of the Higher Education Amendments of 1972 (Title IX), which prohibits discrimination on the basis of sex in educational programs or activities; Title VII of the Civil Rights Act of 1964 (Title VII), which prohibits sex discrimination in employment; and the Campus Sexual Violence Elimination Act (SaVE Act). Sexual misconduct is a form of sex discrimination and will not be tolerated. For information regarding Title IX, visit www.uta.edu/titleIX or contact Ms. Jean Hood, Vice President and Title IX Coordinator at (817) 272-7091 or jmhood@uta.edu.

Academic Integrity: All students enrolled in this course are expected to adhere to the UT Arlington Honor Code:
I pledge, on my honor, to uphold UT Arlington’s tradition of academic integrity, a tradition that values hard work and honest effort in the pursuit of academic excellence. I promise that I will submit only work that I personally create or contribute to group collaborations, and I will appropriately reference any work from other sources. I will follow the highest standards of integrity and uphold the spirit of the Honor Code.

Instructors may employ the Honor Code as they see fit in their courses, including (but not limited to) having students acknowledge the honor code as part of an examination or requiring students to incorporate the honor code into any work submitted. Per UT System Regents’ Rule 50101, §2.2, suspected violations of university’s standards for academic integrity (including the Honor Code) will be referred to the Office of Student Conduct. Violators will be disciplined in accordance with University policy, which may result in the student’s suspension or expulsion from the University.

Lab Safety Training: Students registered for this course must complete all required lab safety training prior to entering the lab and undertaking any activities. Once completed, Lab Safety Training is valid for the remainder of the same academic year (i.e., through the following August) and must be completed anew in subsequent years. There are no exceptions to this University policy. Failure to complete the required training will preclude participation in any lab activities, including those for which a grade is assigned.
**Electronic Communication:** UT Arlington has adopted MavMail as its official means to communicate with students about important deadlines and events, as well as to transact university-related business regarding financial aid, tuition, grades, graduation, etc. All students are assigned a MavMail account and are responsible for checking the inbox regularly. There is no additional charge to students for using this account, which remains active even after graduation. Information about activating and using MavMail is available at [http://www.uta.edu/oit/cs/email/mavmail.php](http://www.uta.edu/oit/cs/email/mavmail.php).

**Campus Carry:** Effective August 1, 2016, the Campus Carry law (Senate Bill 11) allows those licensed individuals to carry a concealed handgun in buildings on public university campuses, except in locations the University establishes as prohibited. Under the new law, openly carrying handguns is not allowed on college campuses. For more information, visit [http://www.uta.edu/news/info/campus-carry/](http://www.uta.edu/news/info/campus-carry/).

**Student Feedback Survey:** At the end of each term, students enrolled in classes categorized as lecture, seminar, or laboratory shall be directed to complete a Student Feedback Survey (SFS). Instructions on how to access the SFS for this course will be sent directly to each student through MavMail approximately 10 days before the end of the term. Each student’s feedback enters the SFS database anonymously and is aggregated with that of other students enrolled in the course. UT Arlington’s effort to solicit, gather, tabulate, and publish student feedback is required by state law; students are strongly urged to participate. For more information, visit [http://www.uta.edu/sfs](http://www.uta.edu/sfs).

**Final Review Week:** A period of five class days prior to the first day of final examinations in the long sessions shall be designated as Final Review Week. The purpose of this week is to allow students sufficient time to prepare for final examinations. During this week, there shall be no scheduled activities such as required field trips or performances; and no instructor shall assign any themes, research problems or exercises of similar scope that have a completion date during or following this week unless specified in the class syllabus. During Final Review Week, an instructor shall not give any examinations constituting 10% or more of the final grade, except makeup tests and laboratory examinations. In addition, no instructor shall give any portion of the final examination during Final Review Week. During this week, classes are held as scheduled. In addition, instructors are not required to limit content to topics that have been previously covered; they may introduce new concepts as appropriate. Emergency Exit Procedures: Should we experience an emergency event that requires us to vacate the building, students should exit the room and move toward the nearest exit. There are three immediate exits. One is located in the lecture hall itself. The other two are immediately to the left and right of the lecture hall main entrance. When exiting the building during an emergency, one should never take an elevator but should use the stairwells. Faculty members and instructional staff will assist students in selecting the safest route for evacuation and will make arrangements to assist individuals with disabilities.

**Student Support Services:** UT Arlington provides a variety of resources and programs designed to help students develop academic skills, deal with personal situations, and better understand concepts and information related to their courses. Resources include tutoring, major-based learning centers developmental education, advising and mentoring, personal counseling, and federally funded programs. For individualized referrals, students may visit the reception desk at University College (Ransom Hall), call the Maverick Resource Hotline at 817-272-6107, send a message to resources@uta.edu, or view the information at [http://www.uta.edu/universitycollege/resources/index.php](http://www.uta.edu/universitycollege/resources/index.php).
The IDEAS Center (2nd Floor of Central Library) offers free tutoring to all students with a focus on transfer students, sophomores, veterans and others undergoing a transition to UT Arlington. To schedule an appointment with a peer tutor or mentor email IDEAS@uta.edu or call (817) 272-6593.

The English Writing Center (411LIBR): The Writing Center Offers free tutoring in 20-, 40-, or 60-minute face-to-face and online sessions to all UTA students on any phase of their UTA coursework. Our hours are 9 am to 8 pm Mon.-Thurs., 9 am-3 pm Fri. and Noon-6 pm Sat. and Sun. Register and make appointments online at http://uta.mywconline.com. Classroom Visits, workshops, and specialized services for graduate students are also available. Please see www.uta.edu/owl for detailed information on all our programs and services.

The Library’s 2nd floor Academic Plaza offers students a central hub of support services, including IDEAS Center, University Advising Services, Transfer UTA and various college/school advising hours. Services are available during the library’s hours of operation. http://library.uta.edu/academic-plaza
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Lab Summaries

LAB 2
GLOBAL INDICATORS OF CLIMATE CHANGE

Purpose & Objectives
This exercise will utilize data sets from the Environmental Protection Agency (EPA), National Aeronautics and Space Administration (NASA), and National Oceanic Atmospheric Administration (NOAA) to examine global indicators of climate change. After completing this exercise, students will be able to:

1. Identify the major greenhouse gases and explain how they contribute to global climate change.
2. Analyze graphical representation of changes to global surface temperature, sea level, and land and sea ice concentrations and draw conclusions about trends.
3. Evaluate changes in their personal habits that could reduce greenhouse gas emissions.

LAB 3
SOIL CHARACTERISTICS AND PLANT GROWTH

Purpose & Objectives
In this exercise we will look at how the size of soil particles and the availability of nutrients affect the growth of plants. After completing this exercise the student will be able to:

1. Determine the water-holding capacity of different kinds of soils.
2. Observe differences in the growth of radish plant roots in different kinds of soil.
3. Measure biomass production of radish plants following two weeks of growth in different soils.
4. Determine the effects of fertilizer on the growth of the radish plants.

LAB 4
HABITAT AND NICHE

Purpose & Objectives
The purpose of this exercise is to develop an understanding of two important ideas in ecology: habitat and niche. The instructor will select three habitats that vary significantly from one another and select five plant species that you will count in each of the three habitats. This will allow you to explore the concepts of habitat and niche by comparing the numbers of each plant species found in each of the habitats. After completing this exercise, the student will be able to:

1. Relate abiotic characteristics in a habitat to the kinds of plants found in the habitat.
2. Describe how species with a broad niche differ from those that have a narrow niche and provide examples from the species studied in the exercise.
3. Describe the concept of niche overlap and provide examples of niche overlap from the species studied in the exercise.
4. Identify biotic and abiotic environmental factors that may restrict the distribution of a species.

LAB 5
COMMUNITY STRUCTURE

Purpose & Objective
In this exercise we will use a quadrant method to analyze the structure of a plant community by identifying specific plant species and determining how common each species is in the study area. After completing this exercise the student will be able to:

1. Use the quadrant method for studying communities
2. Determine the density and relative density if each species in the community.
3. Determine the frequency and relative frequency of each species in the community.
4. Determine which species of plants are dominant in a community.
5. Determine if plants have a clumped, random, or uniform distribution.

LAB 6 & 7
AIR POLLUTION

Purpose & Objectives
In this exercise the students will quantify the various levels of ultra-fine particulate matter (UFPM) in the air at different urban locations. Student will also record ambient levels of UVPM for a fixed period of time, and record the locations at which the measurements were made. After completing this exercise, students will be able to:
1. Measure time-resolved concentrations of UVPM at high-traffic, low-traffic, indoor, and other source locations.
2. Examine the UVPM count data and relate the measurements to possible inhalation health concerns.
3. Assess the potential for control measures to reduce human exposures.

LAB 8, 9 & 10
TOXICITY TESTING (LD50) (this is the signature assignment, details set out below)

Purpose & Objectives
The purpose of this exercise is to determine the LD50 (concentration at which 50% of the test animals die) for several kinds of common household materials.

After completing this exercise the student will be able to:
1. Measure the effect of various toxic materials on brine shrimp (Artemia salina).
2. Determine the LD50 (Lethal Dose 50%) for a variety of toxic materials.

LAB 11
ESTIMATING POPULATION SIZE

Purpose & Objectives
This exercise explores a common method used by biologist to estimate population size. After completing this exercise the student will be able to:
1. Estimate the size of a population using the mark-recapture technique.
2. State factors that limit the accuracy of the mark-recapture technique.
3. State why estimates of populations may be necessary.

LAB 12
HISTORICAL CHANGES IN HUMAN POPULATION CHARACTERISTICS

Purpose & Objectives
It is possible to study changes in many human population characteristics by gathering information from cemetery records and obituaries, since cemetery records provide information about the past while obituaries provide information about current times. After completing this exercise, the student will be able to:
1. Describe changes in human mortality and survivorship between past and modern times.
2. State how changes in human mortality and survivorship have influences population growth.
3. Describe social, biological, and economic factors that contribute to human survivorship.
LAB 13
PERSONAL ENERGY CONSUMPTION

Purpose & Objectives
The purpose of this exercise is to collect specific information about personal energy use, assess the cost of energy use, and identify opportunities to reduce the amount of energy used.

After completing this exercise, the student will be able to:
1. Calculate energy savings from reducing the size of a window, changing the kind of window or changing the inside temperature of a building.
2. Interpret R-values.
3. Calculate energy loss from a dripping hot water faucet.
4. Examine the implications of an individual's lifestyle on energy consumption.
5. Determine the efficiency of different kinds of light bulbs.
6. Use energy consumption information available for consumers.
7. Determine the energy used by specific electrical devise.
8. Evaluate the long-term cost of purchases of energy consuming products.

LAB 14
EVALUATING RENEWABLE ENERGY SOURCES

Purpose & Objectives
There are conflicting claims about the cost effectiveness and environmental effects of utilizing various renewable energy sources. In this exercise you will use information from the National Renewable Energy Laboratory (NREL) and other sources to gain insight into some of the issues related to renewable energy development. After completing this exercise the student will be able to:
1. Access information from the NREL website.
2. Determine the potential for wind energy development in their local area and their state.
3. Calculate the solar energy potential for their locality.
4. Evaluate the cost of ethanol fuel.
5. Evaluate the potential for using currently available biomass for energy production.
6. Evaluate the cost of producing electricity from various renewable energy sources.

SIGNATURE ASSIGNMENT – Toxicity Testing

Background
Every day we handle toxic materials (gasoline, oil, paint, pesticides, prescription drugs, bleach, etc.). Because many people do not appreciate the toxic nature of commonly used materials, toxic materials find their way into groundwater and waterways when they are used or disposed of improperly. Often people pour unwanted toxic materials down drains or flush them down the toilet. In other cases, these materials are simply poured on the ground where they are washed into waterways or contaminate groundwater. When toxins enter waterways and groundwater, they contaminate drinking water sources and affect aquatic life. Aquatic organisms may be killed or weakened by exposure to toxins or their bodies may accumulate toxic molecules.

Toxins can have a wide variety of effects on an animal's biological functions. Some toxins affect important physiological functions such as respiration and have an immediate effect. Others affect functions at particular times in an organism's life, while others affect the genetic foundation of an organism. Teratogens are toxins that cause abnormalities in the development of organisms. For
example, in humans, excessive consumption of alcohol during pregnancy causes mental and physical changes in the embryo. Mutagens are toxins that cause changes in the DNA of organisms, which can lead to a wide variety of problems. Carcinogens are toxins that cause disruption to the regulation of tissue growth, leading to cancer.

Toxicity testing
Determining the toxicity of materials requires a standard method of comparison. A typical method is to determine the concentration of a toxic material that cause 50% mortality in a population of test animals. This is called an LD₅₀ (Lethal Dose 50%) test of toxicity. For obvious reasons, we do not purposely do LD₅₀ studies on humans, but typically use rats or mice in toxicity studies and assume that the results we see in rats or mice are similar to what would happen in humans. However, for a variety of reasons, different species of animals respond differently to the same toxin. For example, rats are very sensitive to dioxin while humans are not.

Experimental setup

Introduction
Many household items that we deal with on a regular basis are toxic materials, but we don't usually think of them as being toxic. In this exercise we will determine the LD₅₀ concentration for solutions of copper sulfate (CuSO₄) and several common household chemicals to the brine shrimp, Artemia salina. As this is a communal exercise the class will be divided into groups; and this also permits the testing of a greater range of materials.

Materials
(a) quantity of newly hatched brine shrimp, (b) copper sulfate solution, (c) other chemical solutions (i.e., peroxide, bleach, vinegar, coffee, nicotine, ethanol, etc.)*, (d) pipettes, (e) petri dishes (f) graduated cylinders, and (f) magnifying glasses or dissecting microscopes.

Methods
(a) label 5 petri dishes as follows: 10% CuSO₄, 1% CuSO₄, 0.1% CuSO₄, 0.01% CuSO₄, and 0% CuSO₄, (b) pour enough of each solution into the petri dish to cover the bottom of the dish, (c) pipette 10 brine shrimp into each dish (avoid eggs), and (d) record date and time on Petri dish. For two other toxic chemicals follow the same procedure used for the CuSO₄ dilutions.

*using the saltwater solution in which the brine shrimp normally live (a) make stock solution of the household chemical to be used as a concentration of 100% (b) prepare a 10% solution by taking 10 mL of the stock solution and adding 90 mL of brine shrimp medium to it, (c) to prepare a 1% solution, take 10 mL of the 10% solution and add 90 mL of brine shrimp medium, (d) in similar fashion, prepare a 0.1% solution and (e) a 0.01% solution, lastly (f) as a control, use the unaltered brine shrimp medium.

Data collection
1. Examine the petri dishes for the three experiments at 24 hours and again at 48 hours and in each case record the number of brine shrimp that have died. Record your data on Table 1 for CuSO₄, on Table 2 for other substance 1, and on Table 3 for other substance.
2. Using data from Tables 1-3, plot the data on Graph 1. For CuSO₄, on Graph 2, for other substance 1, and Graph 3 for other substance 2.
   a. There will be two lines on each of the graphs: one for the number of brine shrimp that died by 24 hours and a second for the number of brine shrimp that died by 48 hours.
   b. If needed, enter the data into Excel and use the scatter plot option to generate the graph. You will also need to convert the concentration axis to a log scale. Because you cannot take the log of zero, enter 0.00001 for the concentration of the control.
Table 1 LD$_{50}$ 24 and 48 hours

<table>
<thead>
<tr>
<th>CuSO$_4$ Concentration</th>
<th># dead shrimp</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>24 hr</td>
</tr>
<tr>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>10%</td>
<td></td>
</tr>
<tr>
<td>1%</td>
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<td>0.1%</td>
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<td>0%</td>
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</table>

Table 2 LD$_{50}$ 24 and 48 hours

<table>
<thead>
<tr>
<th>Other toxin 1 Concentration</th>
<th># dead shrimp</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>24 hr</td>
</tr>
<tr>
<td>100%</td>
<td></td>
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<tr>
<td>10%</td>
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<td>0.1%</td>
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</table>

Table 3 LD$_{50}$ 24 and 48 hours

<table>
<thead>
<tr>
<th>Other toxin 2 Concentration</th>
<th># dead shrimp</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>24 hr</td>
</tr>
<tr>
<td>100%</td>
<td></td>
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<tr>
<td>10%</td>
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3. Examine the graphs and determine the concentration at which 50% of the brine shrimp died at the end of 24 hours and at the end of 48 hours for each of the three experiments. You will have two LD$_{50}$ concentrations: one for 24 hours and one for 48 hours (See the example graph).

   a. In the hypothetical example graph shown below, the dark line represents the mortality at 48 hours and crosses 5 (half the organisms died) between concentration 0.01 and 0.1 at approximately a 0.05% concentration.
   
   b. The lighter colored line represents mortality at 24 hours and crosses 5 between 0.1 and 1 at approximately a 0.3% concentration.
Reporting
The communal reporting of the assignment data, the results, the interpretation of results, and the discussion of results will be on the form of an oral presentation by each group, and a written report prepared by the members of each group. The discussions in both formats should also pay attention to the following:

1. A control is an important part of any experiment.
   a. What is the purpose of the control in each experiment?
   b. Did all the brine shrimp survive in all the controls?
   c. Was there a difference in the number of brine shrimp that died in the controls at 24 hours and 48 hours?
   d. What might have contributed to any difference in the number that died at 24 and 48 hours?

2. Which of the substances you tested was the most toxic to brine shrimp?

3. LD50 tests have been called inhumane because test animals die during the test.
   a. Should LD50 determinations be allowed? Why or why not?
   b. Would you feel differently if the animals being tested were mice, rabbits, or monkeys? Why or why not?

4. How do the results you obtained in this exercise relate to humans?
   a. Do you think each of the compounds would have the same level of toxicity in humans as they do in brine shrimp?
   b. Would you be comfortable using these toxicity results to set standards for exposure for humans? Why or why not?

5. The level at which you first detect an effect is called the threshold level. Was there a concentration below which you could not detect an effect on the number of brine shrimp that died in the CuSO4 solutions or the solutions of other household chemicals?

6. Would an LD50 toxicity test be useful in evaluating teratogens, mutagens, or carcinogens? Why or why not?

7. Obtain the Material Safety Data Sheets (MSDS) for the chemicals you tested. Simply go to the Internet and type in MSDS followed by the name of the chemical
   a. What are the published LD50s for the substances you tested?
   b. How do the LD50s from the MSDS compare to the LD50s you determined for brine shrimp?