MATH 5010

**Title:**  ***The Simple Affine Cipher***

***Lesson Plan***

**Authors:** Adam Rowley and Natalia Wilson

**Topic:** Simple Affine Cipher

**Connection to Core Curriculum:**

Secondary Mathematics III:

Standard F.BF.1 Write a function that describes a relationship between two quantities.

**Overview:** This activity will expand the knowledge and applications of functions. Students will learn how to create a function and its inverse based on recognized patterns.

**Objectives:** Discover x=(x+a)b does not create every possible order of the alphabet based on how the function is created. Students will be able to find patterns in an encoded message. With prior knowledge of one word in the encoded text they will look at the difference between the values and expansion and identify the values in the simple affine cipher function that created the encoded text. Given the simple affine cipher function they will be able to use the function to decode the message.

**Materials Needed:** We will need the PowerPoint we put together for our presentation. We will also use the whiteboard and of course markers. The students will need the applet Adam created. They will also need the printed encoded message with extra space for scratch work and a writing utensil.

**Technology:** The technology used by us will be the projector for the powerpoint and the whiteboard. Each student will need to have a computer for this activity. A link will be provided for them to access an applet. They will use this applet to cut back on some of the calculations needed for decrypting the message.

**Role of Technology:** This applet will allow students to quickly generate ciphers formed from the equation x=(x+a)b, observe properties of modular arithmetic, and save time consuming arithmetic required in some of the proposed algorithmic code breaking strategies.

**Web Reference:** [**https://www.geogebra.org/m/x3wvxh7n**](https://www.geogebra.org/m/x3wvxh7n)

**Activity Plan:**

We will first give a presentation on affine ciphers. We will describe what they are and how they work. We will build on the knowledge of functions and the application of them. We will also describe rules that will help them through their discovery of affine cipher encryption. This will last approximately 7 to 10 minutes.

Then we will give them a decrypted message to decode using the original applet Adam made. We will let them explore the applet and decrypt the message. Both of us will walk around the room, answering questions and giving further explanation where needed. After they have had time to explore, approximately 5-6 minutes, we will come together as a class and introduce a specific encrypted message. This message will demonstrate the limitations of the affine cypher encryption and lead to discussion that will fill the remaining time of our activity. The discussion will include their findings, limitations and applications of this encryption method.

Some areas we want to highlight for clarity include modules. When I was first learning about it this was a point of confusion for me. After a simple explanation I understood the concept. However, what helped me the most was comparing it to how I understand time and how to add hours. Another point we want to highlight is the shift and expansion that addition and multiplication give to the output of a function. This will help students as they use algebra and logic to decrypt the message.

**Included documents:** PowerPoint emailed as another attachment because we love trees.

**References:**

*Index of Coincidence*. (2019). Retrieved from dCode: https://www.dcode.fr/index-coincidence

Utah State Board of Education. (n.d.). *Secondary Mathematics Core*. Retrieved from Utah Education Network: https://www.uen.org/core/math/7-12.shtml

The first is the source I used to encrypt the message for the PowerPoint. The second was used to find the connection to the core curriculum.