TEACHING AND LEARNING PORTFOLIO

by

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Learning

Research Teaching

This portfolio submitted in partial fulfillment of the requirements for the Delta Certificate in Research, Teaching, and Learning.

Delta Program in Research, Teaching, and Learning
University of Wisconsin-Madison

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Teaching and Learning Philosophy

"All truths are easy to understand once they are discovered; the point is to discover them."
–Galileo Galilei

Why? A child's basic question can be thoughtful yet intrusive. Although we might not have the answer to each particular question, the question itself invites us to embrace curiosity in learning and engage in a better understanding of our world. As children grow older their questions often cease as new interests pull their attention from education toward other endeavors. Learning is a process we encounter everyday and I believe it is important to encourage people to retain their interest in life-long education. My goal is to create an environment for learning where curiosity and questioning is encouraged through my teaching philosophy, practices, and student participation that will reach beyond the classroom and into the greater community and endure throughout a life-time.

Personal interest in teaching

The most important characteristic a teacher can posses is caring. Someone who has a personal investment in their teaching and the students they encounter will excel. This characteristic is also apparent in how a teacher approaches each class they lead. I am invested in teaching. This can be seen through my commitment and actions; most recently as a Teaching Assistant for graduate and undergraduate courses at the University of Wisconsin-Madison, creating a training program for future Teaching Assistants within my graduate program, and leading outreach activities for the general public. I am invested in education which means I continually work to find the most appropriate ways to teach a class regardless of size, will strive to find the most effective ways to reach diverse learning, and that I will reflect on my teaching strategies and student learning to improve my approach.

Adaptable teaching style

Regular assessment and reflection is key to improving the learning of my students and helps me to adapt my teaching style to focus on the strengths of the students. I leave each teaching situation thinking about what went well, but more importantly thinking about what could be improved. Using my past experience, as well as formal and informal assessments from the students, I can modify my teaching approaches (lectures, slides, worksheets, activities, etc.) to match the learning styles of my students. As a TA for environmental organic chemistry (TOX631) I started the semester leading discussion sessions where I would narrate calculations on the board and give an answer. As the semester continued, I realized I was leading a problem set based lecture not a discussion. The students would not bring their class notes or even a notebook to record the information I was sharing during these lessons. I decided a different approach would be more beneficial for the students. I started explaining the problems and asking questions directed at the students while writing out the calculation process. I asked students to identify what information was known and what information was needed before we could calculate and answer the main question. This method allowed students to actively participate in the discussion and gain a better understanding of the material.

I have taken it upon myself to participate in programs such as the Delta Program where innovative approaches to teaching and learning are explored. I am excited to try these innovative techniques to help students learn. In particular, I have a strong interest in using peer groups, flipped classrooms, and hands-on activities to bolster classroom learning. In my disciplinary courses, I plan to use scheduled lectures for brief clarifications of course material but to use most of the time for peer group work and fostering understanding of knowledge applications by looking at real world scenarios. These active learning techniques will be used to engage students in the course material and encourage them to ask the questions how and why.

Student participation in the classroom and community

Once students start to learn through participation in classroom activities, I believe the next step is to encourage them to apply that knowledge in their community. One way to foster community involvement is to create class-related materials that are applicable to the local community. For example, in a course focused on sustainable food I plan to teach students about gardening, the benefits of community gardens, and how to grow vegetables in containers. An example group project in such a course would ask students to educate local citizens about sustainable food. The students would be asked to design posters or flyers about growing vegetables and health benefits from a balanced diet. These materials could be handed out at local events such as neighborhood block parties, farmers markets, or school events. The students might even host an event and invite community members to attend an educational session and start their own container gardens.

Relating course material to the real world can engage students and show them how to use class information to help other people. The idea of relating class topics to the community may not be applicable to every lesson but across an entire course there are ample opportunities to help connect students with real-world applications.

I believe that education is a privilege that should be shared with everyone and I hope to transfer my passion for learning into the ways I teach. I strive to bring enthusiasm about learning to my students, renew their curiosity, and encourage them to not only ask “Why?” but also, “Why not?”

Teaching Assistant Experience in Environmental Organic Chemistry

Background

One requirement for graduate students in the Molecular & Environmental Toxicology program at the University of Wisconsin-Madison is to be a Teaching Assistant (TA) for a graduate level course. After a graduate student finishes their first year and completes the core courses required by the program, they become a TA. Graduate students are paired together and assigned to work with one another for a specific course.

One of the courses TAs most dread being assigned is TOX631: Environmental Organic Chemistry. Unlike my peers, I wanted to be a TA for TOX 631. I had enjoyed the class as a first-year graduate student and spent hours every week completing the homework assignments, despite the fact that the material did not pertained to my research.

Although I valued this course there were several concerns I had about the overall management of the class and in particular, the discussion sessions. These were shared concerns among students as we would frequently discuss our frustrations. My biggest concern was how the TAs prepared for and led their discussion sessions and distributed the homework assignments. TOX631 is already viewed as a difficult course with seemingly impossible material to understand. The students felt strongly that the TAs should work to make the course more approachable and foster confidence in the students rather than setting up roadblocks.

One of the first issues I decided to focus on was the lack of preparation and understanding of the material TAs exhibited during the discussion sessions. At times, TAs were unable to explain calculations, let alone the practical importance of the problems. Students had a hard time seeing the relevance of the material and felt lost. Another concern I had centered on the homework sets. The homework problems were confusing and students found it challenging to identify the core question that needed to be solved. Moreover, some problems did not include all of the values that were necessary to complete the calculations. When the students had questions about the problems, the TAs were not prepared to discuss homework questions and help the students work through them.

I struggled through the course as a graduate student but I enjoyed the subject and the material. Upon completing the course, I made a personal vow to become a TA for TOX631 and improve the student learning in the course. As a TA for TOX631, I created a Discussion Syllabus to provide students with helpful tips for the entire course. I made electronic copies of discussion session questions with answers and posted the information online for the students. During the first discussion session there were several questions I was unable to answer. After the discussion, I figured out how to address those questions and posted a response online for the entire class and my fellow TA.

One other important goal for me was to make sure all the work I put into the course could be easily transferred to the next generation of TOX631 TAs. I accomplished this by converting all the homework and answer keys into electronic formats that could be easily modified. Most importantly, I listed all the calculations in an understandable format in the answer keys and provided a grading scheme to foster fair grading.

I am very proud of my accomplishments as a TOX631 TA. I identified problems with the teaching model and made alterations to improve the course and student learning and then made the changes sustainable with electronic materials. The artifact that follows includes examples of my Discussion Syllabus, a subset of questions from Discussion Session 1, a subset of responses to question posed by students following Discussion Session 1, Homework Set 2, and Homework 2 Solutions including the grading scheme.

Course Summary:

The goal of TOX631 is to provide the tools necessary for assessment of the behavior, distribution, and fate of organic chemicals in the environment. Chemical and physical processes that govern the movement of organic toxicants from source to receptor will be examined. Influences of physico-chemical properties on the partitioning of organic chemicals between various media, including air-water, sediment-water, biota-water (bioaccumulation), and others, will be investigated, followed by transport processes and reactions. Concepts will be linked together using mathematical models of environmental systems.

The discussion section focuses mainly on assistance with problem sets and may also be used to discuss papers assigned in class.

Artifacts: Discussion and Homework Material for TOX631

I. Discussion Section Syllabus

MET/SS/CEE 631 & CEE 502: Toxicants in the Environment: Sources, Distribution, and Fate

Spring Semester 2011
2:30-3:30PM Thursdays Soils 357

TAs: Kristina Blanke kblanke@wisc.edu
Sung Kyoung Lee slee49@wisc.edu

Office Hour: Tuesdays 6:30-7:30PM at Steenbock Library

Homework:
Posted on Learn@ UW Wednesdays and collected the following Wednesday in class
Homework will be graded and handed back on Fridays in class

There are 12 scheduled Discussions

631 Class Advice:

- Work together with other students and form study groups
- Try to look over the homework assignments before Thursdays so you can ask questions at Discussion
- When you have homework questions, try figuring out the problems in your study group before contacting a TA
- TAs can be contacted via e-mail with questions or to set up a time to meet if the Office Hour does not fit in your schedule
- TAs will answer e-mails between 10AM and 5PM during the week; we may also answer e-mails at night and on the weekends but there might not be a quick response
- Class material builds upon itself, if there are concepts that are not clear, ask for extra help in the beginning before the material becomes too complex
- For homework and exams, SHOW ALL YOUR WORK – in case there is a calculation issue, you may still receive partial credit for having the correct work process
- Also, always state any assumptions made when answering homework or exam questions
- Bring class notes to Discussion and actively participate so you become familiar with the process used to think through problem examples

Library Reserved Materials

Required Text: Reserved at Steenbock, Wendt, and Wisconsin's Water Libraries
Schwarzenbach, R.P., P.M. Gschwend, and D.M. Imboden, *Environmental Organic Chemistry*, 2nd edition. John Wiley & Sons, 2003.

Supplemental Texts: Reserved at Steenbock Library
Mackay, D. *Multimedia Environmental Models: The Fugacity Approach*, 2nd edition, Lewis Publishers, 2001.

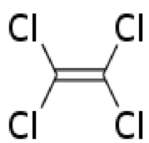
II. Discussion Section 1 – Subset of Problems and Solutions

Discussion 1 – Chapters 3 & 4

Problem 1 – mole fraction concentration
Problem 2 – vapor pressure – temperature relationship

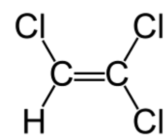
Problem 1:

PCE – tetrachloroethene or perchloroethene
(chlorocarbon; dry-cleaning fluid)



M_i (g/mol)	165.0
Density (g/cm^3)	1.62
V_T (L)	5.0

TCE - trichloroethylene
(chlorocarbon; industrial solvent)



M_i (g/mol)	130.0
Density (g/cm^3)	1.46
V_T (L)	10.0

Conversion Factor:
1 cm^3 = 10^{-3} L

Find the mole fraction concentration of PCE in a solution containing PCE <u>and</u> TCE.

a. How many grams of PCE?

$$\frac{1.62\ g}{cm^3} \times \frac{cm^3}{10^{-3}\ L} \times 5.0\ L = 8.1 \times 10^3\ g \text{ mass of PCE}$$

b. Determine moles of PCE.

$$8.1 \times 10^3 g \times \frac{mol}{165\ g} = 49\ mol\ PCE$$

c. How many grams of TCE?

$$\frac{1.46\ g}{cm^3} \times \frac{cm^3}{10^{-3}\ L} \times 10.0\ L = 1.46 \times 10^4\ g \text{ mass of TCE}$$

d. Determine moles of TCE.

$$1.46 \times 10^4\ g \times \frac{mol}{130\ g} = 112\ mol\ TCE$$

e. Find the mole fraction concentration of PCE.

Mole fraction concentration:

$$x_i = \frac{n_i}{n_i + n_j} \text{ or } x_i = \frac{n_i}{n_T}$$

$$\boldsymbol{x_{PCE}} = \frac{49\ mol\ PCE}{49\ mol\ PCE + 112\ mol\ TCE} = \mathbf{0.30}$$

Problem 2:

PCE – perchloroethene

T_m = -19.0 °C
T_b = 120.8 °C
V_T = 50.0 m^3

Data

T (°C)	p_i* (mmHg)	State of PCE
-20.6	1	solid
13.8	10	liquid
40.1	40	liquid
61.3	100	liquid
100	400	liquid
120.8	760	liquid/gas

Conversion Factors:
0°C = 273K
1 mmHg = 1.33×10^{-3} bar

Find p_i* of PCE in bar at 20°C.

a. Convert T from °C to K.

-20.6°C + 273 = 252K [See table below for all other values]

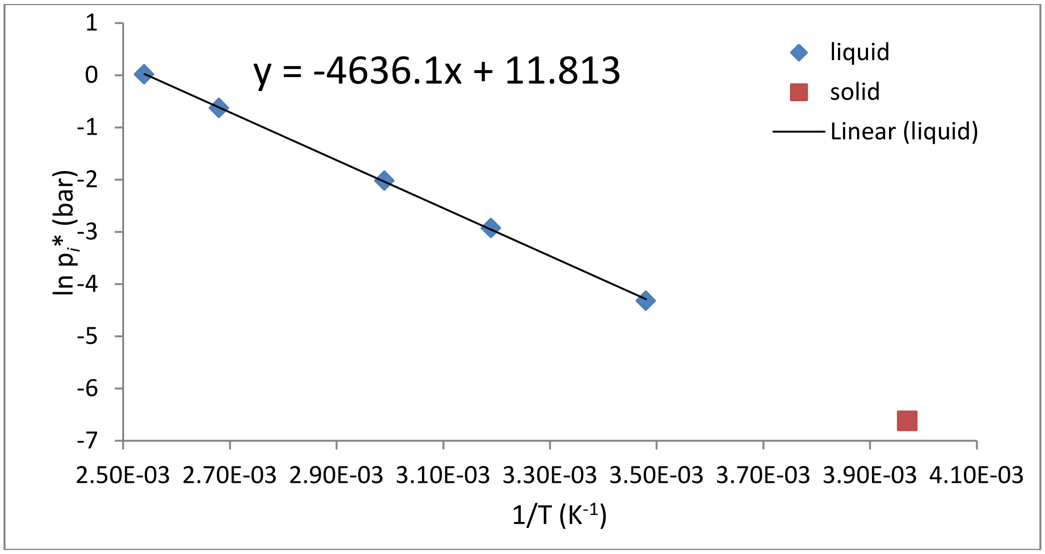
b. Convert p_i* from mmHg to bar.

$$1\ mmHg \times \frac{1.33 \times 10^{-3}\ bar}{mmHg} = 1.33 \times 10^{-3}\ bar$$ [See table below for all other values]

c. Find 1/T (K^{-1}) and ln(p_i*).

T (K)	1/T (K^{-1})	p_i* (bar)	ln(p_i*) (bar)
252	3.97×10^{-3}	1.33×10^{-3}	-6.62
287	3.48×10^{-3}	1.33×10^{-2}	-4.32
313	3.19×10^{-3}	5.32×10^{-2}	-2.93
334	2.99×10^{-3}	1.33×10^{-1}	-2.02
373	2.68×10^{-3}	5.32×10^{-1}	-6.31×10^{-1}
394	2.54×10^{-3}	1.01	1.07×10^{-2}

d. Plot graph and find trendline for liquid PCE since at 20°C PCE is a liquid.



e. Use least squares fit line to determine p_i* at 20°C (or 293K).

The trendline follows the integrated *van't Hoff* equation, which is referred to as the *Clausius-Clapeyron* equation. This equation assumes that A = $\Delta_{vap}H_i/R$ and that $\Delta_{vap}H_i$ is constant over a range of temperatures.

$$\ln p_{iL}{}^{*} = \frac{-A}{T\ (K)} + B$$

Use the liquid trendline to determine p_i* at 293K:

y = -4636.1x + 11.813

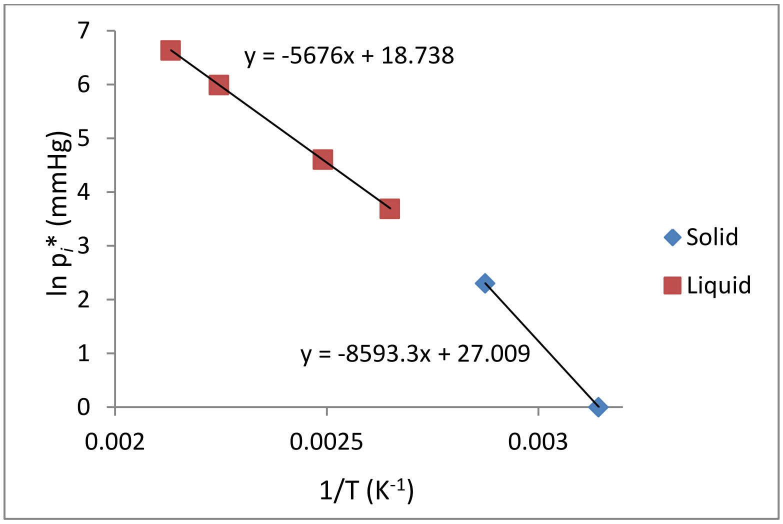
ln p_i* = [-4636.1 x (1/293)] + 11.813

ln p_i* = -4.01

p_i* = $e^{-4.01}$ **= 1.81x10^{-2} bar**

Additional Discussion Information:

If a phase change exists in the data, be sure to use the slope of the appropriate line (liquid or solid) to calculate the p_i^*.



Reference: Illustrative Example 4.1 pgs. 108-109 from SGI

Also, for a subcooled liquid, be sure to extrapolate from the appropriate line (liquid) for calculations.

Remember for Liquids:

- Use the *Clausius-Clapeyron* equation over small temperature ranges (0-30°C/K) since

$$\frac{\partial \Delta_{vap} H}{\partial T} = 0$$

- Use the *Antoine* equation over broader temperature ranges

$$\ln p_{iL}{}^* = -\frac{A}{T + C} + B$$

This will include dependence on temperature in order to improve the prediction

III. Discussion Session 1 - Subset of Responses to Students Questions

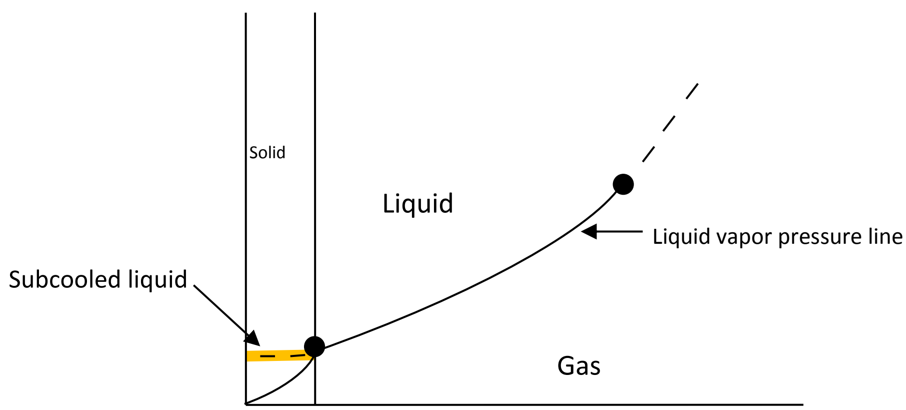
Discussion 1 – Question Responses

1. Why do we need to know how to calculate the mole fraction concentration?

The mole fraction concentration calculation is important to understand because it will be used in future calculations that are more in depth. Examples include calculations for fugacity, chemical potential, partition coefficients, and compound concentrations. There will be more uses for mole fraction concentration as the semester continues.

2. What is a subcooled liquid?

Subcooled liquid: a compound that is in liquid phase at a temperature below its saturation temperature or at a pressure above its saturation pressure.



Pg. 101 from SGI shows a phase diagram similar to the one above and pg. 103 SGI has an explanation on subcooled liquids.

The vapor pressure of a subcooled liquid identifies information about a compounds molecular interactions in its pure liquid at a temperature when the compound is a solid. These properties are important to understand for molecular situations in environments where the molecules exist in a liquid state (an example is when the compound is dissolved in water) even though the compound would be a solid if it were in a pure solution.

3. When do we use the *Clausius-Clapeyron* equation?

Clausius-*Clapeyron* equation – more information found on pg. 105 of SGI.

The *Clausius-Clapeyron* equation is an integrated form of the *van't Hoff* equation:

$$\frac{\partial \ln p_{iL}{}^{*}}{\partial \mathrm{T}} = \frac{\Delta_{vap}H_i(T)}{RT^2} \qquad \textit{van't Hoff} \text{ eqn}$$

The *van't Hoff* equation can be integrated if we assume that $\Delta_{vap}H_i$ is constant over a given temperature range.

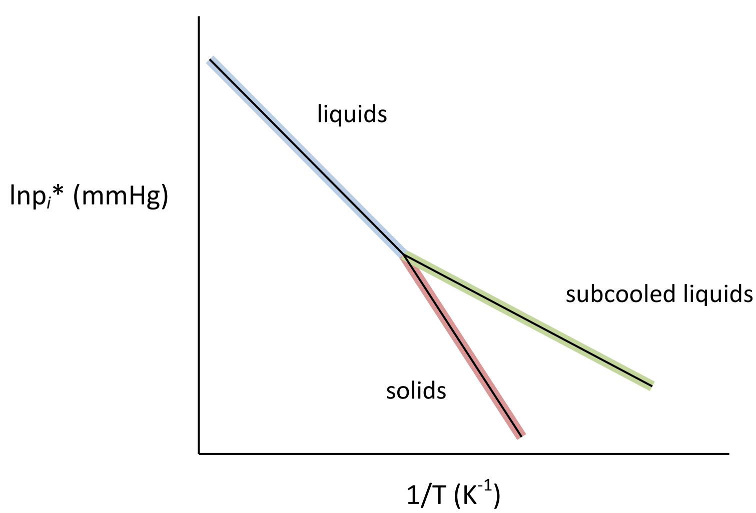
$$\ln p_{iL}{}^{*} = \frac{-A}{T\,(K)} + B \qquad \textit{Clausius-Clapeyron} \text{ eqn}$$

For vapor pressure data over a narrow temperature range, vapor pressures at other temperatures can be calculated given that the compound does not change phase over the temperature range considered (liquids do not become solids).

For Discussion 1 Problem 2, we could have used the *Antoine* equation to give us better results since the temperature range was more than 30°. Using the *Clausius-Clapeyron* equation was acceptable since we used the data points where PCE was a liquid; there was no phase change. Also, Problem 2 was done so we would understand how to use the *Clausius-Clapeyron* equation when extrapolating information from data sets.

4. How do you extrapolate data to determine the pressure?

When using data to extrapolate pressure information, there are three lines to consider depending on what type of compound phase you are interested in using. Figure 1 found on pg. 109 in SGI is similar to the one below. Data will be extrapolated for a compound from one of the three lines highlighted below when finding a liquid, solid, or subcooled liquid pressure (using the solid or subcooled liquid line depends on temperature and pressure).



IV. Homework Set 2

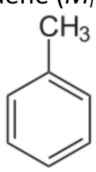
MET/CEE/SS 631
CEE 502

Homework Set 2
Due: February 16, 2011

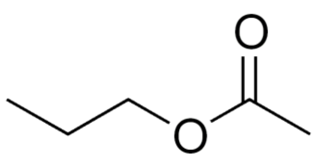
1. Answer the following questions:
   A. Which thermodynamic function needs to be known to assess the temperature dependence of the vapor pressure of a given compound?
   B. How can this function be estimated from experimental data?
   C. What caution is advised when extrapolating vapor pressure data from one temperature to another?

2. Estimate the rotational symmetry number (σ), the molecular flexibility number (τ), and the hydrogen bond number (HBN) for each of the compounds below:

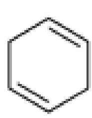
   (a) Toluene (M_i=92.14 g/mol)



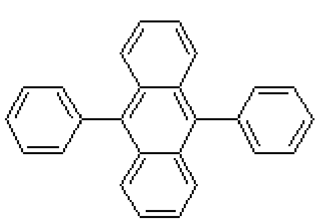
   (b) Propyl acetate (M_i=102.13 g/mol)



   (c) 1,4-cyclohexadiene (M_i=80.13 g/mol)



   (d) 9,10-diphenylanthrancene (M_i=330.42 g/mol)



3. For some odd reason you decide to juggle two glass bottles, containing 1L DMSO **each**. Never having juggled before, you drop the bottles which promptly shatter and the solvent spreads over the floor. Soon you can smell the solvent vapor in the air. Answer the following questions:

   (a) What is the maximum DMSO concentration (g/L) in the air that you can expect in the room (T = 20°C)?

   (b) How much (mL) of the solvent has evaporated if the air volume is 30 m^3? (Neglect any adsorption of DMSO to the walls and on the furniture.)

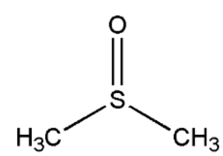
   (c) If the same accident happened in your sauna (volume 15 m^3, T = 80°C), what maximum DMSO concentration (g/L) and how much (mL) of the evaporated solvent would you and your friends be exposed to?

Important Information

Using *CRC Handbook of Chemistry and Physics (Lide, 1995)*, you find the following vapor pressure data for DMSO:

T (°C)	25	50	75	100
p_i*(kPa)	0.084	0.431	1.67	5.27

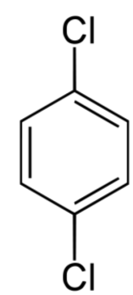
Molecular formula: C_2H_6OS
Molecular mass, M_i = 78.13 g·mol^{-1}
Density, ρ_i = 1.1004 g·cm^{-3}
Melting point temperature, T_m =18.5°C
Boiling point temperature, T_b = 189°C
Saturation vapor pressure, p_i^* = $10^{1.74}$ Pa



4. Pure 1,4-dichlorobenzene (1,4-DCB) is still used as a disinfectant and air freshener in some public toilets. As an employee of a large city's health department, you are asked to evaluate whether the 1,4-DCB present in the air in such toilets may pose a health problem to the toilet personnel who are exposed to this compound for several hours each day.

   (a) You go to the library and get the following vapor pressure data from an old edition of the *CRC Handbook of Chemistry and Physics (Lide, 1995).*

T (°C)	29.1(s)	44.4(s)	54.8	84.8	108.4	150.2
p_i* (mm Hg)	1	6	10	42	101	400



   What is the maximum possible 1,4-DCB in the toilet air at 20°C. Calculate this concentration in g/m^3.

   (b) You have no time to look for vapor pressure data, but you know the boiling point (T_b = 174.0°C) and melting point (T_m = 53.1°C) of 1,4-DCB. Calculate the concentration of 1,4-DCB in g/m^3 at 20°C and compare this result with that obtained in Part a.

   (c) What is the maximum 1,4-DCB concentration in the air of a public toilet located in Death Valley (temperature at 60°C). *Hint: repeat steps a and b at the new temperature and compare results.*

V. Homework Set 2 - Subset of Solutions and Grading Scheme (Questions 2 and 3)

631/502 - HW 2- Solutions (Chapter 4) – ***30 points total***

2. (*6 points total: 1.5 points per compound – 0.5 for each value calculation*)
SGI information on σ (pg.126), τ (pgs. 113-114, 125-126), HBN (pg 114)

   a. Toluene

σ = 2 planer symmetry = 2, no rotating symmetry (2x1=2)
τ = 0 τ = Σ(0 SP3 + (0.5*0 SP2) + (0.5*1 RING)) – 1 = -0.5 ≈ 0
HBN = 0 $HBN = \frac{\sqrt{(0*OH)+(0*COOH)}+0.33\sqrt{0*NH_2}}{M_i} = 0$

   b. Propyl acetate

σ = 1 identity
τ = 2.5 τ = Σ(3 SP3 + (0.5*1 SP2) + (0.5*0 RING)) – 1 = 3.5 – 1 = 2.5
HBN = 0 $HBN = \frac{\sqrt{(0*OH)+(0*COOH)}+0.33\sqrt{0*NH_2}}{M_i} = 0$

   c. 1,4-cyclohexadiene

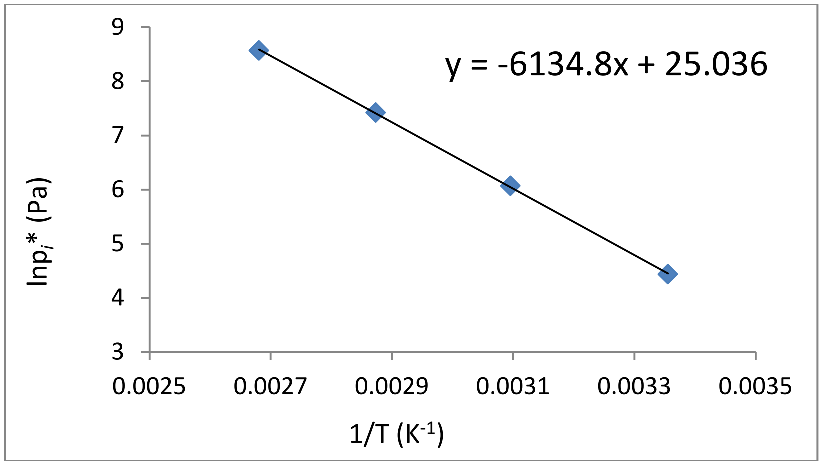
σ = 4 planer symmetry = 2, rotating symmetry = 2 (2x2=4)
τ = 0 τ = Σ(0 SP3 + (0.5*0 SP2) + (0.5*1 RING)) – 1 = -0.5 ≈ 0
HBN = 0 $HBN = \frac{\sqrt{(0*OH)+(0*COOH)}+0.33\sqrt{0*NH_2}}{M_i} = 0$

   d. 9,10-diphenylanthrancene

σ = 4 planer symmetry = 2, rotating symmetry = 2 (2x2=4)
τ = 0.5 τ = Σ(0 SP3 + (0.5*0 SP2) + (0.5*3 RING)) – 1 = 1.5 – 1 = 0.5
HBN = 0 $HBN = \frac{\sqrt{(0*OH)+(0*COOH)}+0.33\sqrt{0*NH_2}}{M_i} = 0$

3. (*6 points total: 2 points per part*)
   a. Plot data 1/T (K^{-1}) vs lnp_i* (any unit of pressure)

Phase	T (°C)	T(K)	1/T (K^{-1})		p_i* (kPa)	p_i* (Pa)	lnp_i* (Pa)
liquid	25	298	0.00336		0.084	84	4.43
liquid	50	323	0.00310		0.431	431	6.07
liquid	75	348	0.00287		1.67	1670	7.42
liquid	100	373	0.00268		5.27	5270	8.57



Find maximum concentration of DMSO (g/L) in the air at 20°C (293K)

$$y = -6134.8x + 25.036$$

$$\ln p_i^* = [-6134.8 \times (1/293)] + 25.036$$

$$\ln p_i^* = 4.098$$

$$\mathbf{p_i^*} = e^{4.098} = 60.23 \text{ Pa}$$

$$60.23 \text{ Pa x } \frac{1\ bar}{10^5\ Pa} = \mathbf{6.023 \times 10^{-4}\ bar}$$

$$PV = nRT \text{ modified to } \frac{n}{V} = \frac{P}{RT}$$

$$\frac{n\ (mol)}{V\ (L)} = \frac{6.023\ x\ 10^{-4}\ bar}{\left(8.314\ x\ 10^{-2}\ \frac{L\ bar}{mol\ K}\right) x\ (293\ K)} = 2.472 \times 10^{-5} \text{ mol/L}$$

$$\frac{2.472\ x\ 10^{-5}\ mol}{L}\ x\ \frac{78.13\ g}{mol} = 1.93\ x\ 10^{-3}\ \frac{g}{L}$$

$$\mathbf{C_{DMSOg} = 1.93 \text{ X } 10^{-3} \text{ g/L}}$$

b. Find the amount (mL) of evaporated DMSO in the air volume of 30 m^3

$$\frac{1.93\ x\ 10^{-3}\ g}{L}\ x\ \frac{L}{10^{-3}\ m^3}\ x\ 30\ m^3 = 57.9\ g$$

$$57.9\ g\ x\ \frac{cm^3}{1.1004\ g}\ x\ \frac{mL}{cm^3} = 52.6\ mL$$

evaporated DMSO = 52.6 mL

c. Find maximum concentration of DMSO (g/m^3) at 80°C (353K) and the amount (mL) of evaporated solvent with an air volume amount of 15 m^3

$$y = -6134.8x + 25.036$$

$$\ln p_i^* = [-6134.8 \times (1/353)] + 25.036$$

$$\ln p_i^* = 7.657$$

$$\mathbf{p_i^*} = e^{7.657} = 2.115 \times 10^3 \text{ Pa}$$

$$2.115 \times 10^3 \text{ Pa} \times \frac{1\ bar}{10^5\ Pa} = \mathbf{2.115 \times 10^{-2}\ bar}$$

$$PV = nRT \text{ modified to } \frac{n}{V} = \frac{P}{RT}$$

$$\frac{n\ (mol)}{V\ (L)} = \frac{2.115\ x\ 10^{-2}\ bar}{\left(8.314\ x\ 10^{-2}\ \frac{L\ bar}{mol\ K}\right) x\ (353\ K)} = 7.208 \times 10^{-4} \text{ mol/L}$$

$$\frac{7.208\ x\ 10^{-4}\ mol}{L}\ x\ \frac{78.13\ g}{mol} = 5.631\ x\ 10^{-2}\ \frac{g}{L}$$

C_{DMSOg} = 5.63 x 10^{-2} g/L

$$\frac{5.63\ x\ 10^{-2}\ g}{L}\ x\ \frac{L}{10^{-3}\ m^3}\ x\ 15\ m^3 = 8.447\ x\ 10^2\ g$$

$$8.447\ x\ 10^2\ g\ x\ \frac{cm^3}{1.1004\ g}\ x\ \frac{mL}{cm^3} = 7.68\ x\ 10^2\ mL$$

evaporated DMSO = 7.68 x 10^2 mL

Reflection

I had high expectations for myself when I became a TOX631 TA during the spring 2011 semester. My goal was to make the course better for the students, TAs, and professor. There were many things I feel I did well including concentrating on the students needs for understanding the material and keeping the professor informed about how the students were doing in the course. I provided the students with many course resources including electronic copies of the discussion material and recorded lectures.

Another important role I played as a TA was to make the course material accessible for future TAs. I worked to improve the level of detail included in the homework problem solution sets and transferred the homework and answer keys in an electronic format. My goal was to make all the materials easily transferable and modifiable such that the problems sets could be changed and improved over the years. Most of my time spent as a TA was focused on organizing the material and creating electronic versions. My goals were to improve the course material to help the students learn better but there is much work that still needs to be done with an eye towards student learning. The students went through the semester struggling with the material but had good grades at the end of the semester. After partaking in Delta courses and better understanding the need for student assessment at many levels, I realize the need to assess the impact of the changes I implemented on actual student learning. While I helped the students by giving them easy access to course material, making sure the homework assignments included all the pertinent information, and trying my best to answer questions or direct students to other resources, I did not do enough student assessment of learning. I realize that my efforts were focused on improving the course for the TAs and now needs to move toward improvements more specifically focused on the students.

If I were to TA TOX631 in the future, I would redesign the format of the discussion section. I would focus on core concepts during my lecture portion and change the problems so that small groups could work together to solve a question and then present the calculations and theories relevant to the problem to the rest of the class. I would also try to show real world examples so the students can see how this material is important to everyday life.

My focus would not only be on helping the students complete their homework assignments but also on their understanding of lecture material. I would use classroom assessment techniques such as having them articulate the muddiest point; I would ask students to write down a concept covered in the previous class lecture that wasn’t clear. I would organize those points and give the information to the professor so they could briefly touch on those topics before starting new material.

These are a few examples of how I would change my teaching if I were a Teaching Assistant in the future. My hope is that these changes strengthen the course and student understanding.

Delta Internship: Developing and Implementing a Teaching Assistant Training Program

Background

Molecular & Environmental Toxicology Center Teaching Assistant Training Program

Summary: Graduate students in the Molecular & Environmental Toxicology Center are required to be Teaching Assistants (TAs) in one of four core courses during their second or third year of graduate school. Students are required to TA for one semester but receive no formal training prior to assuming this role. My Delta internship focused on the teaching-as- research question: Will a TA Training Program, which incorporates the core ideas behind the Delta Pillars, improve graduate students teaching skills during their TAships? Through this TA Training Program, TAs will identify their core responsibilities in each course, discuss teaching strategies that can be used in discussion sessions, and learn how to use student feedback to improve students' learning of course material. Evaluation of the TA Training Program will be done during the training session and upon completion of the TA assignment to determine if any of the knowledge and skills gained from the Training were implemented during the actual TA experience. The Training program will occur annually in August before the semester starts and will include 3-7 participants. The overall goal is to improve the preparation graduate students receive before becoming a TA such that their students learn more effectively.

INTRODUCTION

Graduate students in the Molecular & Environmental Toxicology Center (METC) are required to serve as a teaching assistant (TA) for one semester during their second or third year in graduate school but no formal training is provided for these students. Students are expected to learn their responsibilities and how to be TAs by watching what their previous TAs have done and to follow that example. The lack of formal TA training in METC, has led to the propagation of ineffective teaching practices that has perpetuated through the years. While there are other science programs on campus that offer TA training programs for graduate students working in undergraduate courses, the unique requirement of METC for graduate students to TA graduate level courses has left a gap in preparation. In addition, METC students all TA in four of the core METC courses thus it is imperative to design a training program specific to METC.

Graduate teaching assistants play an important role in college education whether the class is directed towards undergraduate or graduate students. Teaching assistant training can have a huge impact on the effectiveness of TAs. Unfortunately, training is not always available in certain university programs which leave TAs with no prior training or previous experience, unprepared for the critical role they play in the classroom. Research has shown that TAs with prior teaching experience and/or training are more effective than those without experience or training (Prieto & Altmaier, 1994). It is important for graduate students to teach in some capacity during their graduate education since these opportunities can benefit their future careers. Teaching experience is important for students who want to pursue faculty positions despite the concern that many think it is more valuable to have research experience than teaching experience, but this does not benefit students in the classroom (Shannon, Twale, &

Moore, 1998). Educators at the college level need to be better prepared because teaching seems to be a lost priority at large universities (Rushin *et al*, 1997). One place to start is with the training of future faculty members during their experience as a TA. Training graduate TAs is an important way to enhance their teaching experience and prepare these TAs for future academic careers (Rushin *et al*, 1997). Therefore, some type of training should be encouraged, if not required, for all TAs.

Many different types of training programs exist and there are key aspects included in each of them. Two important aspects of any TA training should include intellectual and interpersonal tasks (Lowman & Mathie, 2009). Both of these aspects deal with TA responsibilities in the classroom and relationships between TAs and faculty/students. It is also important that training programs assist with graduate TA instruction and assessment (Kurdziel, J.P., Turner, J.A., Luft, J.A, & Roehrig, G.H., 2003). Each TA training program should be modified to include pertinent information that is useful to the program and classes involved. Some aspects of current TA training programs include using a panel of previous TAs to inform new TAs about what to expect in different situations and answer questions, information on effective teaching strategies, advice on interactions with faculty, methods on grading and giving feedback on homework, and ways to evaluate student learning (University of Delaware, 2011; UCLA, 2011). All of these previous points are important inclusions in order to train TAs to be well-rounded and effective.

APPROACH

Participants. The population consists of METC graduate students who have completed their first full year of graduate school and have taken the four core METC courses (MET 625, 626, 631, and 632/633/634). These students will be TAs in their second or third year of graduate school. Each year, the Training Program will have 3-7 participants.

Program Design. The TA Training Program will consist of one session that lasts five hours. The program agenda is listed as Appendix A. The program will introduce each TA to their teaching responsibilities for their specific course and review the role of TAs in general. The session will model various teaching techniques that TAs could use during their discussion sections. The sessions will also incorporate the three pillars of the Delta Program: Teaching-as-Research, Learning Communities, and Learning-through-Diversity. The pillars will be used to show TAs how to observe and reflect on their teaching practices while giving them resources to seek advice from other people interested in teaching and understanding how to use multiple techniques when teaching.

Sustainability. To ensure that the METC TA Training Program continues after the pilot session, a faculty member associated with METC will commit to identifying a current METC graduate student to lead the session each year. An application will be filled out by any METC graduate student who has completed the Training Program themselves and is interested in leading the Training for the next two years. Each year two graduate students will lead the TA Training Program: one leader will have led the program during the previous year and the other leader will be a new leader and will lead the program the following year as well. Program leadership will overlap for the Training Program for continuity every year.

EVALUATION

Several evaluation questionnaires will be distributed during and after the TA Training Program. The first evaluation will be completed at the beginning of the Training session to identify any questions the TAs have and to assess the comfort level of each TA relative to their upcoming TA experience. The first evaluation is Appendix B. Another evaluation is given to each participant after the conclusion of the TA Training to determine any questions that still remain for the participants and their comfort level relative to their upcoming TA experience after completing the training session (Appendix C). A final evaluation will be used to determine if any of the skills or resources discussed during the TA Training Program were used during each TAs experience and is distributed after the participants completed their TA experience (Appendix D).

RESULTS

Preliminary Results from beta-Test

Three METC graduate students were TA's in the Spring 2012 semester. Prior to their TA experience they had a brief Training session to obtain materials and gain knowledge about available resources. The itinerary for this pilot Training is Appendix E. A pre- and post-training evaluation was given to each student and the surveys are listed as Appendix F and G, respectively. Responses to the pre- and post-Training questionnaire are listed below in Table 1 and Table 2, respectively.

Table 1. Pre-TA Training Survey Responses

What questions or concerns do you have about being a TA?
❍ New topics being presented – becoming familiar with them ❍ Will I have much time for research/paper writing, etc.? ❍ Do I know the material well enough to explain it to others?
What would you like to learn from this training?
❍ Ways to balance TA/lab ❍ How to help students the most ❍ I want to make sure I know how to use Learn@UW for posting lectures, setting up dropbox, etc. and booking rooms ❍ Know what is usually expected of me in terms of duties ❍ Familiarize myself with the resources I have available to me ❍ Advice on difficult questions, how to handle "needy" students

Table 2. Post-TA Training Survey Responses

What questions or concerns do you still have about being a TA?
❍ Still concerned about administration things (minor) ❍ Same question about knowing the material
What did you learn from this training?
❍ I learned more about managing my time (setting weekly max. time spent, splitting aspects of the course up and devoting X amount of time to each…) ❍ I learned ways to make discussion more interesting and useful, ways to supplement paper presentations ❍ Learned several tips on establishing TA-student relationship, leading discussions, and active learning strategies ❍ I learned how to engage students through active learning and low-high risk questions

DISCUSSION

This project is still underway and will be completed after the spring 2013 semester. Data will be collected from the beta-test group and half the pilot group in January 2013. The rest of the pilot group data will be collected in June 2013. At that point the data sets will be analyzed to determine if the TA Training Program aided in TA effectiveness.

Expected results would show that the Training Program addresses the concerns of future TAs and has given them resources that they incorporated into their classes. These two main points can be identified with the pre- and post-evaluation answers. If the response to the question about the new TAs concerns is different between the two evaluations then this may show that the concerns were addressed or solutions realized during the training. Looking at the responses to the first question in Tables 1 and 2, some of the concerns were still valid after the Training. The concerns here dealt with specific logistical issues and personal understanding of the course material. Both of these concerns are outside the scope of the Training Program and will not be included in the future because they focus on personalize issues that need to be dealt with by the individual. The second questions from Tables 1 and 2 address the other main point of the Training, that the TAs are given resources to utilize in their classes. The responses to these questions identify the information participants would like to see in the training and what information was most helpful in preparing them for their TAship.

Responses from the beta-test group showed that the informal Training session was beneficial for the TAs by giving them a basic understanding of their role and resources to use in the class. This group also gave specific example in the post-evaluation of what they learned showing that the TAs were able to connect the information given to them to specific needs they will have in their courses. The final evaluation post-TAship will hopefully show that the TAs did utilize the suggested resources from the Training program.

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Artifacts: Training Appendices

Appendix A - METC TA Training Agenda

Date: TBD
Time: 9AM – 2PM
Location: TBD

Time	Activity
9 AM	Welcome/Introductions/Pre-Training Questionnaire
9:20 AM	Part 1: TA Expectations • Requirements • Balancing TA responsibilities with grad school, research, and life in general • Meet with METC Director during semester
9:45 AM	Part 2: Teaching-as-Research • Classroom assessment techniques • How to give effect help when answering student questions
10:20 AM	Break
10:30 AM	Part 3: Learning-through-Diversity • Understanding your students • Utilizing different learning styles • Planning discussion lessons • Engaging students in material
11:15 AM	Part 4: Learning Communities • TA resources • Presentation skills
NOON	Lunch with previous TA's from each course/ discussion about TA concerns
1:30 PM	Recap of lunch discussion/Post-Training Questionnaire
2 PM	Training is over ☺

Appendix B – Pre-TA Training Program Survey

1. What are characteristics of an effective TA?
2. On a scale of 1 to 10 (1 being low, 10 being high), how confident are you in being an effective TA?
3. What questions or concerns do you have about being a TA?
4. What do you hope to learn from this TA Training Program?

Appendix C – Post-TA Training Program Survey

1. What can you do to be an effective TA?
2. On a scale of 1 to 10 (1 being low, 10 being high), how confident are you in being an effective TA?
3. What questions or concerns do you still have about being a TA?
4. List at least two things you learned from this TA Training Program.

Appendix D – After Completion of TA Experience Survey

1. Did you use any of the resources identified during the TA Training Program while you were a TA? If yes, which resources?
2. Did you use any of the techniques you learned during the TA Training Program in your course when you were a TA? If yes, which techniques?
3. On a scale of 1 to 10 (1 being much less than average, 5 being average, 10 being much more than average), how much time did you spend preparing for your TA experience during the semester?
4. On a scale of 1 to 10 (1 being low, 10 being high), how effective were you as a TA?
5. What aspects of the TA Training Program, if any, were helpful to you during your TA experience?
6. What additional topics do you think should be included in the TA Training Program in future years?

Appendix E – beta-Test METC TA Training Itinerary

Date: January 2012
Time: 1:30PM – 3:30PM
Location: WID

Time	Activity
1:30PM	Welcome/Introductions
1:45PM	Answer pre-training questions • What questions or concerns do you have about being a TA? • What would you like to learn from this training?
2:00PM	TA Responsibilities
2:10PM	Specific Course Responsibilities
2:20PM	Balancing the TA Role
2:30PM	Office Hours
2:40PM	Active Learning/Engaging Students
3:00PM	Tips on leading Discussions
3:10PM	Answer post-training questions/Reflection • What questions or concerns do you still have about being a TA? • What did you learn from this training? Personal Reflection • Write down two things you learned during this training that you will try during your time as a TA.
3:20PM	Exchange electronic documents
3:30PM	The End ☺

Appendix F – beta-Test Pre-Training Survey

1. What questions or concerns do you have about being a TA?
2. What would you like to learn from this training?

Appendix G – beta-Test Post-Training Survey

1. What questions or concerns do you still have about being a TA?
2. What did you learn from this training?

Reflection

How has your internship experience influenced your understanding of Teaching-As-Research Learning through Diversity, and Learning Communities?

The Delta Internship has sculpted my teaching ideology in many ways and has broadened my ability to improve my teaching skills. This experience gave me the opportunity and tools necessary to use my research skills in a teaching environment. I am confident that I will be a more effective teacher in the future by utilizing the skills I learned while working with students and using assessments to measure the impact of my approaches.

<u>Teaching-as-Research</u>
The Molecular & Environmental Toxicology Center (METC) requires their graduate students to be a Teaching Assistant (TA) for 1 semester but there is no formal training or guidelines for students. The goal of my internship project was to design a TA Training Program specific to the needs of METC graduate students and to provide future TAs with effective teaching tools and resources before they fulfill their TA responsibilities. The internship aided in my understanding of ways to assess teaching and how to use qualitative and quantitative data to measure student learning and identify areas of improvement. Using a TAR approach, I collected data on the TA Training Program and used it for session improvements. The METC TA Training Program will serve a small group of students (3-7) every year; therefore collecting meaningful quantitative data is difficult since the number of subjects is small. I am now more aware of how to analyze qualitative data and how to use the data from open-ended questions to guide my evaluation efforts of the TA Training Program.

<u>Learning Communities</u>
Before I started to design an appropriate TA Training Program, I looked to the learning community for ideas and contacted several science-related programs (Biocore, College of Agriculture and Life Science, etc.) that currently hold TA Training Programs for graduate students working in undergraduate courses at the University of Wisconsin-Madison. I learned about what each program entailed and gathered resources from these existing programs. During the semester, I attended Roundtable Discussions and Brown Bag Buzz sessions to gathering the perspectives of others in the teaching community. I incorporated their ideas into the METC Training. Attending the Delta Internship seminar was also beneficial in seeing how other graduate students were able to use the concepts of learning communities in their projects and I was able to use some of these ideas in the training plan I created. All of the programs I attended were advantageous in designing a TA Training specific to METC that could be evaluated and assessed for improvement.

<u>Learning through Diversity</u>
It is important to recognize that teachers are often comfortable presenting course material in a certain way and students often learn best from a particular teaching method. Sometimes the most effective teaching styles do not match for teachers and students. My goal was to prepare future TAs to use a variety of teaching styles in order to engage a diverse range of student learners. The TA Training program will help future TAs understand how to utilize multiple methods of teaching to reach all students. A key aspect of this Training includes showing participants how to use different strategies, like small group discussions or mini-presentations, so the TA's teaching style benefits more students through the diversity of presented course material.

Tox Land Outreach Game

Background

Synopsis

Graduate students in the Molecular & Environmental Toxicology Center (METC) at the University of Wisconsin-Madison develop outreach activities for the general public with the goal of teaching the public how a person's actions can affect other people, animals, and the environment. METC outreach activities are presented at two campus events open to the public: Wednesday Nite @ the Lab in December and Science Expeditions in April, along with smaller venues such as afterschool programs. These outreach activities are designed to teach people of all ages, from elementary school to adulthood, and promote a better understanding of toxicology. Tox Land, an outreach activity I created for METC, is a life-sized game that teaches players how a person's daily actions can lead to positive or negative outcomes/consequences for them personally or for the world. I articulated the learning goals for this game, designed it and created an evaluation so we could determine what participants were learning from this activity. The game has proven popular among participants who attend scientific programs open to the public and our goal is to evaluate if participants are improving their general knowledge about toxicology by partaking in the game Tox Land.

Overview Tox Land is a life-size game that takes participants on a colored pathway through toxicology-related events at a local and global level.

Learning Goals for Tox Land are listed below and are for all participants ranging from first grade to adult. Each Learning Goal can be adjusted in depth depending on the age of the participant. Participants who play the game should be able to:

1. **Explain what toxicology is and that Toxicologists are scientists.**
2. **Discuss how daily occurrences have toxicological effects on people, animals, and the environment.**
3. **Identify toxicologically relevant situations that have occurred at a global level.**

How to Play All players will line up at the START and the game leader will first ask all participants if they know what toxicology is and what toxicologists are; once participants respond, both terms will be further elaborated upon. The first player will pick the top card and read (or be read) what it says. The player then needs to decide if the card is depicting an activity that will benefit or harm people, animals, and the environment. The player with the card is encouraged to discuss the topic with the other players. Card topics will be discussed and explained. After player #1 has moved to their spot on the game board, which is determined by the colored square(s) on the cards, it is player #2's turn to pick a card and read it (or have it read) out loud. All players continue to take turns picking cards, reading them to the group, and moving down the colored path until they reach the END. As players make their way from START to END they pass by several signs that identify global situations related to toxicology and the world. Each sign reads like a story when describing these global events. Once players make it to the END they receive a prize for finishing the game.

Evaluation Participants who finish the game are asked to fill out a short questionnaire, as shown below. These evaluation questions target the previously stated Learning Goals and are designed to determine if there is an increase in knowledge about toxicology in general, how personal choices may affect others and global situations that have toxicological relevance.

Tox Land Evaluation Questions

1. What did you learn about toxicology?

2. In your own words, what do you think this game was trying to show?

3. Did this game increase your understanding about daily choices that can affect people, animals, and the environment?

□ Yes □ Maybe □ No

4. Did this game increase your understanding about important global situations and how they affect the world?

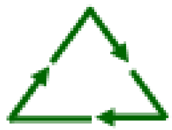
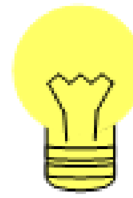
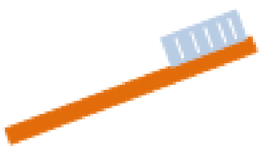
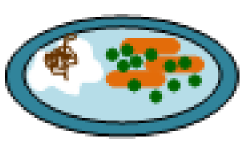
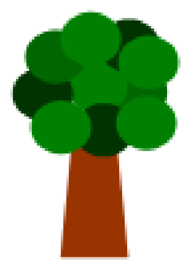
□ Yes □ Maybe □ No

Finale

Learning Goals were determined and used to create relevant evaluation questions that would identify if the game effectively teaches the correct ideas and concepts about toxicology. Tox Land was picked for evaluation since this game is commonly used during outreach events. Collecting evaluation information allows us to ensure that the correct ideas are demonstrated by the game and that participants understand those key points. Evaluations are important as we continually try to improve current outreach games, such as Tox Land, and design new activities that teach about toxicology.

Artifact III: Tox Land Game Components

Playing cards:

When you have leftover food, you store it in a reusable food storage container instead of using plastic wrap which will be thrown away. 	You use recyclable plastic cups and plates at large gatherings instead of polystyrene cups and plates which are not recyclable. 	You switch all your incandescent light bulbs to compact fluorescent light (CFL) bulbs. 
You turn off the faucet when you brush your teeth so water is not running when you do not need it. 	An adult fixes a leaky faucet or a running toilet to save water. 	An adult switches to paperless billing or electronic bills instead of paper bills sent through the mail. 
You use the microwave to reheat small amounts of food instead of using a stove or oven. 	You participate in a park cleanup on Earth Day. 	You plant a tree. 

Reflection

Outreach is an important way to communicate science to the general public. Graduate students in my program, Molecular & Environmental Toxicology, seek ways to partake in outreach and I find it important to be involved in these activities. Besides attending outreach events, I think it is important to frequently design new material to use when discussing science with the general public. I created Tox Land to inform children about important aspects relating to Toxicology. To my surprise, it's not just the children who enjoy Tox Land but adults ask to play as well.

This game can be modified for different age groups by changing the questions and conversations that each card initiates. When children pick a card that reads, "You plant a tree." I ask them if this is good or bad for people, animals, and the environment. Then we talk about why this would be good and focus on how plants are beneficial to cleaning the air. If an adult picked the same card I would ask them if this was a good or bad action too. Our following conversation would discuss clean air but also different types of trees to plant and where we could plant trees. We would also talk about other ways to help the environment with landscaping. The cards are informative and lead to science based discussions. The most rewarding part is when participants realize there is a new way they can conserve energy or keep material out of landfills.

Creating Tox Land and determining learning goals was a great way to reflect on teaching to a broad audience. The learning goals also help focus the presentation of game material and the conversations that arise from playing the game. Another great aspect in my experience with Tox Land was determining ways to evaluate the effectiveness of the game in helping participants meet the learning goals. Evaluation and reflection are important techniques to use in teaching at any level to make sure students and participants have a positive experience and learn something valuable.

Conclusion

My contributions to teaching started when I progressed from the role of student to that of a TA. From that point forward I realized how much a teacher can impact their students simply by the way they prepare their course material. Since then I have realized material presentation, use of class time, and the style of homework questions also play a role in enhancing student learning. I have gained an appreciation for teaching and learning that fuels my passion to continue teaching.

Throughout my graduate career I have sought ways to teach undergraduate students through research mentoring, peers in courses as a TA, and the general public in outreach activities. All of these teaching experiences are important and each uses a unique approach to engage the audience. Being able to participate in different styles of teaching allows me to adapt my teaching style to the needs of the students.

My favorite example of modifying my teaching strategies occurred when I began teaching first grade Sunday school. I already participated in a Delta course about effective communication to the general public and a seminar on mentoring but was not as prepared as I thought I should be to design lesson plans for children. The first couple classes were a learning curve for me but then I realized that the information I was learning through the Delta program could be used in my first grade class as well. I started thinking more about the strategies I'd learned and how to make my class more active for the children. At that time I was also co-facilitating a course about research for undergraduates. I started using the ideas from the Delta program in my first grade class and eventually used what I learned from the children to help modify how I led the undergraduates and vise versa. This was a great way to use common practices and still reach multiple levels of learners.

I'm excited to learn more about effective teaching tools I can use for students of any age. I also look forward to teaching opportunities in the future. I continually find ways to improve my current teaching skills by participating in teaching-based discussions and symposiums. I hope to utilize what I have learned in a course of my own and am eager to see how my research skills integrate into my teaching to facilitate better student learning.