Madison Public Schools

# Physics and Engineering - Unit 3 - Asteroid Warning!

## Unit Focus

Students will apply their knowledge of the universal law of gravitation to analyze the threat of near earth objects to our planet and/or our moon. Students will apply knowledge of computer modeling to model the behavior of a moving object to predict its future position given the presence of multiple external forces. This unit allows students to communicate complex models and complex data into a simple graph or pictorial representation for a wider audience. Students will research the challenge of detecting near earth objects (NEO) and build a system to predict if an object (comet, asteroid, etc.) will crash into the earth.

## Stage 1: Desired Results - Key Understandings

### Standard(s)

**Next Generation Science**
*High School Engineering Design: 9 - 12*

- Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. *HS-ETS1-2*
- Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem. *HS-ETS1-4*

**NGSS/NSTA Science & Engineering Practices**
*NGSS Science & Engineering Practices: 9-12*

- Develop and/or use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and/or solve problems. *SE.9-12.2.6*

**Student Growth and Development 21st Century Capacities Matrix**
*Critical Thinking*

- Analyzing: Students will be able to examine

### Transfer

**T1** Analyze qualitative and quantitative data to interpret patterns, draw conclusions, and/or make predictions.

### Meaning

| Understanding(s) | Essential Question(s) |
|---|---|
| **U1** The motion of an object can be determined and/or predicted by using its position, velocity, and acceleration.<br>**U2** Energy that is stored in an electric, magnetic, or gravitational field depends upon the position of the objects in the field.<br>**U3** Objects in motion remain in straight-line motion at constant speed, and objects at rest remain at rest unless acted upon by unbalanced forces. (Newton's 1st law).<br>**U4** Attractive and repulsive interactions at a distance (e.g., gravitational, magnetic, electrical and electromagnetic) can be described by using the concept of fields.<br>**U5** The acceleration of an object depends upon its mass and the net force acting on it. | **Q1** How do the fundamental forces of the universe explain the behavior and interactions of objects? (e.g. particles, people, stars, planets)<br>**Q2** How can position of an object in a field affect the amount of energy it has stored?<br>**Q3** What do the results tell me? What patterns do I see or what conclusions can I draw? |

### Acquisition of Knowledge and Skill

| Knowledge | Skill(s) |
|---|---|
| **K1** Newton's law of gravitation<br>**K2** Velocity and acceleration are vectors | **S1** Calculating the net force on an object in 2 Dimensions given positional information |

| Stage 1: Desired Results - Key Understandings | | |
|---|---|---|
| information/data/evidence to make inferences and identify possible underlying assumptions, patterns, and relationships. *MM.1.2*<br><br>*Collaboration/Communication*<br>• Product Creation: Students will be able to effectively use a medium to communicate important information (findings, ideas, feelings, issues, etc.) for a given purpose. *MM.3.2* | **K3** An acceleration vector is the result of a net force vector and the mass of an object<br>**K4** The velocity of an object will change if an acceleration is associated with that object<br>**K5** 2D and 3D vectors are required to model real world objects | **S2** Predict a future position given current position, velocity and acceleration vectors<br>**S3** Create visual representations of data to communicate a concept or result<br>**S4** Use iterators or loops in a computer simulation to simulate the passage of time<br>**S5** Create high level parameters for computer simulations to simply future changes to a model |