**Lesson Planning Template**

**COSMOS EDUCATIONAL TOOLKIT: Why can’t submarines communicate below the surface?**

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| **Grade/ Grade Band**: 7-12 | **Topic:** BPSK and QPSK | **Lesson #** \_\_\_\_\_ **in a series of** \_\_\_\_\_ **lessons** |
| **Brief Lesson Description**: Data Transfer type: BPSK and QPSK |
| **Specific Learning Outcomes**: What is the difference between BPSK and QPSK? |
| **Narrative / Background Information**  |
| **Prior Student Knowledge Required:** Binary code, functions, simple probability. |
| **Problem Solving Practices (Ex: Standards for Mathematical Practice):** [CCSS.MATH.CONTENT.HSF.IF.C.9](http://www.corestandards.org/Math/Content/HSF/IF/C/9/)Compare properties of functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).[CCSS.MATH.CONTENT.7.SP.C.5](http://www.corestandards.org/Math/Content/7/SP/C/5/)Understand that the probability of a chance event is a number between 0 and 1 that expresses the likelihood of the event occurring. Larger numbers indicate greater likelihood. A probability near 0 indicates an unlikely event, a probability around 1/2 indicates an event that is neither unlikely or likely, and a probability near 1 indicates a likely event. | **Main Content Ideas:** 1. How does get data gets moduated?
2. How does the data get transferred?
3. what does it look like when data gets transmitted one bit at a time vs. two bits at a time?
4. What is the probability of error as we increased the number of bits as per transfer?
5. How does the noise interfere with the transmission?
 | **Possible Multidisciplinary Concepts:** Computer Science |
| **Possible Preconceptions/Misconceptions:** **Many students think that function is only used in math. This lesson is a good example of application of function in real life situations.** |
| **LESSON PLAN – 5-E Model**  |
| [**ENGAGE: Opening Activity – Access Prior Learning / Stimulate Interest / Generate Questions:**](http://www.youtube.com/watch?v=PUB1GU_tvpI&safe=active)  How does data gets transmitted through air accurately? How do we evaluate the probability of error? |
| **EXPLORE: Lesson Description – Materials Needed / Probing or Clarifying Questions:** PSK worksheets, Cosmos GNU - radio software |
| **EXPLAIN: Concepts Explained and Vocabulary Defined:**In this lesson the concept of two different types of data transmission is illustrated.One is BPSK and QPSK**Key Vocabulary:** 1. Modulation - a process of digital code being converted into waves
2. BPSK - Binary Phase Shift Keying: Data is being transferred one bit at a time.
3. QPSK -Quadrature Phase Shift Keying: Data is being transferred two bits at a time.
4. Probability of error
5. Symbols - different types of waves
6. Noise - additive value that cause modification to the symbols.
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| **ELABORATE: Applications and Extensions:** This application can be extended by calculating the distance between the **predetermined location** and the received symbol. |
| **EVALUATE:** **Formative Monitoring (Questioning / Discussion):** Students will write and share the venn diagram that summarizes the similarities, differences and what commonality between BPSK and QPSK. **Summative Assessment (Quiz / Project / Report):** Project: Students can research and report the advantages and disadvantages when data bits are increased when it is being transmitted?What is the acceptable possibility of error? or would that depend on the type of data that is being transmitted? |
| **Elaborate Further / Reflect: Enrichment:**  |