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| **Lesson Title:** How do I keep my information safe? | **Unit #:**  **1** | **Lesson #:**  **2** | **Activity #:**  **4** |
| **Activity Title: Collecting Coins Challenge** |

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| **Estimated Lesson Duration:** | **6 days** |
| **Estimated Activity Duration:** | **4 days** |

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| **Setting:** | **~~2~~ 3 Classrooms that have no contact with each other than the information projected on the board.** |

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| **Activity Objectives:** |

Students will

1. develop protocols using cryptographic methods to collect the most coins.

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| **Activity Guiding Questions:** |

* How can I send encrypted messages without allowing attackers to steal my wealth?

| **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 New Learning Standards for Science (ONLS)** |
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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)** |

| **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, ONLS and/or CCSS):** |

[CCSS.MATH.CONTENT.6.NS.B.2](http://www.corestandards.org/Math/Content/6/NS/B/2/)

Fluently divide multi-digit numbers using the standard algorithm.

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

[Game Rules](https://docs.google.com/document/d/13BiQfaUD-pjzq-H2phktycpv_fGUbju1LowPHLGmn4c/edit?usp=sharing)

1 lock box per group

About 10 combination locks with combinations written on a slip of paper.

1 Coin jar for each group (pasta sauce jar)

Projector with [Public Key](https://docs.google.com/spreadsheets/d/1Cx9XGghx7RzXBwXLsllM7xxHZrWs8QfIn6npCz-eD98/edit?usp=sharing) posted in both classrooms.

Large bag of pennies, poker chips, or play coins.

Engineering Design Notebooks (EDN)

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| **Teacher Advance Preparation:** |

1. ~~Laminated~~ Printed Game Rules sheets for students
2. Projected Google Sheet to inform/update students on all teams’ progress during the game.

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| **Activity Procedures:** |

1. Introduce the challenge. See rules here.
2. In both classrooms, project the shared [Google Sheet](https://docs.google.com/spreadsheets/d/1Cx9XGghx7RzXBwXLsllM7xxHZrWs8QfIn6npCz-eD98/edit?usp=sharing) (Public Key) for all groups to see.
3. Allow students to work with their groups to develop a protocol for the challenge. Have students detail their protocols in their EDNs.
4. Separate groups into ~~two~~ three rooms. Allow the students to play the game.
5. Teams can ask the notary (teacher) to project information for the other half of their team via the public key.
6. Periodically, collect all boxes/locks and allow the students a few minutes to assess their progress and make adjustments to their protocols.
7. When game play has ended, allow students to reflect in their EDN. Give groups time to share their strategies and write changes they would make to their protocols if they were to complete this challenge again.
8. Upon completion of the games, have teams determine their most effective protocols and share them in a [blog post](http://ihms6cryptography.blogspot.com/2015/12/research-and-reflection-post.html) for all students to read.
9. Discuss what the students read and ways to improve even the best protocols.

**Formative Assessments:** Link the items in the Activities that will be used as formative assessments.

Small group redesign discussions and Share-It portions of the EDN.

**Summative Assessments:** These are optional; there may be summative assessments at the end of a set of Activities or only at the end of the entire Unit.

Final writing assignment in the EDN. “Coin Collection Challenge”.

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| **Differentiation:** Describe how you modified parts of the Lesson to support the needs of different learners.  Refer to Activity Template for details. |

Throughout the game, I modified the rules to allow all students equal time to participate. During the first round of game play, the team in one of the rooms never received their box. Eventually, teams were given limited time with the boxes which added a time constraint to the challenge as well. I also added a [culminating blog post](http://ihms6cryptography.blogspot.com/2015/12/research-and-reflection-post.html) allowing teams to share their protocols when the game had ended. The students then, read through the posts and we held a class discussion about which protocols were the best and why. The students also addressed what they read in their final “Share-It” discussion in their EDNs.

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| **Reflection:** Reflect upon the successes and shortcomings of the lesson. |

The game was highly engaging. The students loved playing the game and continue to ask if they can play it again. However, many of the teams continued to use a secret key system. Despite requiring all students in the “Eve” or interceptor room to switch and examine other teams’ protocols during the game, some teams continued to use a secret key system. However, some of their protocols were very creative and difficult to crack even after allowing other teams to see them.