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| **Name: James Prugh** | **Contact Info:** | **Date:** |

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| **Lesson Title :** What is Number Theory and why is it important? | **Unit #:** | **Lesson #1:** | **Activity #: 1** |
| **Activity Title:** Activity 1 |

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| **Estimated Lesson Duration:** | 1 class period |
| **Estimated Activity Duration:** | 2 class periods |

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| **Setting:** | High school classroom |

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| **Activity Objectives:** Students will develop an appreciation and understanding of simple number theory. |

The students will explore number theory by:

1. generating prime numbers form 100 – 999 and sharing method results and patterns
2. discussing the importance of prime numbers in internet security
3. trying to factor numbers into primes
4. trying to prove that the sum of two evens is even
5. prove the Pythagorean theorem
6. using the Pythagorean theorem to derive the distance formula
7. using the distance formula to find the general form of the equation of a circle

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| **Activity Guiding Questions:** What does number theory mean to you? Why is number theory important? How is number theory used in internet encryption? |

Is there a pattern to determining prime numbers?

Can you factor numbers into primes? If so, how?

How do you prove that the sum of two evens is even?

How can you prove the Pythagorean theorem?

How can the Pythagorean theorem be used to derive the distance formula?

How can you use the distance formula to find the general form of the equation of a circle?

| **Next Generation Science Standards (NGSS)** | |
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| **Science and Engineering Practices (Check all that apply)** | **Crosscutting Concepts (Check all that apply)** |
| Asking questions (for science) and defining problems (for engineering) | Patterns |
| Developing and using models | Cause and effect |
| Planning and carrying out investigations | Scale, proportion, and quantity |
| Analyzing and interpreting data | Systems and system models |
| Using mathematics and computational thinking | Energy and matter: Flows, cycles, and conservation |
| Constructing explanations (for science) and designing solutions (for engineering) | Structure and function. |
| Engaging in argument from evidence | Stability and change. |
| Obtaining, evaluating, and communicating information |  |

| **Ohio’s Learning Standards for Science (OLS)** |
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| **Expectations for Learning - Cognitive Demands (Check all that apply)** |
| Designing Technological/Engineering Solutions Using Science concepts **(T)** |
| Demonstrating Science Knowledge **(D)** |
| Interpreting and Communicating Science Concepts **(C)** |
| Recalling Accurate Science **(R)** |

| **Ohio’s Learning Standards for Math (OLS) and/or**  **Common Core State Standards -- Mathematics (CCSS)** | |
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| **Standards for Mathematical Practice (Check all that apply)** | |
| Make sense of problems and persevere in solving them | Useappropriate tools strategically |
| Reason abstractly and quantitatively | Attendto precision |
| Construct viable arguments and critique the reasoning of others | Look for and make use of structure |
| Model with mathematics | Look for and express regularity in repeated reasoning |

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| **Unit Academic Standards (NGSS, OLS and/or CCSS):** |

[CCSS.MATH.CONTENT.HSN.RN.A.1](http://www.corestandards.org/Math/Content/HSN/RN/A/1/)

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| **Materials**: (Link Handouts, Power Points, Resources, Websites, Supplies) |

<https://docs.google.com/viewer?a=v&pid=sites&srcid=ZGVmYXVsdGRvbWFpbnxqYW1lc3BydWdoMjAxNnxneDozNmQwZjZkOTlkZjM0N2Vj>

<https://docs.google.com/viewer?a=v&pid=sites&srcid=ZGVmYXVsdGRvbWFpbnxqYW1lc3BydWdoMjAxNnxneDozZjRiMzE5ZDNjZTJkM2Uz>

<https://www.youtube.com/watch?v=GKTexzwFpck>

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| **Teacher Advance Preparation:** |

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| **Activity Procedures:**   1. Show Stuxnet clip and briefly discuss 2. Introduce big idea – have students generate essential questions 3. Select essential questions and have students generate challenges 4. Give each student a list of numbers from 1 to 100 and ask them to find all primes. Discuss results and share the difference between prime and composite 5. Show a clip from NUMB3RS about internet security 6. Have the students work in groups of 4 to see which group can generate the most prime numbers from 100 – 999. 7. Share the methods results and any patterns that might be found 8. Discuss the importance of prime numbers in internet security 9. Introduce the Fundamental Theorem of Arithmetic. Students in their groups of 4 will attempt to factor numbers into primes – puzzle? 10. Next, ask each student to prove that the sum of two evens is even 11. Divide students into groups of 4 and have each prove the Pythagorean theorem differently 12. Ask each group to use the Pythagorean theorem to derive the distance formula 13. As a class, define a circle. Each group is to use the distance formula to find the general form of the equation of a circle |

**Formative Assessments:** Prior to the video, students will take a 4-question quiz pretest. Also checked for understanding of 6 -13 in procedure above.

**Summative Assessments:** Each student is asked to write a general form for the equation of a circle, including a graph of a specific case.

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| **Differentiation:** Students will be grouped and roles will be identified according to strengths. Each group will have a person initiate, clarify, summarize, and record. Students will be placed in a group that will utilize their strengths and support their weaknesses. |

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| **Reflection:** |

Throughout the first part of the year, I would introduce and demonstrate simple proofs. Most students found these interesting, and I was surprised at their lack of experience with such work. I found this pre-work especially helpful when I introduced the unit on number theory. Students were familiar with prime numbers, but failed to see the relevance until the connection was made with encryption and cybersecurity. The Stuxnet clip really got their attention, and we watched an entire episode of NUMB3RS that dealt with internet encryption.

I was very pleased with the activity and the level of student involvement.