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Nature of Science and Math Practices

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Article:

Holmes, B. (2015, June 05). Monkeys' cosy alliance with wolves looks like domestication. Retrieved June 07, 2019, from https://www.newscientist.com/article/dn27675-monkeys-cosy-alliance-with-wolves-looks-like-domestication/

When I was thinking about an article to use I thought about my goals for the students I will be teaching next year. My classroom will be a blend of International and Domestic English Language Learners. The class motto is “The Power of Community” and the first few weeks involve a lot of learning about their new home and their classmates. Creating a trusting and safe space to practice language, while exploring concepts and vocabulary that they are encountering in their core science, language arts and math classrooms is my goal.

I wanted to use an article that was short and not daunting, that used new vocabulary in context, and that could also be linked into the focus on community. I wanted an article that would lend itself to listening, speaking, reading and writing practice. When planning my first semester, I kept going back to our readings during the first week that focused on integrating

lessons and creating a network of knowledge. It is important to me that students can see the connections between lessons and understand, “why are we learning this, how does it fit into the big picture?” The community piece is the glue that makes them aware of how the learning connects to their own lives (Windschitl, 2018). I thought this article fit well with the culture I am trying to cultivate and the focus of my classroom.

To start the discussion I would first project the picture at the start of the article on the wall for the students. This would be my “anchoring event” (Windschitl, 2018, pg. 3). I would give my students some time to digest this picture, and provide them with word banks to draw vocabulary from, and time to prepare their thoughts. I would ask students:

- *What is in this picture?* (Goal to make sure we are all working from the same vocabulary, segway into empirical evidence and list some observations on the board under that heading as the discussion continues)
- *What makes this picture interesting?* (Here I would work hard to guide rather than give)
- *What questions might scientists have if they saw this picture or this scene in real life?*

If done well, this opening discussion will unfold into a general overview about several of the tenets of the nature of science: Scientific knowledge is based on empirical evidence, scientific models, Laws, mechanisms, and theories explain natural phenomena, science addresses questions about the natural world and scientific knowledge assumes an order and consistency in natural systems (NGSS, pg 4). The initial PhenoBL is not to go into deep detail yet, but to give a taste of these tenets. The area I would focus on the most strongly is the empirical evidence piece and use, “scientists often use hypotheses to develop and test theories and explanations” to lead into our article (NGSS, pg. 5).

- *What could be some reasons why the wolves are not attacking the monkeys?*
- *What do you think could be the relationship between the wolves and the monkeys?*
- *What do you see in the body language of the animals?*
- *What kind of community do you think they have formed?*
- *What hypothesis would explain what you are seeing in this picture?*
- *What are some other groups that choose to be peaceful and what are their motivations? How could this apply to the picture?*

This questioning of the picture would start to paint an image that, "scientific knowledge is based on empirical evidence," "scientific knowledge is the result of a human endeavor, imagination and creativity," and "science distinguishes itself from other ways of knowing through the use of empirical standards, logical arguments and skeptical review" (NGSS, pg. 5). That being said, much of what is linked back depends on how the students engage with the material. This part is a bit open-ended. The NGSS standards I listed above are where I would lead the students if they were unable to organically elicit thoughts I could link back to standards. Most standards can be applied to this picture and I would look at organic ways of contributing to their comments to bring about familiarity with the tenets. It could go in other ways—just as easily.

This preview can also integrate some of the thought processes involved with the tenets of Math. The most obvious one would be, "Making Sense of Problems and Persevere in Solving them: they analyze givens, constraints, relationships, and goals. They make conjectures about the form and meaning of the solution and plan a solution pathway" (NOS, pg.1). We are looking at the picture; that is the given. We are thinking critically about the relationship between these two species and trying to understand why these animals are acting such a peaceful way and we are contemplating the problem before jumping to a solution. We are also practicing our "verbal

descriptors," and "using a picture to conceptualize a problem" (NOS, pg.1). Depending on how successfully the conversation goes, hopefully we can also practice Math Tenet 3, "constructing viable arguments and critiquing the reasoning of others" (NOS, pg.1). As students pontificate the reasoning behind the peaceful relationship between the animals, they will practice making arguments for their reasoning, as well as, examining and critiquing those arguments of their classmates.

Next we would look at the first paragraph and brainstorm what the article meant by "giving peace a chance." What empirical evidence is cited in this paragraph? Perhaps, to start off, we would list the empirical evidence that the author explains. Then, as we finish the last sentence in the first paragraph, "while the wolves ignore the potential meals of the baby geladas in favor of rodents". (Holmes, 2015) I would elicit the questions: what are the scientists are wondering? What questions do they have about the community of the Alpine Grasslands? This would loop in Math Tenet 3 again as "they justify their conclusions, communicate them to others, and respond to the arguments of others."

This second paragraph is especially insightful as it references the informational box at the conclusion of the article. The author draws a parallel between the domestication of dogs and the relationship between the monkeys and wolves. The author explains how this research project was started to examine if the relationship between the monkeys and wolves was similar to the domestication of dogs by humans a number of years ago. This paragraph leads back to the standards in a plethora of ways. Most notability "scientists use hypotheses to develop and test theories and explanations," and "models, mechanisms and explanations collectively serve as tools in the development of scientific theories." (NGSS pg. 5) We can look at the hypothesis and the pattern of the way the relationship between man and dog serves as an example for what might be happening in the alpine grasslands. We can talk about the history of human and

dog interaction as a possible model and how the hypothesis was developed from this model. The research project was created to test this. [*Cultural Note: I would also take this time to talk about how the relationship between man and dog exists in the student's respective cultures, how it exists in the American culture and draw parallels. This would strengthen the bond of community with the students and help them relate to each other. It would be linked back to shared understanding all around the world and has the potential to link back to Science as a Human Endeavor]*

The second paragraph can also be linked to Math Tenet 3, "they reason inductively about data, making plausible arguments that take into account the context from which the data arises." (NOS pg.1) We look at the model as data and how the argument arose from looking at the model. We can discuss how a hypothesis is a plausible argument resulting from logical thinking and previous data. However, a hypothesis is not a theory because there is not enough supporting data, which is why experiments are designed to look into the hypothesis and strengthen it or show its flaws. You can take this connection one step further and integrate Math Tenet 4 by "creating an equation or flow chart" to show the relationships in the two scenarios. (NOS, pg.1) After creating a flowchart they can theorize if the relationships are the same. They can add to and alter this model as they keep reading the article.

Next comes that data. We can look at the experiment itself. Is it enough to quantify theory? Is it just a stepping stone in a longer process? What could it mean? This would link back to "scientific explanations can be probabilistic," and "a scientific theory is the substantiated explanation of some aspect of the natural world, based on a body of facts that have been repeatedly confirmed through observation and experiment, and the science community validates each theory before it is accepted" (NGSS, pg.5). This also can be linked back to Math Tenet 2 as the students learn "the ability to contextualize, to pause as needed during the manipulation

process in order to probe into the referents." It forces them to stop and really think about the data, and not only what it means, but what it doesn't mean.

After the article break, the author talks about two very different explanations for the data as to why the wolves are more successful hunters when surrounded by monkeys (Holmes, 2015). "Science knowledge has a history that includes the refinement of, and changes to, theories, ideas, and beliefs over time" (NGSS, pg. 5). This is a great time to talk about how science is constantly evolving and subject to change. How sometimes research and experimentation raises more questions instead of answering them. This should be linked back to the original questioning work that we did about the picture and how this data circles back to the same process (and standards) we did in the beginning. What further research could be done to find out which of the two ideas might be correct? It is important to show students how the process can start all over again in light of new evidence.

This is just a small snippet of how this article can be used. Through Socratic questioning the majority of science standards can be incorporated into a lesson on this article. Math is a bit more tricky as the thought processes can be applied but the practicum would take some external sources to fully develop. However, with a bit of effort, a rigorous math activity could easily accompany this lesson. One thing I really liked about this article is that it is just a piece of the path to understanding the Alpine Grasslands. The original connection they wanted to make to man and dog didn't work and it raised more questions than it answered. We now know why the wolves are there, but we don't know why the monkeys let them be there. We don't really know why the presence of the monkeys make the hunting grounds more fertile. We have some data, but it doesn't paint the full picture. I think this article really shows what it is like to be a practicing scientist. It paints science in a very real light.

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