Sarah Frazer's TE 861A Unit Responses

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Unit 1: Individual Response

What is the vision of scientific literacy that the articles put forward, and how might this vision play out in your classroom?

The authors of Project 2061 strongly believe that the goal of science education is to produce adults who are conscious of the ever-changing world around us, and who are knowledgeable enough to develop authentic solutions to the problems that are eternally arising such as acid rain or deforestation (*Science for All Americans*). Currently, science education is plagued by overworked teachers who are underprepared in their own content area, instruction that encourages students to memorize answers instead of exploring unsolved questions, and a depth of content that is far too much for students to truly learn and understand. Project 2061 suggests that by teaching less, science educators will be able to teach the content better, specifically in developing the scientific literacy of all students – such as teaching students to think in a scientific way, and to understand and apply key principles of science in the natural world (*Science for all Americans*). To think about it another way, instead of teaching students specific scientific content, *Benchmarks* suggests that educators teach students how to learn science, and that every lesson be based not on content but on the process of learning. Essentially, the content of any lesson could be substituted with other science material, and the learning goals of the lesson would not change.

Obviously, it is becoming increasingly imperative to educate our students such that they become adults who are able to not only function productively in society, but to aid in producing the solutions to the next generation's problems. I once heard a statistic that claimed we are preparing our students for jobs that do not even exist today. How can we possibly do this without producing scientifically literate young adults? In my own classroom, I believe every lesson should have a learning goal or outcome that focuses on scientific literacy, similar to the goals that *Benchmarks for Scientific Literacy* suggested. I also believe that what my students learn is not nearly as important as *how* they learn, and that they recognize that as well. My school incorporates habits of mind and character education into all core content areas, and my students reflect on their learning and progress after nearly every activity. I also agree with *Benchmarks* in that one curricular method is not going to be productive for every group of students, and that educators from all disciplines should feel comfortable working together to determine the curriculum that will create the type of adult they wish to produce.

Unit 2: Individual Response

Briefly describe the multiple uses of assessment included in Chapter 5. What uses are new to you? Explain why assessment has such a central place in this description of the reform agenda.

If our goal as science educators is to produce young adults who are scientifically literature, we must begin to look at our assessment practices in a new light. The *National Science Education Standards* suggest that in order for reform in science education to take place, teachers must participate in improved assessment techniques that will allow for increased communication to all stakeholders. Assessment should not only be a tool that drives instruction, but it should also be a learning process for students. All scientific areas of understanding should be measured using multiple methods, as this will lead to the best results in improving science education (*NSES*, 76).

In the past, educators and stakeholders alike have viewed assessment as written tests that indicate whether students have learned the material presented to them. *NSES* proposes that assessments can and should include much more than written student work – they should give students opportunities to demonstrate their understanding in ways that are similar to what they will experience in real life (*NSES*, 78). Many traditional assessments focus on "inert" knowledge, or students' ability to memorize random bits of knowledge. As educators, we must allow students to apply these bits of knowledge to real world situations – matching up the content being tested to the way we measure student understanding, or in other words, stimulating and examining "active" knowledge (*NSES*, 83). These authentic performance assessments should be used not just to drive instruction and provide data about student achievement, but also to both make explicit to students what is important to learn, and to encourage them to take responsibility for their own, self-directed learning. Just as members of the scientific community converse with one another about their own knowledge, we must support our students in identifying qualities in their work that demonstrate understanding of certain concepts.

None of these uses of assessment are completely new to me, although it is a daunting undertaking to incorporate real-world, authentic performance tasks into all aspects of the scientific curriculum I teach. I try to always encourage my students to reflect on their knowledge, and I give them lots of choice in determining how they will exhibit their understanding of material. As a teaching team, we write "I can…" statements for all benchmarks that we teach, making the content accessible to students as well as providing them with a simple way to determine if they have truly learned the material – if they *can do* what the "I can…" statement says.

Unit 3: Individual Response 1

Question 1: What do you find to be the key points of each of the readings? Describe the key points each reading makes about understanding, and your reaction to them.

Article 1: White, R. and Gunstone, R. *Probing Understanding*, Chapter 1: "The Nature of Understanding." (1992)

Authors White and Gunstone do not settle on one definition of understanding in education. In fact, they believe that the low levels of student comprehension the country is experiencing are a direct effect of limited definitions of understanding that school districts endorse (2). Instead, White and Gunstone propose that understanding can be comprehended at multiple levels, from basic to complex.

At a fundamental level, students can understand concepts; in other words, they can use images or experiences to give meaning to a word or definition. Because different people can "understand" concepts differently (or make connections between their own unique, personal experiences), it leads to the conclusion that understanding lies on a continuum and can never truly be complete (4).

The authors suggest that an individual may also have an understanding of an entire discipline. As it is impossible to claim that one person – no matter how learned – could have all of the knowledge of an entire content area, it is reasonable to say that there is no one set of skills or understandings of which a discipline is comprised (7). As teachers, we must impart to our students the idea that the understandings necessary to be successful at any scientific subject are subjective. Once again, we see evidence that understanding is not linear (7).

Throughout their description of the multiple facets of understanding, one point becomes clear in the authors' explanation of understanding: it is multi-dimensional, and is uniquely constructed by the learner (13). Understanding is not a concrete target, the product of which looks the same for each person. It is developed by the individual, based on the experiences and meanings that make sense for him or her. Because of this, we as educators need to recognize that limited assessment techniques relay the message to students that understanding is equivalent to the repetition of facts. Instead, we need to widen our assessment methods, encouraging our students to develop more authentic learning strategies (15).

I firmly agree that understanding does not look the same for all of my students. I often hear them making comparisons between new information and past experiences, and this does indeed help them grasp more complicated concepts. I also believe that by providing more authentic and relevant assessment options during the learning process, my students will develop a deeper understanding of what it truly means to be a scientist.

Article 2: Wiggins, G. and McTighe, J. *Understanding by Design*, Chapter 2 and Chapter 4. (1998)

Wiggins and McTighe depict a very relevant picture of understanding for educators. Although society interchangeably uses the words “understanding” and “to know,” the authors claim that there is a significant difference between knowing how to do something and knowing *why* an answer is acceptable (39). Understanding signifies that one is able to transfer and apply knowledge to novel situations.

According to the authors, there are six main aspects of understanding which we must promote in our students: explanation, interpretation, application, perspective, empathy, and self-knowledge. The ability to explain can be encouraged on assessments and in daily assignments by asking students to show their work or explain why something is the case (88). Interpretation can be improved upon by giving students constant practice interpreting purposefully vague situations. They need to see that there is not always a “right answer” to every question (92). Application can be promoted by teaching through performance-based learning and using authentic tasks that provide our students with real world scenarios where they can practice adapting their knowledge (94). Perspective requires that students have many opportunities through our instruction to envision solutions from multiple viewpoints (97). To cultivate empathy, students need to have chances during their learning to make predictions about the effects of decisions, theories and ideas made by themselves and others (100). The final aspect of understanding that the authors describe is self-knowledge. As teachers, we need to do a better job encouraging our students to reflect on their progress as learners, so they can honestly depict what they do and do not know and understand (102).

Wiggins and McTighe believe that as teachers, we need to provide more opportunities for students to practice transferring and applying knowledge in the classroom, so they will be successful in the real world (43). Ultimately, we must remove the misconception of our students that learning is somehow related to the “taking in” of knowledge, and show them how to transfer their knowledge to successfully problem solve no matter the scenario – the definitive outcome of true understanding (103).

My school already employs the “Understanding by Design” method for developing units. We write enduring understandings and essential questions based on the material we are teaching that we hope our students will comprehend by the end of our unit and take with them in the future. We also implement project-based and hands-on science curriculum that provides for opportunities to transfer knowledge to real-world situations.

Article 3: Wiske, M. (ed.), "Teaching for Understanding – Linking Research With Practice," Chapter 2. (1998).

Wiske spends the majority of this chapter describing the difference between the two major views of understanding – as a performance or as a representation – then clearly illustrates why he believes that education should support understanding through performance. He states that the main goal of education is to provide students with the knowledge and understanding they need to be successful in the real world (39). Knowledge can be defined as the ability to reproduce information when prompted, while understanding is the capacity to think and act flexibly based on that information (40).

Many educators maintain the theory that understanding is representational, or that it is something students can "attain" by being able to create a mental model that depicts the information being presented to them (44). Others believe that this mental model can be adapted into an action schema, a model that is being constantly modified as new information is added (47). Wiske rejects both these ideas of understanding as incomplete; he asserts that understanding can only be observed through performances (51).

The performance view of understanding suggests that students only truly understand when they are able to apply their knowledge in unfamiliar scenarios that stretch their abilities (43). These performances vary with a person's development and with content area, thus authentic tasks are the best way to give students experience in the classroom. As there is no full entity to "attain" in this view, students move along a continuum, continually developing their understanding and abilities, while teachers act more as coaches and facilitators than instructors (52).

Wiske suggests four elements as a framework for educators wishing to implement performance-based understanding in their practice (54). One must start with generative topics, or broad themes that are relevant and engaging for students. Understanding goals establish a sense of purpose and direction for teachers and students, guiding their progress. Understanding performances are the desired outcomes of student understanding, and should be flexible, difficult, and intentionally selected by the teacher throughout the entire course of learning. Finally, ongoing assessment should be used frequently and should be informative feedback for students on their mastery of the concepts.

I agree with Wiske that understanding is best viewed as performance-based. I teach multi-aged groups of students, and the understanding an eleven-year old creates develops quite a bit over the three years they are with me; what they are capable of as fourteen-year olds is entirely different. My students also thrive when given plenty of feedback – one of our main philosophies is continuous progress/mastery learning – and they use it to their advantage to master topics.

Article 4: Unger, Chris. *What Teaching for Understanding Looks Like,* Educational Leadership, (February 1994), p 8-10.

This article was an extension of Article 3: *Teaching for Understanding* that gives specific, concrete examples of what effective utilization of the framework described by Wiske looks like in action.

Unger states that generative topics are most successful when they are not only central to an understanding of the discipline, but also when they make rich, meaningful connections to students' lives (8). Teachers should involve students in determining the understanding goals for the unit, as it will encourage them to be more interested and involved (9). It is also important to provide students with the standards for assessment at the beginning of the unit because they are powerful guides for the teacher/student team (9).

Through his examples, Unger demonstrates that true understanding takes extensive time, but that this time is undoubtedly worthwhile. Students can use the time, when guided effectively, to develop their own deep understanding of a topic (9). Ultimately, Unger concludes that teaching for understanding helps enforce the belief to students that an education is not something you *do*, but rather is something teachers and students collaborate to create (10).

I enjoyed seeing specific examples how the framework for teaching performance-based understanding could be implemented in the classroom, as the Wiske article was very theoretical.

Unit 3: Individual Response 3

Question 3: Drawing on all the course readings so far, as well as your own experience, what do you mean by "understanding" in a science education context?

I firmly believe what all of the readings seem to suggest: understanding is complex, multi-faceted, unique to the individual, continually able to develop, and based on a transfer of knowledge to new situations. Instead of just teaching mass amounts of scientific knowledge, I think it is more important to cover material deeply and for a longer amount of time in order to cement understanding (Wiggins and McTighe, 45). My students need authentic, performance-based learning activities as well as assessments to effectively learn how to transfer knowledge to unfamiliar scenarios that they may encounter with science in the real world (Wiske, 43). As an educator, I cannot teach meaning – I must facilitate my students' interaction with content through scenarios that provide them opportunities to create their own meaning (Wiggins and McTighe, 103). My assessments should be varied and directly connected to what is being taught, especially in science education where students regularly participate in and follow the scientific method to conduct laboratory experiments (White and Gunstone, 2). Ultimately, I hope my students come to recognize the true purpose of education; that it is not repetition of fact but deep understanding that will help them become successful and scientifically literate adults.

Unit 4: Individual Response 1

Question 1: Write 4 or 5 statements about students' concepts from Driver, et al. that caught your interest. Choose one of these statements that is important to you and explain its significance. Be sure to cite the reading and provide specific reasons for its importance.

As a secondary science educator, it is obvious to me that students come into my classroom with pre-existing ideas about the way the world works. I am constantly taking advantage of this when I make analogies between things they already understand to new material. The Driver, et al. article confirmed this; children acquire ideas about phenomena based on personal, sensory encounters, and that these ideas progress through a generally linear developmental schema over time (p 1 and 45). I was surprised to find that most research supports the idea that these concepts children create are not personally unique or culturally dependent – students from all nationalities and backgrounds develop similar constructs for understanding the world (2). It is the responsibility of the teacher to fully comprehend not just the learning objectives for a particular concept, but also his or her students' past experiences with the topic and how their experiences differ from the reality (8).

Perhaps most profound to me was the idea that experience in a science classroom is not enough. Students must also have significant opportunities to discuss their thoughts and ideas with their peers, as this allows them to expand on and perhaps modify their initial conclusions through appropriate conversation and debate (6). I do my best to design experiential, hands-on, project based learning opportunities for my students, but it has become clear to me that if my students are not given the time to process and discuss what they have learned, my effort will have been in vain. Driver states that students need to understand that the activities they participate in are designed to help them reflect on how their observations are connected to scientific theory (7). As a teacher, I need to guide them through activities and purposeful discussion toward appropriate interpretations of their experiences.

Unit 4: Individual Reponse 3

Question 3: Design a prompt and use it to gain information about your own students' conceptions of an aspect of science.

We are beginning a unit on hydrology, so to get an idea of what my students know about the properties of water I had them take a short true/false quiz. We discussed the answers as a class, and I asked students to explain why they selected their response (thus eliciting the "Student Conceptions" column below). This was followed by a short lesson on the properties of water, then a laboratory experiment where they compared how many drops of water they could add to the surface of a penny before and after detergent was spread on it. Finally, we revisited the ideas in the short true/false quiz to determine what ideas they had taken away from the lesson.

Issue	Goal Conceptions	Student Conceptions
Surface Tension	Water has an extremely high surface tension, due to attraction between molecules.	Most students did not understand the concept of surface tension.
States of Matter	Water unusual because it is the only substance that is larger in the solid form than in the liquid form.	While most students knew that water gets larger when it freezes, they could not explain why ice floats instead of sinks.
Solvents	Water dissolves more substances than any other solution, causing it to be known as the "universal solvent."	Many students believed that acids were more powerful solvents than water.
Boiling Point	The boiling point of water is dependent on atmospheric pressure – so higher altitudes, which have a lower pressure, also have a lower boiling point.	Most students did not recognize that altitude (or even pressure) has an effect on boiling point of water. A significant number of students also did not know the boiling point of water (at sea level).

True or False?

_ Water gets smaller when it freezes.

_ Water has a high surface tension.

_ More things can be dissolved in acid than in water.

_ It takes more energy to heat water at room temperature to 212° F than it does to change 212° F water to steam.

_ Raindrops are tear shaped.

_ Water boils quicker in Denver, Colorado than at sea level.

Unit 5: Individual Reponse 1

Question 1: Choose one of the Key Findings and write a brief reflection on how that particular finding plays (or doesn't play) into the ways in which you teach your students science.

Brain research continues to play an important role in the process of educating our students. The Commission on Behavioral and Social Sciences and Education (CBASSE) states that if our goal is to produce young adults who can think critically, express themselves clearly, and effectively solve problems, we must provide our students with more than just facts – we need to help them create knowledge that is connected to and constructed from what they already know (9-10).

Although I recognize the importance of each of the key findings, I appreciate most the third category of a metacognitive approach to learning (18). At the beginning of each term, students are introduced to the "I can…" statements for the unit. They write and journal about what they already know and create posters with some of their questions about what they would like to learn. Throughout the unit we reference these "I can…" statements frequently. We address student questions and allow time for regular discussion and journaling so students can reflect on what they have learned and how it relates to what they already knew about the topic. This permits them to monitor their growth and recognize patterns in their thinking, as CBASSE suggests they should (18).

Unit 5: Individual Reponse 3

Question 3: What is your reaction to the Mercedes Model? Specifically, how can Figure 1 and Table 1 help you (or any science teacher) to plan and teach more effective sequences of lessons that will nurture development of students' understanding and application of science knowledge?

As an educator, it was quite evident to me after reviewing the Mercedes Model that we spend far too much time building students' knowledge bases, but not nearly enough time allowing them to effectively process and understand the facts so they will become useful to them in the future. As Table 1 references in the "Knowledge Base" column, we stress the importance of scientific vocabulary, various "end of chapter" questions, and occasional laboratory experiments. However, it is important that the study of a concept not end here. Students must take that knowledge and extend upon it in order to fully understand it and make use of it. For example, instead of just memorizing vocabulary, students should learn where the words originated from, how they are used, where they have used them before and when they might use them again, and they should properly use them throughout a unit of study in explanations, projects and presentations. The Mercedes Model also clearly illustrates that the purpose of the teacher is not to make connections for the students, but to guide students in the right direction to make connections themselves.

Unit 6: Individual Reponse 1

Question 1: Read Chapter 7 in Teaching for Understanding*. What are the limits to what you as a teacher can learn by analyzing students' work? Push against the text as well as read with it; feel free to make use of past experiences as well as ideas in the chapter.*

I feel that especially with the increased demands from standardized tests, teachers are feeling more and more pressured to label student understanding based on particular summative assessments. However, giving students feedback on their work does not need to exist in either a shade of black or white –the Teaching for Understanding Framework suggests exactly the opposite. Teachers can learn the most about their students' understanding by assessing dimensions of their work, not necessarily their overall work as a whole (231). Wiske describes this beautifully when he identifies understanding as, "a dynamic system in the process of change, not a static judgment stamped upon a student as identity" (230).

Not only can utilizing the dimensions to score student work help give students more individualized feedback, but they also give the teacher some very important information about instruction as well. If many students scored low in one of the dimensions, it should be clear that the teacher needs to improve on his or her lessons in that particular area (228-229). Students are also more willing to work harder on developing their weaknesses when they get lots of positive feedback on what they did well in other dimensions (231). Self-reflection is an important, life-long skill that all of our students should demonstrate before they leave our classrooms. I truly believe from my own practice that forming relationships with students is key – they will not trust your feedback or be willing to work on improving themselves unless they know you are truly supporting them.

Unit 6: Individual Reponse 2

Question 2: Plan a lesson which includes embedded assessment.

Summary
Lesson title: Investigating Our Traits
Prepared by: Sarah Frazer
Subject area: Life Science – Genetics and Heredity
Technology integrated: Online poll/survey tool (http://obsurvey.com); Glogster (http://glogster.cor
Length of lesson: 2-3 (55 minute) class periods
Suggested grade level: Middle School

Lesson Abstract: This lesson is meant as part of an introduction to a unit on genetics and heredity. By investigating some of their own observable characteristics, students will gain a better understanding of the differences in certain phenotypes, as well as using their own data to conclude that certain traits and controlled by only one gene while others are controlled by multiple genes. They will use an online survey tool (obsurvey.com) to create a survey of traits they wish to explore, have others participate in the survey, and then analyze the results in graphic form through the obsurvey.com reporting tools. Finally, they will produce an online poster using glogster.com and share their results and conclusions with the class.

Lesson Objectives:

- **Main Objective**: Students will begin to explore the I Can... Statement: "I can describe how the characteristics of living things are passed on through generations," by investigating various different traits to form their own opinions about how characteristics are inherited.
- Students will use appropriate scientific tools (meter sticks and other metric measurement tools) to collect data.
- Students will use online tools (obsurvey.com and glogster.com) to collect, analyze and report data.

Student NETS Standards Alignment:

- Student NETS 3d– Research and Information Fluency: Students apply digital tools to gather, evaluate and use information. Students process data and report results.

- Student NETS 4c—Critical Thinking, Problem Solving, and Decision Making: students use critical thinking skills to … solve problems … Students collect and analyze data to identify solutions and/or make informed decisions.

Materials:

- Small squares of scrap paper
- “Investigating Our Traits” handout (attached)
- Online poll/survey tool: (http://obsurvey.com)
- Measurement tools (rulers, meter sticks, tape measurers)
- “Analyze Our Data” handout (attached)
- Glogster (http://glogster.com)
- Computer with projector for student presentations

Detailed Lesson Procedure:

Introduction:

- As a warm up activity, give each student a small square of paper. Give them five minutes to silently write down 5-10 bits of information that describe the way they look at that moment, so that another person could identify them.
- Collect all of the squares of paper, and explain that you will be reading off the traits and the students should try and guess who you are describing.
- As you read, write the traits on the board one by one, in two columns: things that are not inherited (like clothing color, accessories, hats, etc) and things that are inherited (like eye color, hair color, hair texture, etc). Do NOT title these columns.
- After you have had students guess several student descriptions, encourage them to work in groups to give a title to each of the columns on the board. This allows them to think about the difference between inherited and non-inherited traits.
- Have them share their ideas, then explain how some traits can be inherited (meaning they are encoded in your body and are naturally expressed) and some are things that a person does throughout their lifetime that are not inherited.
- **Assessment**: Encourage students to think of other inherited or non-inherited traits to add to the list.

Main Lesson:

- Introduce the “Investigating Our Traits” activity (handout in appendix). Explain that students must work in groups to create a survey to collect data about different traits. They should select 10 of the traits given on the handout to investigate.
- Groups are to be assigned with ONE technology “expert” who has been trained to use Obsurvey on a previous day and can teach the remainder of their group.
- Once they have selected their traits, they should use the site http://obsurvey.com to create a survey for their classmates and family to take. In order to save their results, students will need to create a free account (using an email address) or sign in using their Facebook account.
- An opportunity for differentiation could be telling some groups of students what types of questions to ask (ie multiple choice, short answer, check boxes, etc) in their survey, while allowing other groups to determine this on their own.

- Once they have created their survey and had it reviewed by a teacher, they can share the URL of their survey with another group.
- Each group member should take the survey of another group. Students may need to measure their hand span, their long jump, height, or reaction time using meter sticks or a tape measure. They will need a space where they can move around to record this data. Assessment on whether or not they know how to use these tools can take place while the students are collecting their data. The teacher can step in to redirect students who are not using the tools in the correct way.
- Each group member should take their own survey link home and have family or friends who are not in the class take the survey as well. Students who do not have a ruler at home may need to borrow one. They should have at least a total of 20 people take the survey to have enough data.
- The next day in class, have students sign back in to their account and take a look at their data. Obsurvey.com allows students to download the data in graphic form as a picture.
- Students should analyze their data using the attached “Analyzing Our Data” handout. This handout also explains the presentation of their data through http://glogster.com.

Assessment:

- To assess student understanding of the concept of phenotypes or observable traits, each small group of students will create a Glog (on glogster.com) that presents their data. Students can download their data from obsurvey.com as pictures, and then arrange these with a conclusion in their online poster.
- Students will each present their results by projecting their Glog in front of the class and explaining their data and conclusions.

The Next Step…

- During or after presentations of the online posters, students will be asked to independently describe a trait that is inherited and one that is not (basic knowledge) and to explain how they know the difference (basic understanding). If students are unable to do this, the next lesson will begin with a sorting task, where they are given many different characteristics on small pieces of paper and have to identify if they are inherited or not inherited and be able to defend their choices.

- The Glogs (online posters) can be used as a jumping off point for the next lesson. I do not anticipate that every student in every group will be able to come to a conclusion about which traits are coded by single genes, and which are polygenic, however using the data the students collected in future lessons can be a great way to get them to be more engaged and interested in the material. I can use their data along with prompting questions about the way their data looked to encourage them to think about reasons for their figures.

- If it seemed during data collection that a majority of the students did not understand how to utilize the metric measuring equipment appropriately, a short mini-lesson on metric tools would be necessary.

Investigating Our Traits Handout

You will be investigating some human traits of your classmates, friends and family in order to make some conclusions about how traits are encoded by genes. You will discover which types of traits are determined by one gene, and which have several genes that control them.

Directions:

1) As a group, choose 10 of the traits below.
2) Use a computer to log on to http://obsurvey.com, where you will create a survey to collect data about your traits. One of your group members should create a free account (you can also use your Facebook login information) so that you can log on tomorrow to access your results.
3) Create a survey question for each trait. You may need to create multiple choice, short answer, or check box questions depending on the trait.
4) Once your survey has been reviewed by a teacher, you may share the URL for your survey with another group. Each member of that group must take your survey.
5) Your group needs to take the survey of another group. Each member of your group must take their survey.
6) If you have time, you may take the survey of another group.
7) Email or bring the URL for your survey home and have 2-3 family members or friends take the survey as well. By tomorrow, your group should have at least 20 people that have taken your survey.

Possible Traits

- Hand Span: Distance from tip of pinkie to tip of thumb when hand is fully stretched
- Eye Color: blue, brown, green, hazel
- Freckles: none, few, lots
- Reaction Time: Number of centimeters that pass before you can catch a falling ruler
- Tongue Rolling: Tongue rolls into a tube – yes or no
- Reach: How far up a wall you can touch with your fingertips when standing on tip toe
- Dimples: Dimples on cheeks – yes or no
- Hair Color: Natural hair color – black, brown, blonde, red
- Hair Texture: curly, wavy, straight
- Height: How tall you are

- Hitchhiker Thumb: Your thumb tip bends backward when you give a “thumbs up”
- Earlobe Attachment: Earlobes are attached to the side of your face – yes or no
- Long Jump: How far you can jump with your feet together when standing still
- Widow’s Peak: Your hairline makes a V – yes or no
- Cleft Chin: Your chin has a small dimple – yes or no

Analyze Our Data Handout

You will use an online site to present your human traits data and make conclusions about your results.

Directions:

1) Log back on to your account on http://obsurvey.com. Your group should have a total of at least 20 people who have taken your survey. Click on “Report” to view your data in graphic form. You can download each of your graphs to your server space by clicking on the small button “Download chart as image” under each graph.

2) Log on to Glogster, an online presentation site at http://glogster.edu. You will receive login information from your teacher. Your group will create an online poster using the site resources to display your data. Your poster needs to include the following:

1. A title and group member names
2. Several pictures, images or graphics
3. Four labeled, graphical representations of your data
4. A short description with each graph describing the data
5. One 3-5 sentence conclusion explaining which graphs depict traits that are controlled by one gene, and which traits are controlled by multiple genes and why.

Unit 6: Individual Response 4

Describe any particular ways in which your thinking about teaching and learning has changed over the last few weeks of this course. Refer to any readings, activities or other experiences along the way that have influenced you.

One of the ideas that has impacted me the most over the past few weeks is from Driver’s *Making Sense of Secondary Science*. Driver suggests that experience in a science classroom is not enough; students need time to discuss lab experiments and hands-on activities with each other if they are truly going to digest and deeply understand the material (6). In one of my middle school science classes, students are investigating parts of the water cycle and in order to learn more about how an aquifer works, they are creating their own aquifers and participating in a series of lab experiments. Although many of these activities are very specific and the outcomes seem fairly obvious to me, it has become evident that students need the review and reflection time after the lab just as much as they need the hands-on time during the lab. They bring up great questions, and I am able to learn from their explanations to one another what they truly understand. For example, one student claimed that the water condensing on his bottle lid came through the plastic from the ice above, instead of from the water inside his bottle that had been heated by the sun. Other students were able to draw pictures for him on the whiteboard, explaining where the water had come from. This was much more powerful for him than having me say “no, water cannot move through plastic.” These dialogues between students also help me in guiding future experiments.

Unit 7: Individual Response 2

Write up a description of what occurred as you taught the lesson from Unit 6. Be sure to include a brief description of what actually occurred in the class, including any adjustments you made in your teaching as a consequence of the data you obtained about students' ideas and reasoning through your embedded assessments; a description of any evidence you have of how the lesson altered your students' understanding of the topic you taught; a reaction to this kind of planning/assessment as a tool for improving your students' understanding; and ideas for making better use of assessments in future planning and teaching.

Review of the lesson plan (also seen above in Unit 6 Response 2):

Detailed Lesson Procedure:

Introduction:

- As a warm up activity, give each student a small square of paper. Give them five minutes to silently write down 5-10 bits of information that describe the way they look at that moment, so that another person could identify them.
- Collect all of the squares of paper, and explain that you will be reading off the traits and the students should try and guess who you are describing.
- As you read, write the traits on the board one by one, in two columns: things that are not inherited (like clothing color, accessories, hats, etc) and things that are inherited (like eye color, hair color, hair texture, etc). Do NOT title these columns.
- After you have had students guess several student descriptions, encourage them to work in groups to give a title to each of the columns on the board. This allows them to think about the difference between inherited and non-inherited traits.
- Have them share their ideas, then explain how some traits can be inherited (meaning they are encoded in your body and are naturally expressed) and some are things that a person does throughout their lifetime that are not inherited.
- **Assessment**: Encourage students to think of other inherited or non-inherited traits to add to the list.

Main Lesson:

- Introduce the "Investigating Our Traits" activity (handout in appendix). Explain that students must work in groups to create a survey to collect data about different traits. They should select 10 of the traits given on the handout to investigate.
- Groups are to be assigned with ONE technology "expert" who has been trained to use Obsurvey on a previous day and can teach the remainder of their group.
- Once they have selected their traits, they should use the site http://obsurvey.com to create a survey for their classmates and family to take. In order to save their results, students will need to create a free account (using an email address) or sign in using their Facebook account.
- An opportunity for differentiation could be telling some groups of students what types of questions to ask (ie multiple choice, short answer, check boxes, etc) in their survey, while allowing other groups to determine this on their own.
- Once they have created their survey and had it reviewed by a teacher, they can share the URL of their survey with another group.
- Each group member should take the survey of another group. Students may need to measure their hand span, their long jump, height, or reaction time using meter sticks or a tape measure. They will need a space where they can move around to record this data. Assessment on whether or not they know how to use these tools can take place while the students are collecting their data. The teacher can step in to redirect students who are not using the tools in the correct way.
- Each group member should take their own survey link home and have family or friends who are not in the class take the survey as well. Students who do not have a ruler at home may need to borrow one. They should have at least a total of 20 people take the survey to have enough data.
- The next day in class, have students sign back in to their account and take a look at their data. Obsurvey.com allows students to download the data in graphic form as a picture.
- Students should analyze their data using the attached "Analyzing Our Data" handout. This handout also explains the presentation of their data through http://glogster.com.

Reflection of the Lesson:

My lesson ended up being very similar to my plan, with very few deviations. I team-taught this lesson with my three other co-science teachers and a group of approximately 100 middle school students.

Every student participated in the introductory activity, and a majority of the students were active contributors in guessing whom each slip described. The more academic part took effect when they had to come up with a way to categorize the traits. Some groups devised their classification system based on types of clothing, such as "accessories" or "outerwear," while other students grouped things based on color or male/female attributes.

Only a few groups seemed to have some background knowledge with genetics and came up with categories based on inherited vs. acquired. Based on Wiggins and McTighe's research on understanding, I knew it was important for the students to "create" this idea of inherited vs acquired traits on their own (*Understanding by Design,* 103). I made note of the groups who came up with this idea on their own when I was walking around during their discussion, and purposefully called on them last. Then I had a discussion with the entire class about how there are many possible ways to sort traits, but that our investigation of genetics had to do with only those traits that were inherited.

This introductory activity was an excellent way to gain knowledge about students' prior experience with genetics so that, as Driver suggests, I could help them in constructing new knowledge (*Making Sense of Secondary Science*, 7). As an embedded assessment, it gave me information about where I needed to provide some additional support throughout the remainder of the lesson. There were several groups of students (most of them were sixth graders who had not has as much experience with genetics) who I spent some time with reviewing the difference between inherited and acquired traits, while some of my more advanced students learned how to use the online tool Obsurvey.com for the next activity. To review, I had the students take some of their own traits and try to fit them in the category of inherited or acquired. I only moved on when I was satisfied that they could do this on their own.

For the Inheriting our Traits and Data Analysis activities, students worked in groups to collect and analyze data. During this time, I mostly provided support with the technology. Students effectively used the metric tools to measure their height and long jump – although this was not surprising, as we have spent a significant amount of time this year reviewing appropriate use of metric tools. My final use of formative assessment was during presentations of each group's Glog (interactive poster). According to *Benchmarks for Scientific Literacy*, it is imperative to provide students with opportunities to learn the scientific process, not necessarily the specific science content (xv). I was not terribly concerned with my students' ability to understand the difference between traits coded by a single gene and those that were polygenic at this point in time as I knew we would be spending more time exploring this concept later. However, I was interested in how the students collected and interpreted their data, which is an important scientific skill. It was quite apparent to me after seeing several of their presentations that a majority of students were having trouble connecting a conclusion to a specific piece of data; they were instead making conclusions based on prior knowledge or random assumptions. This is clearly an area that we will need to spend more time on in the future as it is a crucial skill for students to have if they are to become scientifically literate.

After working in a school with multi-aged classrooms for the past four years, I am fairly experienced with differentiation. I see embedded assessment as a way to help differentiate during a lesson or before beginning another. Instead of focusing only on the end product, it encourages me to continually reflect on my practice, how the students are responding to it, and ultimately allows me to know my students better as learners in order to provide them with appropriate experiences to deepen their understanding.

Unit 8: Individual Reponse

1. Describe each lesson in 1-2 sentences, in terms of the content taught.

1. Students investigated how light bends as it moves through a clear triangular block, specifically as compared to the normal angle.
2. Students made predications and investigated how light would travel through additional objects, identifying lenses that would bend light in similar ways.
3. Students investigated how a prism could split light into colors, making theories about where the color comes from.

2. Observation Notes : Lesson 1

Time Code	Description	Mercedes
0:15	Dan activates prior knowledge, informs students they will be investigating: “Why and how does light bend?”	None
5:50	Students are working in groups to make and draw a prediction about how the light will travel through the triangular block.	Building Knowledge
10:15	Students continue to work in groups to actually pass the light through the triangular block. Dan asks them to copy down the way the rays traveled.	Building Knowledge
11:30	Dan asks guiding questions in small groups to prompt the students to compare their original predictions to what actually happened, and explain the difference.	Developing Understanding
15:00	After interacting with each of the small groups, Dan gathers all students’ attention and instructs them to move on to tracing how the rays travel through the third block.	Building Knowledge
19:30	Dan once again gets all students’ attention and draws what the rays should look like on the overhead projector. He allows students to compare to their own drawings and introduces new vocab: “normal angle.”	Building Knowledge
25:00	Students are asked to write a rule for how light acts as it moves into and out of a block, appropriately using the word normal angle. Dan interacts with small groups, discussing and correcting their initial ideas through prompting questions.	Application
36:35	After noticing most of the groups have written a rule, Dan instructs students to trace the half circle and draw in the normal angle where they think the light will enter the half circle. He walks around to check their drawings. After ensuring they all had it correct, he instructs them to make a prediction of how light will travel through the half circle using the rule they already wrote.	Application

41:50	Students work in small groups check their prediction to the way light actually travels through the half circle. Dan prompts them to think about whether or not the light followed their rule – even if it did not bend quite as much, did it bend the right way?	Developing Understanding
46:50	Dan initiates a large group discussion about the original rules the students wrote: When light enters the block, it moved toward the normal, and when it leaves the block it moves away. He also discusses the results from how the light traveled through the half circle – following the same rule. He explains that they will investigate this more in the next class.	Building Knowledge

None: 5%, Building Knowledge: 50%, Developing Understanding: 35%, Application: 10%

Observation Notes : Lesson 2

Time Code	**Description**	**Mercedes**
0:15	Dan once again activates prior knowledge by reminding students that the previous day, they investigated how light bends according to the normal angle. He asks students to explain to the class about the rule they developed.	Building Knowledge
1:30	Students move themselves into lab groups, set up their equipment. Dan moves about the room assisting with any technology issues.	None
4:40	Once students are settled, Dan reviews how the normal angle affects the way light travels through the block.	Building Knowledge
6:00	Dan asks students to work in small groups to predict what will happen to light traveling through the triangle block when the block is flipped upside down. (He has drawn yesterday's conclusion for them.) They also need to write down in words why they think their prediction is correct.	Developing Understanding
7:00	Dan walks around to ask questions of small groups, ensuring that they are writing their predictions, and prompting them to extend their written explanations by using their rule from yesterday.	Developing Understanding
15:05	Dan instructs all students to test their predictions using the light boxes, followed by a written explanation of why there were any differences between what they expected and what they observed.	Developing Understanding
16:00	Once again, Dan interacts with the small groups to help them interpret their results and begin their explanations.	Developing Understanding
17:45	Dan focuses the attention back to the large group, drawing	Building

	a picture on the board of what they should have observed over the last two experiments with the triangle blocks. He asks them to find another object in their box that will do the same thing as two upside down triangles - but using only one piece.	Knowledge
19:00	Students work in their lab groups to test different pieces from their box. Dan walks around and encourages them to experiment and "try it." He repeats the problem to them multiple times without giving them the answer, just prompting questions to get them to think deeper about the objects.	Developing Understanding
30:30	Dan introduces a new set-up, with two triangles "point to point." He passes out new lenses, then asks students to discuss with their group and then predict what they think will happen to the beams without turning the lights on. Again, they are asked to find an object that will match this, and check their predictions with the light box.	Developing Understanding
44:00	Dan asks students to "mess around" with the single light slit and triangular piece in order to "get color out." Students work in their lab groups to accomplish this, while Dan walks around and pushes students the maximum amount of color.	Developing Understanding
47:25	Finally, Dan introduces the vocabulary "prism," by telling the students they created it. He gives them a "rainbow maker," admitting they will come up with a better name for it the following day, and asks them to draw and label the colors they see through it.	Building Knowledge

None: 5%, Building Knowledge: 30%, Developing Understanding: 65%, Application: 0%

Observation Notes : Lesson 3

Time Code	Description	Mercedes
0:20	Dan helps students set up their light boxes for the activities that day, reminds them of what they were working on the day before.	None
1:30	Dan reminds students that they left off looking and listing the colors. He asks them to look at their list and compare them to the order they see. He has groups share the order and writes them on the board so students can make sure they have them ordered correctly.	Building Knowledge
4:25	Dan gives students "ROY G BIV" acronym to help them remember the order of the colors.	Building Knowledge
5:30	Dan asks the each small group to discuss where the colors	Developing

	come from. He walks around and asks prompting questions to encourage students to think about all possible places the color could come from.	Understanding
9:10	Dan calls on different groups to share their ideas to the rest of the class of where color comes from. Students have several different ideas. Dan asks what they could do to test or argue against the other ideas. The groups spend a considerable amount of time discussing and testing whether the color comes from the light or the blocks themselves.	Building Knowledge
22:15	Dan brings attention back to a group discussion to talk about the “general consensus” – the light is causing the colors. He does not give an “answer” yet, just allows groups to share their ideas.	Building Knowledge
27:00	Dan refocuses the discussion to have the groups test whether or not they could get the colors “back in” to white light., if light really was made up of all the colors. He instructs the groups to test this theory.	Developing Understanding

None: 5%, Building Knowledge: 40%, Developing Understanding: 55%, Application: 0%

3. List the apparent objectives for each lesson. Compare your list with Dan’s objectives. What might account for any discrepancies?

1.Students were to understand how light bends as it moves through a prism. Dan’s goal was very similar, he also wanted students to develop a rule to effectively predict how light bends as it moves through a material.
2.Students were to understand and recognize patterns in how light travels through different objects. Dan wanted his students to be able to apply the rule they had created to recognize and predict patterns in how the light would travel through multiple shaped lenses.
3.Students were to understand that white light is made up of all visible colors. Dan’s objective was identical.

4. Describe at least 2 instances where Dan monitored students’ progress toward his learning goals. Indicate the lesson number/time code, as well as how the information influenced Dan’s subsequent instructional actions.

One instance where Dan monitored student progress effectively was during lesson one starting at 36 minutes. He asked students to draw where they believed light would enter the half circle based on their knowledge about the normal angle from the previous investigation. Dan asked the small groups to explain their drawings to him, correcting any errors before having students draw how light would move through the block. By monitoring student response in their small groups immediately, Dan was able to ensure that students had the necessary knowledge before making additional predictions.

Dan also effectively monitored student progress during lesson two from 7:00 – 16:00. He very purposefully had students write down the reason for their prediction and why their prediction did or did not match what they actually observed. As he talked with students in their lab groups, Dan asked them to extend on their explanations by using the previous day's rule. This gave him additional feedback on how the students interpreted the rule they had created, and whether or not they were able to apply it to a new situation. After making sure they were all able to effectively utilize the rule, Dan was able to move on to a new prompt.

5. Identify and describe two examples of Dan teaching for understanding. Indicate lesson number/time code, and explain why it qualifies as teaching for understanding.

Dan did an excellent job allowing his students to work through the process of understanding how and why light bends. His guided inquiry during lesson 2 very much followed the teaching for understanding framework developed by Wiske – particularly from 19:00-44:00 minutes. Dan allowed students to explore and collect data while finding a lens that bent light similarly to two triangles set end-to-end or point-to-point. Asking prompting questions and guiding students to use (and if necessary, modify) their original rule about light, Dan helped students shape their predictions into theory.

When using teaching for understanding, it is imperative that all activities and assessment clearly match up with learning goals. Dan's learning goal for lesson 1 was for students to understand how light travels through different materials. He was able to assess this between 36:00-46:00 when he asked his students to test their rule on a new shape. If the students truly understood the rule, they would be able to apply it to a new situation. In allowing the students to adapt the rule to this new object, Dan also did an excellent job sharing the "authority" with the students as Wiske suggests, or in other words, allowing them to create their own learning.

6. Identify and describe two examples of Dan missing opportunities to teach for understanding. Indicate lesson number/time code, and describe what could be done differently to better foster understanding.

Overall, I thought Dan did an exemplary job teaching for understanding. Students' ideas were taken into account, they had quite a bit of time to investigate the material using guided inquiry, and he effectively utilized phenomena to engage them. However, there were two instances when I thought he could have done a better job cementing student understanding. During lesson three at 26:30, a student connected light being broken into colors with how black ink can also be split into colors. Dan acknowledged the student's idea, but moved on quickly after saying that ink represented a completely different concept. He could have done a better job demonstrating this to the students, because it was evident in later small group discussion that they were stuck on this idea.

I also thought that the remainder of the third lesson from 27:00 on did not include as much purposeful discussion as previously. Students started the lesson investigating where the color came from, and there were still several who believed the color came from the block and not the light. Dan did not explicitly prove to them that the color came from the light before asking them to experiment with combining the light "back" into white. It seemed to me like some students could walk away from that lesson not entirely convinced that light was the source of the color, whereas this did not seem to happen during lessons one and two.

Unit 9: Individual Reponses

Question 1: Describe the major ideas you've learned about teaching for understanding and why they are important to you. Be sure to draw upon those experiences that you found most valuable in addressing these ideas, such as: your readings, your writings, the planning/teaching you did, the analysis of Dan's teaching, and your interactions with others in the course.

Society regularly uses the phrases "knows how" and "understands" interchangeably, but my work in this course proves they are two very different concepts – particularly when it comes to teaching science. The readings from Wiggins/McTighe, Wiske, Driver, and Gallagher were quite profound in their descriptions of how master educators provide chances to maximize student understanding in their classrooms. This first begins with recognizing student misconceptions while activating background knowledge, then building a knowledge base through engaging, relevant phenomena and guided inquiry, and finally allowing students to demonstrate their understanding through performances that have regular opportunities for self-reflection. There were several key points throughout the readings that especially resonated with me, including Driver's suggestion that students need more than just lab experiences to fully grasp material – they also need plenty of time for discussion with their peers; the idea from *Benchmarks* that students need to be taught more than just scientific content if they are to become scientifically literate adults – they need to be taught the process of thinking scientifically; and finally Gallagher's idea of embedded assessment and how it creates more engaged, harder working students.

To me, teaching for understanding means giving my students regular opportunities to interact with, discuss, make and adapt predictions about, and create performances demonstrating their level of understanding of relevant scientific phenomena. I was able to integrate many of these concepts into my own practice this term. Through teaching and reflecting on my lesson about inherited traits, I recognized how embedded assessment can be extremely useful in identifying students who either have or have not yet mastered a concept. This is especially practical in my school where students are multi-aged and thus often at very different levels in their understanding. By watching and carefully considering Dan's teaching, I gathered ideas about how guided inquiry can be successful in the science classroom, and I appreciated how having students create their own learning by writing a rule that encompassed the concepts they had investigated ultimately produced a more engaged and on-task learning environment. It was also equally as beneficial to see how my colleagues in this class were implementing strategies to promote student understanding in their own classrooms. I hope to be able to apply what I have learned in this class with my own students, ultimately preparing them to think deeper and more scientifically in the real world.

Question 2: Describe how aspects of the course have affected your knowledge and beliefs about teaching for understanding; how might (or will or does) this affect what you do in classrooms. This is two-part question, so be sure to address both aspects.

My main goal for my students is for them to become scientifically literate adults. This course has prepared me to do this by cementing my training in teaching for understanding. Often in science classes, teachers focus on the memorization of facts instead of deep inquiry into concepts. Although drilling facts has never been the central concentration of my practice, I occasionally struggle with creating regular engaging experiences for my students where they develop their own theories and thus their own learning. Through the readings, videos and interactions in this course, I have taken a deep interest in learning how to implement embedded assessment to maximize learning opportunities for my students.

Gallagher suggests that by utilizing the formative assessment cycle, instruction becomes more student-centered and allows them to develop models for what they believe is occurring. Instead of "spoon-feeding" students information, encouraging them to work through the thought process together gives them more ownership over the material and ultimately provides for deeper understanding. This has affected my most current unit of teaching, where students are using soda bottles to model different processes in aquifers. We allow the students to work through the lab, then have discussions afterward where they share what they observed and why they think these observations occurred. This is an excellent example of guided inquiry because as teachers, we never just give our students the answers – even though they quite regularly ask for them! We ask probing questions during and after the lab experiments, and then allow them as a group to construct their own knowledge about aquifers. They are more motivated to share their ideas and even past experience/knowledge because they know we take their ideas seriously and encourage their collaboration. I hope that I can continue to promote this idea that the content itself is not the most important – but that problem solving, collaboration, peer review, and self-reflection are essential in deeply understanding any concept, as well as in becoming scientifically literate.

Question 3: Describe what actions you will take in the coming year to nurture your own continuing professional growth (particularly those based on any experiences or ideas related to this course).

My school has done quite a bit of professional development working with Wiggins and McTighe's Understanding by Design model. We work as a middle school team to write our units, integrating concepts from all content areas to develop enduring understandings, essential questions and "I can…" statements that our students investigate throughout the term. This course however, has given me a much deeper understanding of what understanding truly means, as well as effective strategies for implementing this into our units. I am hoping that during our planning sessions, I can encourage my teammates to think about additional ways of providing students with opportunities to activate their prior knowledge while allowing us to identify their misconceptions, and also to utilize embedded formative assessments during lessons to aid in differentiation and ensure that each student actually understands the material.

Honestly, it has been very rewarding to deeply research teaching for understanding during this course, and to come away being able to connect so much of best practice to what is already being implemented at my school. We often use pre-tests, KWLs, or group discussions at the beginning of a unit to determine what experiences students already have. Throughout a unit, we are constantly revisiting our "I can…" statements so students know our expectations of what they need to understand, and they also can self-reflect on their progress. At the end of a unit, we have a Culminating Event, which is a chance for students to demonstrate their understanding through a (literal) performance in front of their peers, teachers, families and other stakeholders in the community. Although I have been very fortunate to work with a group of teachers who is dedicated to promoting student understanding, I also recognize that there is always room for improvement and refinement. Through my learning in this course, I plan on teaching my team how to utilize the Mercedes Model and improved embedded assessment in order to best provide opportunities for our students to gain and use knowledge to practice problem solving in novel situations.