The Origin of Calculus

Author's Name: Heather McNeill Date of Lesson: N/A Length of Lesson: 5 – 6 days Lesson Topic: The Origin of Calculus Grade Level: 10 – 12 (To be taught at the beginning of a unit which uses Calculus, in a math or science course.)

Concept(s): Calculus is an essential part of the mathematics family and many students go through high school and college having taken at least Calculus 1, some students, all the way through Calculus 3 without knowing any background or history about the beautiful subject. It is said that both Newton and Leibniz invented Calculus in the 17th century, however Newton receives more of the credit since historians believe that Newton quietly and privately invented Calculus eight years before Leibniz and couldn't get the word out due to the great fire in London. Consequently, the information Newton had discovered wasn't known and publicized so when Leibniz made his discoveries which included open announcements, it was the first the public had heard of such knowledge. Regardless the two men lived apart, Newton in London and Leibniz in Germany, and therefore we can confidently say that they both invented Calculus, just at two separate times. Calculus is a vital aspect of mathematics which has two main branches – differential calculus and integral calculus. Techniques we use today to find the change in slope of an equation (differentiable calculus) and the area under the curve (integral calculus).

Materials List and Advanced Preparation:

- The teacher should reserve a computer lab in the library for the students to conduct their research using books, encyclopedias, the internet, etc.

- The teacher also needs to reserve the computer lab on days 5 and 6 of the lesson for the students to write, revise and review their paper (evaluation section).
- Poster board, markers, paper, glue, etc. presentation materials
- A projector to play the video in the engagement section of the lesson.

Performance Objectives:

Students will be able to:

- describe the origins of Calculus.
- report effectively on the information and ideas they discovered to their classmates

- discuss with one another and experience the process mathematicians went through/go through

to discover "new" mathematics.

Safety Considerations: There are no safety considerations for this lesson.

Engagement - Day One: Brainstorming about the Origins and Uses of Calculus

Ask the students to list answers to the following statements on a piece of paper and to be prepared to share their answers with the class.

- Name any professions/careers you know of that use Calculus.
- List any historical events that have relied on Calculus.
- List any leisure activities that use Calculus (probably indirectly).

The teacher will then ask for the students to share their answers, have a class discussion about the different answers students share. Debate the answers and try coming up with more as a whole class. The teacher will then play the following 3 minute video on the origins of Calculus. Students will find additional answers to the above statements in the video they may want to add to their list.

The teacher will then play: <u>http://www.teachertube.com/ viewVideo.php?title= Introduction_to_Calculus</u> <u>Newton&video_id=112798</u>

Following the video, have a second class discussion this time with regards to the video.

- Are there any questions you have from the video?
- Did you hear anything you could add to your list?
- Who founded Calculus? (Students should say either Newton, Leibniz, or both of them together)
- Why do you say him/them?

Inform the class that they will have the opportunity during the next class period to conduct their own research and to come to their own conclusion about who founded Calculus. The teacher will now divide the class into their pairs (assigned by the teacher) and hand out the list of questions the students are to answer in the following class period. Also inform each pair which question(s) they are responsible for presenting to the class; this way the students can begin working on their research that evening if they wish. The reset of the class period is to be used as a brainstorming, planning time.

The research questions are as follows:

- -Where did calculus come from?
- -How was it created?
- -Who developed it?
- -Why would they want to develop Calculus?
- -What good does it do for us today?
- -How did they do Calculus a long time ago before they had calculators?

Exploration – Day Two: Research Day in the Library

The teacher will present the students with a list of the following questions with which the students are supposed to find answers for while doing research in the library. All students are required to find answers for all of the questions but in addition, the students will be divided up into pairs and each pair will be responsible for conducting extensive research into one of the assigned (designated) questions. The students will later present their detailed research results to the class during presentations. The period should be used as a research period, students are to be productively working on answering the given questions.

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Explanation – Day Three: Presentation Day

The students are to present their results from their research to the class either by way of a poster or a PowerPoint. The presentation should last between 3-5 minutes and should completely answer the question. The pair should then address any questions the class may have. While pairs are presenting, the rest of the class should be taking notes on the information being provided while listening attentively and respectfully. The teacher should be able to fit in most if not all the pairs in one class period, however if some are pairs are left out they can expect to present at the beginning of the next day of class.

Elaboration – Day Four: You Be the Mathematician

The teacher will conduct a lesson with the class on what it could have been like to be Newton or Leibniz when they were discovering Calculus. The teacher will provide the class with the general version of a quadratic equation $(ax^2 + bx + c = 0)$ and ask students to prove how it is related to the Quadratic formula. Express to the students that you have already done half the work, finding out that one thing is related to another, now they have to prove/show it. Point out to the class that this task is easier than what Newton and Leibniz had to do, they didn't have anyone to give them an ending result. (We are using the quadratic formula since by this class the students are familiar with the required math to successfully prove/show that there is a relationship, where as it would have been much more difficult to ask them to prove a Calculus theorem when they don't know much (if anything at all) about Calculus. This activity should get the point across that proving mathematics is doable but it can be rather challenging. By the end of the class period the students should have reached a solution and feel proud of themselves for proving mathematics. It is up to the teacher to decide how to allow the students to work on this assignment, whether to have them work individually then in groups, or from groups initially, etc. By the end of the period the

teacher should have a student or group of students explain their solution to the class. As a class, discuss the validity of the solution and decide if any changes need to be made.

Evaluation – Days Five & Six: You Be the Historian

The students are to compose a two-five page double spaced 12pt Times New Roman font paper which answers all of the research questions in detail. The students are to use the information from their notes taken during the class presentations to thoroughly answer each research question. This paper will be done individually and not in the research pairs. The students will be given at least one entire class period to write, possibly two class periods, (depending on the needs of each particular class of students). The paper will be due a few days later, whenever the teacher sees fit.

Bibliography

- "History of Calculus." *Department of Mathematics & Statistics*. Web. 10 Sept. 2011. http://www.mscs.dal.ca/~kgardner/History.html.
- "Introduction to Calculus: Newton." *Teachertube.com*. Web. 10 Sept. 2011. http://www.teachertube.com/viewVideo.php?title=Introduction_to_Calculus___Newton_kvideo_id=112798.