

# Teaching and Learning Portfolio

By

Ashley M. Driver, Ph.D.

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## Teaching Philosophy

“The mediocre teacher tells. The good teacher explains. The superior teacher demonstrates. The great teacher inspires.” ~William Arthur Ward

Within this quote lies my main goal as a teacher and the hopefully result of hard work to improve my skills in teaching. Over my academic career I've met instructors who have fit in all the aforementioned categories with the fewest number comprising the last. I can better understand this stratification after being more critical of the classroom environment. It is one thing to present material to students and another to engage students, especially in the sciences.

I think it's critical for one to understand the true meaning of teaching science. Contrary to popular belief it's much more than textbooks and exams, pop quizzes and lab exercises. It's a process that should encourage and challenge one of the most fundamental elements of science: discovery.

But what is discovery? It's the act of investigating, interpreting, applying knowledge, and gaining new perspectives. Although basic in principal, discovery has appeared to be somewhat lost in translation among classrooms that rely heavily on memorization and regurgitation of material. As such, it is my goal to incorporate this concept into my own teaching methods and provide opportunities for students to question material and investigate real-life problems in science.

It is important to keep students engaged, to foster the use of discovery in their own learning experience. Lectures, although PowerPoint based, should provide stop-points for student interaction or discussion and material from these periods can then be applied when addressing more complex issues in the research literature. Discussions should be based around these topics to encourage students to create thoughtful and thorough conclusions. Recent news articles, case studies, and research papers will be used to foster these periods. Laboratory sessions should be designed and integrated with the current lecture material to enforce critical topics and provide a chance for a student to bring the science to life

To determine the effectiveness of these methods, assessments should be short and given often. This allows for feedback on the student's understanding of the material in addition to the level of understanding that the class as a whole is taking away from the teaching sessions. This is also an opportunity for the teacher to assess what messages the students are actually taking away from each period and how effective the teaching methods are. Examinations should target the diversity of learners within the classroom and consist of application questions where students should connect concepts rather than just repeat vocabulary and reactions.

I never want to stop learning and I never want to stop learning how to teach. We live in an ever-changing world and as such I think that it's critical to adapt to each setting and learn through your students what methods work and what ones don't.

In addition to all of this, I want to bring enthusiasm with my teaching. To inspire someone, you must make him or her believe in the material and concepts as much as you do. Through this you can build trust with the student, as they will understand that you are there to help foster their understanding. In turn, the instructor can have trust in the student to provide a strong effort to learn the material.

Instructors are responsible inspiring the next generation and as such it is a responsibility to take care in teaching. I take personal regard to this as the main reason I entered into graduate school (with the goal of teaching) was because of two instructors who took the extra time to have enthusiasm and commitment to their teaching. Because of them I am inspired to teach today, and can only hope to perpetuate through a student in the future.

## **Introduction: Integrating the Delta Pillars into my teaching**

My work with the Delta program has shown me the importance of incorporating the three main pillars into my teaching practices. That is, Learning-Through-Diversity, Learning Communities, and Teaching-As-Research. The following artifacts will reflect my experiences incorporating these pillars either singly, or in combination to improve and refine my teaching practices. Specifically, Artifact 1 will address my experiences as a mentor to undergraduate students in the lab. Through these students I began to appreciate the real meaning of “diversity” as I was faced with students who had starkly different research backgrounds and career goals. I also encountered differing abilities in the lab, which made me think more critically about my role in the lab for them. In addition, I participated in a course on mentoring which incorporated the importance of learning communities. I was then able to further my experiences of diversity, in artifact two.

During artifact 2 I reflect on my teaching experiences in a veterinary genetics course. While designing and executing my lecture for this course I found that I had to consider multiple aspects of the student body diversity ranging from background knowledge, religious beliefs (as my lecture was on controversial embryo work), and learning styles (to name a few). In addition, there was a new aspect of diversity with the potential that students may have actually been a product of IVF and as such it was critical to take care in my presentation of the technology. Prior to my experiences with Delta, I had not thoroughly considered these dynamics. Through this realization though, I believe I was able to more effectively connect with the students during lecture, allowing them to become more comfortable and actually have fun learning. This continuation of making learning fun is then discussed in my third artifact.

Artifact 3 will present the third pillar of Delta: Teaching-as-Research. During this artifact I will present data from a study I conducted at the Wisconsin Institute for Discovery where I implemented inquiry-based learning. During my time here I was able to work with 7<sup>th</sup> grade students and assess the effectiveness of these methods while teaching genetics. I believe you will find the results both exciting and encouraging.

In the last artifact presented, I will circle back to my experiences with learning communities. This past summer I was able to be a breakout facilitator at a conference aimed at teaching (Teaching and Learning in the Animal Sciences). It was during this time that I was able to speak with others about the pillars of Delta and the hope for change in teaching for our students.

## **Artifact 1: Improving communication and learning with an undergraduate mentee**

The undergraduate research scholars program (U.R.S.) provides the opportunity for incoming freshman to receive early experience and training in research laboratories on campus at the University of Wisconsin-Madison. My professor asked my permission to take on a U.R.S. student and I saw this as a great opportunity to work hands-on with a student who had minimal training. My student was in the pre-pharmacy track and had no prior experience in the laboratory. As such I wanted to make sure that the lab would provide an inviting environment (rather than intimidating). As such, I provided her with a detailed handout that broke down laboratory techniques and information into simpler more straightforward diagrams and tables. I worked one-on-one with the student to train her in basic techniques (*i.e.*, - how to use a micropipette) and trained her by first showing how to use the tool, observing her use the tool (and providing time for any questions), and then allowing her to be independent with the tool (but still being available if needed). This allowed her to gain independence over time. I also met with her for 5-10 minutes each day she came in the lab to go over what she had accomplished, what her goals were, and anything she had questions about. After two semesters, she had learned basic laboratory techniques and collected a small amount of data, which she presented in a poster session for U.R.S.

## **Artifact 1: Initial handout for mentee at the beginning of mentoring experience Khatib Lab Basics: Measurements and Pipetting**

Composed by: Ashley M. Driver

So before we get into detail on a project for you to complete, it's very important we get the lab basics down first. Learning these methods correctly can be used throughout your academic career as a scientist, so take your time and ask any questions you may have. Furthermore, without good technique your results can be ruined or incorrect (which is both frustrating and simply no fun). So let's get started:

### **The Basics:**

Our lab functions on using very small amounts for reactions and as such its important to get comfortable working in microliters ( $\mu\text{l}$ ). Below are examples of two basic conversions you should know:

$$\begin{aligned} 1 \text{ milliliter} &= 1,000 \mu\text{l} \\ 0.5 \text{ milliliters} &= 500\mu\text{l} \end{aligned}$$

### **Pipetting:**

The most important technique you may ever learn (in my opinion!) is how to properly pipette liquids. It may seem simple but one slip can completely throw off a reaction (remember you will be working with small amounts!). When you are learning remember to take your time. When you rush you can make mistakes so just relax and go slowly so that you get things measured out correctly ☺ You are here to learn and I want to make sure that you are able to be successful!

The pipettes we have in the lab come in a different range of volumes. Always use the correct pipette for volumes, and don't go beyond the range of volume marked on it as you can break the pipette! The basic pipettes we have are those that go from:

0.1-2.0  $\mu\text{l}$   
0.5-10 $\mu\text{l}$   
2-20 $\mu\text{l}$   
20-200 $\mu\text{l}$   
200-1,000  $\mu\text{l}$

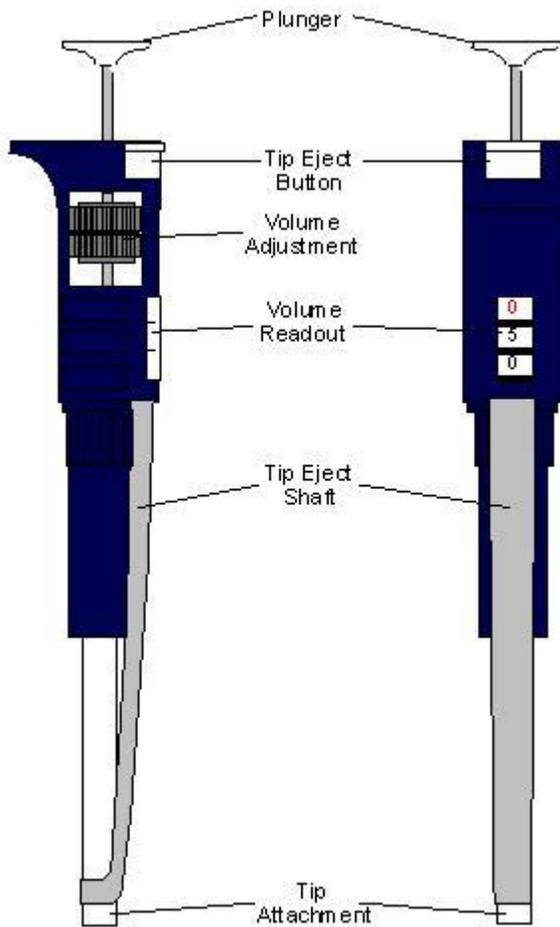
If the volume you need to pipette overlaps between two different pipettes (i.e.-You need to measure out 0.8  $\mu\text{l}$ ...the 0.1-2.0 $\mu\text{l}$  or 0.5-10 $\mu\text{l}$  could be used) try to use the pipette on the lower range, as it will be more accurate to your amount. This is just a general rule of thumb though and as long as your volume is in a correct range either pipette will get the job done though.

I found a pretty handy video on pipetting basics, which I think will be very helpful in giving you an intro before you come into the lab. I apologize in advance as the video itself is small in size but the pointers it gives are really valuable. I'd appreciate if you'd please watch this video prior to coming into the lab. It can be found at:

<http://biosci191.bsd.uchicago.edu/labdocs/pipetting.mov>

Along with different sized pipettes there are different sized disposable tips that we use for them. On the top of each pipette will be a color (Blue, Yellow, or White). Rule of thumb is that the color on the top of the pipette matches the color of tips you should be using! Never fear if you forget this, as the tips will only fit on the pipette they belong to so you can't match the wrong tip to pipette (but you can feel silly when you try to!). The tip/pipette matching goes as follows:

0.1-2.0  $\mu\text{l}$  (White/clear tips)  
0.5-10 $\mu\text{l}$  (White/clear tips)  
2-20 $\mu\text{l}$  (Yellow tips)  
20-200 $\mu\text{l}$  (Yellow tips)  
200-1,000  $\mu\text{l}$  (Blue tips)



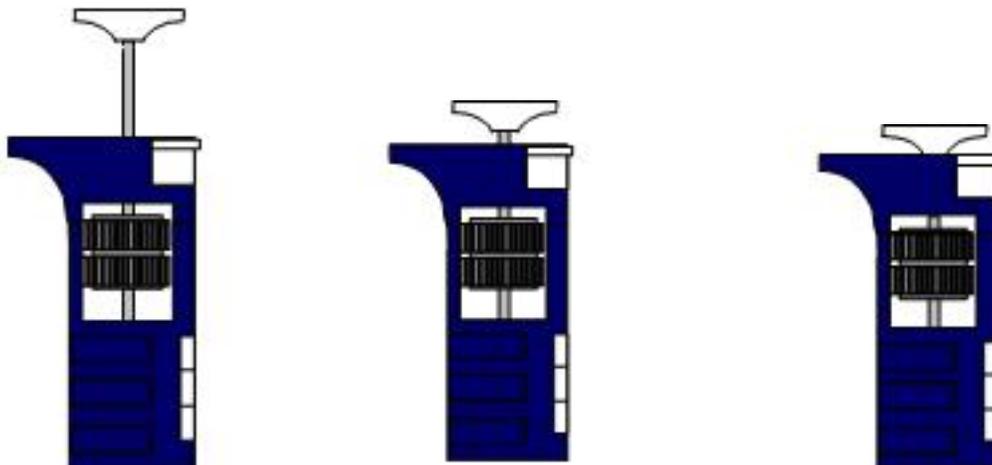
**Pipetting basics:**

- 1.) The line on the volume readout is your decimal
  - a. **DO NOT** go past the limits of the pipette!!
  - b. If your pipette has a **BLACK ring** that says “unlock/lock” you must turn it to unlock before changing volumes.
- 2.) Tips coordinate with the color on the plunger of the pipette
  - a. Yellow tips to yellow pipette
  - b. Large clear tips for blue pipette\*
- 3.) Once there is liquid in the tip do not tip the pipette upside down or lay it down!
- 4.) To eject a tip off of pipette use the ejection button by your thumb.

**Position 1:** Pipette plunger is at rest.

**Position 2:** Plunger is pushed to **FIRST** stop point (resistance).  
-Pick up sample (go back to position 1)

**Position 3:** Plunger is completely depressed  
-Depositing sample (then go back to position 1)



**Reflection:**

Overall, I believe the techniques that worked best were the use of an initial handout with diagrams on basic techniques and rules/guidelines for the lab. This allowed the student to know initial standards for the lab and have a “cheat sheet” for basic techniques that she may need a reference for. I also believe that by allowing her to observe, show, and then independently work gave her the opportunity to explore the science without feeling that she was left “alone” to figure out how things work. She seemed willing to become independent as long as she knew that I was available if needed.

To improve my mentoring, I also later enrolled in a Mentor Training Seminar through the Delta program. This seminar course brought together grad students who had either mentored in the past or had current mentees. We met and discussed challenges, benefits, and approaches to having a student. I was able to use my experiences to share with other and improve my own perspective of being a mentor. One of the topics we discussed focused on facing diversity in our mentees. When you meet your student there are many factors to consider including their interest level, future plans, background training, and basic math skills. One must also consider how responsible the student is and how independent they are. I think to address these matters it would be of best interest for both mentor and mentee to survey each other. Perhaps give a handout with scenarios asking 1-10 how comfortable would they feel (I.e.- How comfortable are you handling and operating a micropipette? On a scale of 1-10 how comfortable are you with calculating dilutions). This would provide a starting point for mentor and mentee and perhaps allow the mentee to become more comfortable in the lab. Although I tried to address this with my mentee, I know that I can be more thorough in my initial meetings to make sure we have a good understanding of each other. In addition, I would have more structured meetings with my mentee, as this would facilitate better progress between mentor and student and allow for perhaps more productive conversations. I may also present a small survey or checkpoint quiz to make sure they have a good grasp of what is occurring in the lab.

## **Artifact 2: Integrating active learning through case-studies into standard veterinary genetics lecture**

On the University of Wisconsin-Madison campus there is an upper level Veterinary Genetics lecture that is taught each Spring semester that consists of approximately 20-30 students. It's during this course time that students learn about applied molecular genetic techniques in terms of human and animal conditions. My Ph.D. professor rotates teaching this course and during the Spring 2010 semester asked if I would be a teaching assistant. I had guest lectured the course the prior academic year but had not been involved beyond that. By becoming a teaching assistant I was actively involved in laboratory activities and grading. I also attended more lectures to stay informed about the material students were learning.

In addition, I was able to guest lecture again for the course. With the goal of improving on my lecture from the prior year, I decided to integrate some active learning techniques to help break-up the teaching session and involve students more. Tools that I utilized included PowerPoint slides with open questions (that I would ask the students to answer), Graphs/tables that I would stop and ask the student to explain, and a break-out session towards the end of the period where students formed groups and discussed questions related to case-studies I presented.

More specifically, I lectured on the genetics of *in-vitro* fertilization (IVF) for my lecture. During this time period I presented information on genetic disorders and potential links to IVF, genetic diagnosis tools for IVF, and lastly the use of genetics to create "designer" babies. It was from this that I presented 2-3 case studies regarding differing reasons for using genetics with IVF. Students were then allowed to discuss in groups of 3-4 the potential sides for the argument made in the case study. Then, the whole class was brought back together to discuss opinions. If there was a quiet moment where students weren't responding, I had questions prepared which I asked to continue dialogue and conversation.

### **Case Study Example:**

In a tragic bonfire accident in 1999, Alan and Louise Masterton lost their youngest child, three-year-old Nicole. Devastated by their loss, the Mastertons, who have four sons, argued that whilst they were not seeking to replace Nicole, they had been trying for a daughter for fifteen years. Louise Masterton had been sterilized after the birth of Nicole and needed IVF to have another child. The Mastertons wanted the HFEA to allow them to undergo IVF treatment and select a female embryo using embryo biopsy. They argued that their family had a strong psychological need for a daughter. However, the HFEA will only consider an issue if a clinic applies to them for a license. The Mastertons could not find a UK clinic that was prepared to take up the case on their behalf and so sought treatment in Italy instead. However, only one male embryo was produced, and this was donated to an infertile couple.

Source: The BioEthics Education Project (<http://www.beep.ac.uk/content/114.0.html>)

## **Artifact 2: Reflection**

Overall, students were much more engaged in the lecture using active learning versus the semester prior (without active learning). Evidence of this, could be noted in the high level of student engagement. At the end of the lecture when the case studies were presented student discussion actually ran over the class period. However, students stayed to finish final points. This showed that the student interest was high enough to find importance in concluding thoughts rather than rush out of the class. In addition, student feedback was very positive (and enthusiastic) about the material. Evidence of student satisfaction was present in the final class evaluations where numerous students mentioned that they really enjoyed my lecture.

Although I found success in use of the case studies to promote active learning, there are some changes that I would make to improve the student experience. As I mentioned before, learning through diversity has become part of my teaching focus. I was impressed and somewhat amazed at the responses I received from students when discussing the case studies. Although I was expecting scientific/biology answers some people brought in politics or religion. I even found out that one of the students had a sister born from IVF. I had never considered the diversity of opinion among students. I think it may be helpful in the future to perhaps survey the students prior to the class-period to understand their background and their current knowledge of the topic. This would allow me to adjust my lecture and also to remain respectful with a topic that can be rather controversial. Although I want to teach the topic, I don't want to offend or to make students uncomfortable and so remembering to prepare for the diverse answers and understanding I will face is critical.

### **Artifact 3: Assessing the effectiveness of inquiry-based hands on outreach laboratory activities on improving student knowledge in genetics**

#### **3.A Abstract:**

Studies have shown that both middle and high school students in the United States have insufficient knowledge in the field of genetics. In addition, there is a high occurrence of misconceptions about genetic topics, especially those involving molecular genetics. Since these students are the future, it's important to investigate and improve on current methods to best prepare them for careers and higher education. One way to improve student knowledge is to challenge them through inquiry-based learning, which focuses on deep-thinking and student collaboration. To incorporate these methods into student learning, a hands-on genetics laboratory activity was designed and implemented at the Wisconsin Institute for Discovery. Twenty-seven seventh grade students participated in an hour and a half long laboratory that taught basic principles of DNA. Two main activities were used which fostered student discussion and exploration through collaboration and simulation of real laboratory experiments. Both activities were designed to address common misconceptions about molecular genetics/DNA presented by the American Academy for the Advancement of Science's Project 2061. Assessment was done through pre-/post- testing to determine if the students were able to apply knowledge gained in the activity. The assessment consisted of four questions that integrated recall with application of knowledge. In addition, students were asked to rate their interest of genetics on a scale of 1-10. Results showed statistically significant improvement on overall pre-/post- test scores (Fisher's Exact Test,  $P < 0.05$ ). In addition, analysis of individual questions showed statistically significant improvement for all questions comprising the total score ( $P < 0.05$ ). However, student interest in the topic remained statistically unchanged. Furthermore, there was no statistical difference between male and female scores. Overall, student scores improved suggesting that the methods used in this laboratory were successful in addressing common areas of misconceptions in genetics and resulted in improved student understanding.

### **3.B Introduction:**

The issue of education standards and the level of understanding our nation's children have become a growing issue. One method to assess how our students are learning is through national testing. The National Assessment of Education Progress (NAEP) assesses knowledge in grades 4, 8 and 12 in the United States. Results from one of the most recent tests (in 2000) showed severe deficiencies in knowledge for both 8<sup>th</sup> and 12<sup>th</sup> grade, with one-quarter of the knowledge exam covering topics in genetics (O'Sullivan et al., 2003).

Among answers given for the genetics portion of the exam there were significant deficiencies on questions dealing with molecular genetics. On all questions within this area no topic had greater than 21% complete answers. Of the lowest scoring topic, "Interpreting Genetic Material", there were only 1% complete answers and 83% incorrect answers given (O'Sullivan et al., 2003).

The American Society for Human Genetics posted a bulletin in 2008 highlighting a follow-up study. This study examined 500 randomly chosen essays from 2,443 total that were submitted for a National DNA Day Essay Contest (Mills Shaw et al., 2008). The purpose of this study was to identify if student misconceptions were still present in genetics and in what categories they could be defined. Among misconceptions, 17% were identified covering "genetic technology", 14% with "patterns of inheritance", 12.8% for both "deterministic nature of genes" and "nature of genes & genetic materials", 8.4% for "genetic basis of disease", 8.2% for "genetic research", and 7% for reproductive technology (Mills Shaw et al., 2008). Thus, misconceptions and misunderstandings are still prevalent and need to be better addressed in the classroom.

#### *Teaching-As-Research Strategy*

One method at improving student performance and understanding in the classroom is by using an inquiry-based approach. Unlike more traditional methods, involving heavier emphasis on memorizing, this approach allows students to investigate problems to better understand the world around them. This methodology also encourages collaboration among students to become involved in deep thinking to test theories and draw conclusions from them. Opportunities may then also arise to relate their findings to everyday life or the world around them.

In a study from Michigan, an inquiry-based approach was used to teach science curriculum to 6<sup>th</sup>, 7<sup>th</sup>, and 8<sup>th</sup> grade students. This method utilizes real-world problems and allows the child to apply, investigate, and conclude how or why the issue is happening. Unlike more traditional methods, involving heavier emphasis on memorizing, this approach allows students to: Investigate problems to better understand the world around them, collaborate among students to become involved in deep thinking, and test theories and draw conclusions from them. Pre- and post-testing results showed significant ( $p < 0.01$ ) improvement in test scores for each year a student participated (Marx et al., 2004). In addition, students who started with low-test scores showed

significant improvement over time suggesting that these approaches may be effective for a wide range of students.

Thus, I hypothesize that the integration of inquiry-based methods for a hands-on laboratory activity will improve student knowledge in genetics.

### 3.C Approach:

For selection of the topics for the laboratories, grade-specific standards that were created by the American Association for the Advancement of Science (AAAS) were used. Based on their Project 2061 database, focus was put on the topics with prevalent misconceptions (<http://assessment.aaas.org/>). According to this database the following questions showed prevalent wrong answers and misconceptions in grades 6-8 (Table 1).

**Table 1: Common student misconceptions regarding genetics and DNA**

Question	Percentage of correct answers
1.) The genetic code is a sequence of subunits in a DNA molecule.	53%
2.) Four different types of nucleotides are used to make up a DNA molecule, not ten, or twenty.	40%
3.) Nucleotides (not amino acids, proteins, or fatty acids) are the subunits that make up DNA molecules.	34%
4.) Both an organism's physical characteristics and its behaviors could be affected by the information in the DNA molecules.	42%

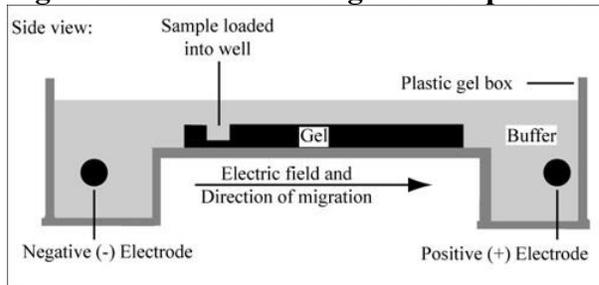
The main learning points (targeting the above misconceptions) are presented to students at the beginning of the session. Specifically these learning goals are 1.) To identify what DNA is and what it is made of (targeting questions 1-3) and 2.) Why and how we can study DNA in the laboratory (targeting question 4).

In order to approach these topics two main activities were developed. The first involved a hands-on activity with magnetic DNA molecules to discover what DNA is made of. Each student is given a single magnetic nucleotide molecule. During the laboratory period they are asked to turn to a neighbor and attempt to match the molecules they are given. A few minutes is provided so that students can discuss what is going on with the molecules and then the class is brought back together to gain conclusions. As the instructor I ask the class what their findings are. Specifically: What molecules paired together perfectly? (Students then raise hands to identify the matches of A-T and G-C). Did anyone create matches other than A-T and G-C? (The magnets will still bind incorrectly, however there will be exposed magnets showing an incorrect pairing). How do those matches compare to the A-T and G-C pairs? (Students then discuss and identify the exposed magnets or bonds between the mismatch pairs). This then transitions to a discussion of why the nucleotide order is important.

The second activity consists of a simulation of gel electrophoresis, a common technique used by researchers to study DNA. Prior to the activity students are presented with facts about DNA sequence (i.e.- The DNA sequence of two different individuals is 99% similar). Thus fostering the ideas that small differences in the DNA sequence can affect characteristics ranging from appearance to health issues. Based on this, there is a growing importance to study these small differences.

The basic mechanisms of gel electrophoresis are presented including a diagram to explain how it works (Figure 1).

**Figure 1: Mechanism of gel electrophoresis**



From this explanation students are able to gain that the negatively charged DNA migrates towards the opposite positive charge. Samples that have smaller DNA fragments (fewer nucleotides) will migrate farther through the gel before getting stopped. Students are then broken into small groups to load sample “DNA” into a gel. Food coloring is used to simulate a sample and students are told that each color of DNA is a different size. Prior to loading the gel they are asked to use the scientific method to hypothesize which sample will move farther through the gel. Then, they are able to work in groups to load the samples. Once loaded, the students return to their seats and the electricity is allowed to flow through the gels to allow sample migration.

Final discussion is then encouraged with a review of the main learning points from the activity.

Since the students will have diverse background knowledge and learning styles, I integrated multiple teaching methods for each laboratory session. For example, I will present a PowerPoint introduction to provide background knowledge on chosen curriculum which helps bring students to a more balanced starting point. Using the scientific method students will be presented with a problem and asked to create a testable hypothesis. From there, hands-on wet lab activities will be used which allows students to collaborate in groups and assess their hypothesis.

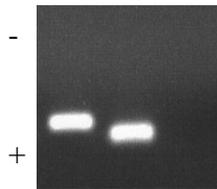
In order to foster the sense of small learning communities, students will work in groups and then gather as a class at the end of the period to share what each group found and how that relates to each other’s results. This allows students to discuss their own conclusions with each other and learn from each other’s discoveries.

All of these strategies will help implement inquiry-based learning as students collaborate during activities to understand the material, are required to think more deeply and hypothesize about an outcome, and can relate the lesson back to real-life (as we discuss how studying DNA can lead to disease identification or crimes).

### 3D: Evaluation of student understanding

In order to assess how effective these teaching methods are, students are presented with both a pre- and post-test consisting of curriculum-based questions. To match the individual pre-/post- test answers the students were asked to create a specific code. Students were also asked to mark their gender. The questions were designed as short answer, which causes the student to use applied knowledge (rather than solely memorization) to answer. The following questions were used for assessment:

- 1.) Draw the shape of a DNA molecule. What is the structure called?
- 2.) Please list the four nucleotides and how they match to make up DNA. Why is it important that they match together in a certain way?
- 3.) Why is it important to study DNA in the lab? Can you give a specific example?
- 4.) Below is a picture of a gel with two DNA samples that have been run through it. Label which band is the larger piece of DNA and which one is the smaller piece. Why are they at different places on the gel??



Students were also asked to rate their interest in genetics on a scale of 1-10 with 1 being no interest and 10 being very interested.

A rubric was then created to assess student answers to each question. The following was used to assess answers.

#### Question 1:

Points	0	2	3
<b>Drawing</b>	No attempt	Ladder shape	Twisted ladder
<b>Naming</b>	No attempt, random comment	Twisted ladder	Double helix

#### Question 2:

Points	0	1	2	3	4	5
<b>Nucleotides</b>	No correct matches	1 point for each correct nucleotide, up to 4 total points				Correct matches
<b>Rationale</b>	No guess	Mutations				

#### Question 3:

Points	0	1	2
<b>Why it's</b>	No guess	Safety, prevent	To screen



### 3E: Results

Overall there was significant improvement in pre-/post- test scores for students, while interest did not significantly change (Figure 2). Gender was not a significant factor with answers (Figure 3).

Figure 2: Average Total Score/Interest

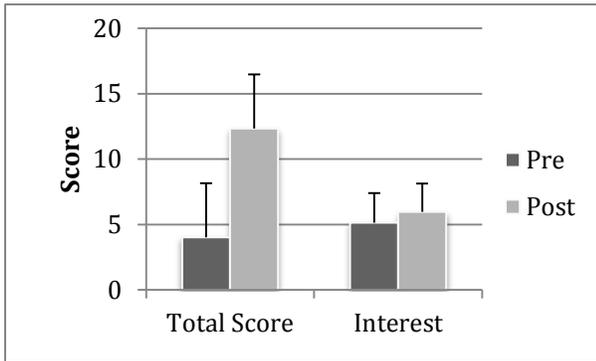
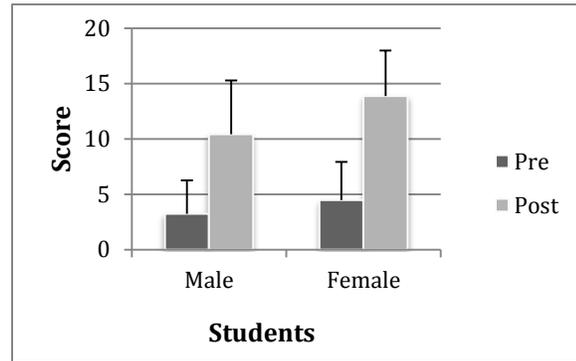
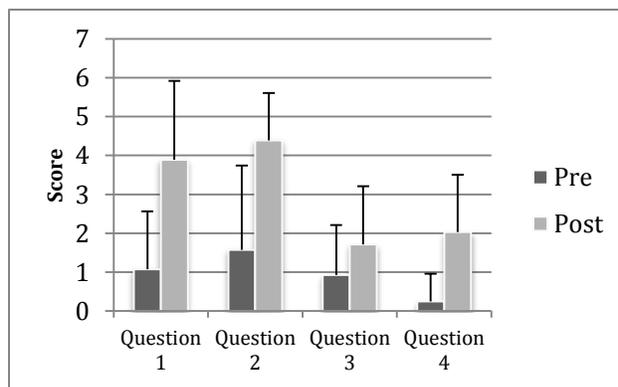


Figure 3: Breakdown of average total score by gender



Since the change in total pre-/post- test scores were significant a breakdown of pre-/post- test scores was also done for each of the 4 questions (Figure 4). All pre-/post- test results for each question were statistically significant ( $P < 0.05$ ).

Figure 4: Individual question pre-/post- responses



### **3F: Discussion:**

Overall, both individual question and overall pre-/post- test scores improved implicating that student understanding increased from this laboratory exercise. Observations of the students showed that they were engaged and that they enjoyed the activities. One strategy that seemed to be effective in this was repetition of material by asking students for answers. It seemed to be entertaining to them as well as foster involvement in the lesson.

I found it particularly interesting that scores improved while interest remained relatively unchanged. Overall, the level of starting interest was intermediate for students (average of 5.14 out of 10). There was a slight increase (to an average of 5.96) but again, not of statistical significance. I find this encouraging though as although student interest was unchanged they were still able to improve in understanding through these activities.

Although this was a small survey of inquiry-based methods, my results support current findings in the literature. Not only have these inquiry methods been shown to be effective in teaching genetics to high school students (Cartier and Stewart 2000) but also to improve the student's experience in the laboratory setting (Myers and Burgess 2003). Thus, these methods may indeed hold a lot of promise for a wide array of topics and ages.

In relation to my teaching-as-a-research question, I fail to reject my hypothesis that "inquiry-based hands-on laboratory activities improve student understanding of basic genetic topics." The pre-/post- test design seemed to be effective in evaluating student understanding. However, I think follow-up studies are necessary to improve upon my methods used and gain a better understanding of student learning. There are a few limitations and changes I would like to see in the future.

First, one of the biggest limitations was in finding genetic education standards to set my curriculum to. Currently, there are no set "national" standards for genetics education but rather state specific outlines. A recent publication by the American Society for Human Genetics assessed state-specific genetic education standards in the United States (Dougherty et al., 2011). More than 85% of states received a rating of Inadequate, calling for more comprehensive genetic education standards (Dougherty et al., 2011). This is indeed happening with the release of The Next Generation Science Standards which are based on the National Research Council (NRC) Framework for K–12 Science Education ([www.nextgenscience.org](http://www.nextgenscience.org)). Thus, more clear and consistent standards can be made as a basis for the curriculum.

Secondly, improvement could be made with the assessment questions themselves. Question 3 showed a common pattern of confused or vague answers by students, which suggests that either the topic was not clearly covered during the lab or that the question itself didn't provide enough direction. Also, it may be helpful to re-write the questions in order of increasing Bloom's taxonomy to show how much depth into the topic the students attained.

Lastly, a follow-up post-test a week or two after the laboratory experience may be a good reflection of knowledge retention as the immediate post-test may show short-term knowledge for the students.

Overall I believe this was a successful attempt at creating effective laboratory activity for students. Informal student feedback during the lab was really positive and overall the students seemed pleased with the activities based on my observations. In addition, I learned a lot about the curriculum design process itself from this experience. For example, I found difficulty in estimating the time it would take to do the activities, as students who are unfamiliar with tools or techniques may take longer. I also learned the importance of having back-up plans for preparation of activities. This also includes moments where I asked questions without much student answer. I had to be able to bring their attention back quickly and help foster discussion.

### **3G: Reflection**

***“How has your internship experience influenced your understanding of teaching-as-research, learning-through-diversity and learning communities?”***

Overall, my experience as a Delta intern at the Wisconsin Institute has been valuable in learning about many facets of teaching. First, and foremost I was able to investigate teaching-as-research which allowed me think critically about the classroom setting. Prior to being involved in Delta I had never considered teaching “as-research.” In fact, I thought it was a linear process of information transferring from one person to the next. Now I understand it is a more circular process, as you are transferring knowledge to the student and they can transfer back to you. No matter if it’s learning what teaching methods are effective or how a student understands material you are describing. I’ve gained a new importance for learning how to teaching and teaching so people can learn, and learning from them.

In terms of learning communities, I have a new found respect for them. I saw how helpful it was for students to work together in the classroom. For the students, they had a common goal of completing the tasks given and learning the material. By allowing them to work together they could learn through each other’s misunderstandings and draw conclusions through combining ideas. I think there is great power in allowing students to teach each other.

Lastly, learning through diversity is something that I have now incorporated into my own teaching. I had not considered all the different levels of diversity in the classroom. I now consider learning style and background styles on of the biggest factors when I prepare to see students. I believe that by becoming more aware of the diversity in the classroom, you become more plastic as an instructor. You can be more prepared for the unexpected. For example, some children in the classroom tended to not have the same attention or focus as others so when I would ask a question; I may get the same answer given more than once. I had to be able to think quick and not make the child, who was eager to participate but didn’t hear or understand the first time the answer was given, a positive answer and keep them involved. I found it rewarding that students seemed to (as a whole) enjoy the experience as much as I did and I felt that I handled the diverse classroom well thanks to my training from Delta.

### 3.H References:

AAAS Science Assessment-Project 2061. (2012). Retrieved from <http://assessment.aaas.org/>.

Cartier J. and Stewart J. (2000) Teaching the Nature of Inquiry: Further Development in a High School Genetics Curriculum. *Science and Education* 9:247-67.

Dougherty M.J., Pleasants C., Solow L., Wong A., and Zhang H. (2011) A Comprehensive Analysis of High School Genetics Standards: Are States Keeping Pace With Modern Genetics? *CBE-Life Science Education* 10:318-27.

Marx R.W., Blumenfeld P.C., Krajcik J.S., Fishman B., Soloway E., Geier R., and Tali Tal R. (2004) Inquiry-Based science in the Middle Grades: Assessment of Learning in Urban Systemic Reform. *Journal of Research in Science Teaching* 41:1063-80.

Mills Shaw K.R., Van Horne K., Zhang H., and Boughman J. (2008) Essay Contests Reveals Misconceptions of High School Students in Genetics. *Genetics* 178:1157-68.

Myers M. and Burgess A. (2003) Inquiry-based Laboratory Course Improves Student's Ability to Design Experiments and Interpret Data. *Advanced Physiology Education*. 27:26-33.

*Next generation science standards*. (2012). Retrieved from [www.nextgenscience.com](http://www.nextgenscience.com)

O'Sullivan C.Y., Lauko M.A., Grigg W.S., Oian J., and Zhang J. 2003. The Nation's Report Card: Science 2000 (NCES 2003-453). U.S. Department of Education, National Center for Education Statistics. Washington, D.C.: U.S. Government Printing Office.

**Artifact 4: Participating in the Teaching and Learning in the Animal Sciences Conference June 19-22<sup>nd</sup>, 2012.**

I was fortunate to be able to participate in a unique national conference held at the University of Wisconsin-Madison during the summer of 2012. The conference titled, “Teaching and Learning in the Animal Sciences” brought together students and faculty to discuss critical issues in teaching and how to improve practices. I was additionally fortunate to be a breakout session facilitator and discuss the incorporation of technology in the classroom. Namely, to discuss how the evolution of technology (i.e.- Smartphones, iPads, E-mail, etc.) has altered communication with students in and out of the classroom.

During the hour-long breakout session I had the participants break into small groups and actively discuss specific topics for about 30 minutes. Then, I brought the groups together to review their findings and facilitated questions and more thought-provoking discussion regarding these topics.

It was extremely satisfying to see the participants work together to create interesting and thought-provoking conclusions. In addition, it was really rewarding to have such discussions as each individual (there were approximately 20 in attendance to this session) had a different point of view. Thus, providing a type of “learning community” where discussion was fostered between those interested in teaching to share experiences and examine current methods and practices.

After the smaller session the conference would re-convene and discuss conclusions from each group. This really provided an avenue to progress from a small learning community to a rather large group. Everyone had a common goal or sentiment to improve teaching and the discussions allowed for collaboration and deep reflection. It was extremely helpful and motivating to see all of the different individuals participate and input opinions and methods. I really hope to see a continuation in events such as these as the overall conference provided a new network of instructors and persons with interest in teaching and serves as a stepping-stone to better and more effective teaching for our students.

# Ashley M. Driver

## Education:

### **Postdoctoral Fellow (2012-present)**

*Cincinnati Children's Hospital*

Division of Human Genetics

Focus of study: Molecular mechanisms of embryonic and postnatal brain development using forward genetics

### **Graduate school- Ph.D. (2008-2012)**

*University of Wisconsin-Madison*

Department of Dairy Science with an emphasis in molecular genetics

Minor: Endocrinology Reproductive-Physiology

Area of expertise: Transcriptomic and functional analysis of genes affecting bovine pre-implantation embryo development

Graduated: August 2012

### **Bachelor of Science (2004-2008)**

*University of Wisconsin-Madison*

Department of Animal Science with a degree in Natural Science

Graduated: May 2008

## Research Experience:

### **Research Assistant (Fall 2008-Summer 2012)**

*University of Wisconsin-Madison*

Trained in methods of *in vitro* fertilization and morphological grading. In addition, experience has been gained in polymerase chain reaction (PCR), restriction enzyme digestion, sequencing, quantitative real-time PCR, and next generation sequencing (RNA-seq). Currently working with RNA interference (via microinjection) and bisulfite sequencing methods.

### **Undergraduate Researcher (Spring 2005-2008)**

*University of Wisconsin-Madison*

Analyzed changes in synaptic protein levels related to chronic pain post-ligation of the sciatic nerve in a mouse model.

## Teaching Experience:

### **Certification in Teaching, Research, and Learning**

*Delta Program- University of Wisconsin-Madison*

In current certificate cohort with completion expected by Spring 2012.

### **Outreach Intern (September 2011-June 2012)**

*Wisconsin Institute for Discovery- University of Wisconsin-Madison*  
Responsibilities include developing and teaching genetics curriculum to high school students in the new embedded teaching labs. Completes Delta certification.

**Guest Lecturer** (Summer 2009-2012)

*University of Wisconsin-Madison*

Course: Introduction to Laboratory Techniques in Gamete and Embryo Biology (Animal Science 375)

**Guest Lecturer** (Spring 2009-2012)

*University of Wisconsin-Madison*

Course: Veterinary Genetics (Animal Science 362)

**Teaching Assistant** (Spring 2010)

*University of Wisconsin-Madison*

Course: Introduction to Veterinary Genetics (Animal Science 361) and Veterinary Genetics (Animal Science 362)

**Teaching Assistant** (Fall 2008)

*University of Wisconsin-Madison*

Course: Reproductive Physiology (Animal Science 434)

**Mentoring Experience:**

**U.R.S. Research Mentor** (Fall 2009-Spring 2010)

*University of Wisconsin-Madison*

Mentored an incoming freshman student from the Undergraduate Research Scholars (U.R.S.) program for one academic year.

**Research Mentor** (Spring 2009)

*University of Wisconsin-Madison*

Was responsible for the oversight of an undergraduate student who completed an independent project.

**Presentations:**

“In-depth RNA-Seq comparison uncovers transcriptomic variation between morphologically similar in-vivo and vitro derived bovine embryos.” Student speaker presentation at the Endocrinology Reproductive-Physiology Symposium on April 12<sup>th</sup>, 2012. Madison, WI.

“In-depth RNA-Seq comparison uncovers transcriptomic variation between morphologically similar in-vivo and vitro derived bovine embryos.” Presented for a poster session during the Accelerate Science through Collaboration

Symposium by Promega at the Wisconsin Institute for Discovery on November 9<sup>th</sup>, 2011. Madison, WI.

“The transcriptomic analysis of imprinted genes during early embryonic development in cattle.” Presented for a poster session at the annual University of Wisconsin-Madison Endocrinology Reproductive-Physiology Symposium on April 13<sup>th</sup>, 2011. Madison, WI.

“Determining the effects of imprinted genes on bovine pre-implantation development.” Workshop talk and poster at the International Plant and Animal Genome Conference in San Diego, CA held January 15-19<sup>th</sup>, 2011.

### **University Services:**

#### **Seminar Committee** (Fall 2010)

*University of Wisconsin-Madison Endocrinology Reproductive-Physiology Program*

Welcomed and escorted guest speakers for the program’s seminar series.

#### **Seminar Planning Committee** (Spring 2009)

*University of Wisconsin-Madison Dairy Science Department*

Selected seminar topics/speakers for the graduate student seminar.

### **Professional Activities:**

#### **Invited reviewer**

Animal: An International Journal of Animal Bioscience (2011-current)

#### **Invited reviewer**

Journal of Animal Science (2012-current)

#### **Break-out Session Facilitator**

Teaching and Learning in the Animal Sciences Conference. June 19-22<sup>nd</sup>, 2012 in Madison, WI.

### **Publications:**

**Driver A.M.**, Huang W., Kropp J., Peñagaricano F., and Khatib H. Knockdown of *CDKN1C* (p57kip2) and *PHLDA2* results in developmental changes in bovine pre-implantation embryos" PloS ONE. [currently under review]

**Driver A.** (2013) Embryo Genomics, in Animal genetics (ed H. Khatib), Chapter 24.

**Driver A.M.** and Khatib H. “Heat shock proteins: potentially powerful markers

for fertility in livestock species.” J Animal Sci. [E-pub ahead of print].

**Driver A.M.**, Peñagaricano F., Huang W., Ahmad K.R., Hackbart K.S., Wiltbank M.C., and Khatib H. “RNA-Seq analysis uncovers transcriptomic variations between morphologically similar in vivo- and in vitro-derived bovine blastocysts” BMC Genom 13:118. [e-pub ahead of print] *Highly accessed*.

**Driver A.**, Huang W. and Khatib H. (2012) Roles of Imprinted Genes in Fertility and Promises of the Genome-Wide Technologies, in Livestock Epigenetics (ed H. Khatib), Wiley-Blackwell, Oxford, UK.

Laporta J., **Driver A.M.**, and Khatib H. (2011) “Short Communication: Expression and alternative splicing of POU1F1 pathway genes in pre-implantation bovine embryos.” J Dairy Sci. 94(8): 4220-3.

Zhang B., Peñagaricano F., **Driver A.M.**, Chen H., and Khatib H. (2011) “Differential expression of heat shock protein genes and their splice variants in bovine pre-implantation embryos.” J Dairy Sci. 94(8): 4174-82.

**Driver A.M.**, Huang W., Gajic S., Monson R.L., Rosa G.J., and Khatib H. (2009) “Short communication: Effects of the progesterone receptor variants on fertility traits in cattle.” J Dairy Sci. 92(8): 4082-5.

Miletic G., **Driver A.M.**, Miyabe-Nishiwaki T., and Miletic V. (2009) “Early changes in Homer1 proteins in the spinal dorsal horn are associated with loose ligation of the rat sciatic nerve.” Anesth Analg. 109(6): 2000-7.