Curriculum: Physics A

Curricular Unit: One Dimensional Kinematics

Instructional Unit: A. Describe the relationship of an object’s position, velocity and acceleration over time when it moves in one dimension

- **Analyze position vs. time and velocity vs. time graphs**
- Analyze position vs. velocity graphs

**Standard Alignments (Section 2)**

| SCCLE: SC2.1.Aa-c; SC2.1.Ba,c,d |
| Knowledge: (SC) 2 |
| CCSS: 11-12.RST.3; 11-12.RST.4; 11-12.RST.9 |
| NETS: 1c,d; 2d; 4c |
| Performance: 1.6, 1.8, 3.5 |

**Unit (Section 3)**

**Learning Targets:**

- Represent and analyze the motion of an object graphically
- Analyze the speed of two objects in terms of distance and time
- Calculate the speed of objects (speed = distance/time)
- Measure and analyze an object’s motion in terms of speed, velocity, and acceleration
- Calculate the acceleration of an object (final velocity-starting velocity/time)

**Instructional Strategies:**

- Strategies for every standard taught:
  - Each day’s objectives are taught using a lab, worksheet, quiz cycle
  - All labs are done in groups of 2-3 students
  - Students will start the day by completing a quiz based on the previous day’s worksheet
  - After the members of the lab group complete the quiz, they will use an iPad to access the classroom website which has videos to supplement their written instructions
  - Students will complete the lab at their own pace using the teacher for help where needed
  - The teacher will sign off on their lab when it is completed and the students will complete a worksheet with problems based on the lab
  - The key for the worksheet is available on the website and they can get help from the teacher when necessary
  - Students will complete a quiz based on the worksheet to next class period

Board Approved 8-3-15
• The labs will have the following outcomes:
  • Students will generate a:
    • Position vs. Time graph and a Velocity vs. Time graph for:
      • constant velocity and determine the relationships between them
      • increasing velocity and determine the relationships between them
      • both constant and increasing velocity and determine the relationship between them
    • Position vs. Velocity graph and determine the relationship between position and velocity
  • Students will learn to:
    • predict the distance an object will travel from the object’s initial velocity and the time the object travels
    • find instantaneous velocity from the average velocity when either the initial or final velocity is zero
    • predict an object’s final velocity from its acceleration and distance

Assessments/Evaluations:

• Formative – students will:
  • complete lab reports for each lab in the unit
  • take a quiz based on the worksheet associated with each lab in the unit. The students may retake each quiz as often as they wish
• Summative: District developed unit test

Sample Assessment Questions:

• Louisa was driving 27.5 m/s when she entered the freeway. If she was accelerating at 3.5 m/s^2 how far did she travel in 5.4 s?
• Jill slowed down from 57 m/s to 29 m/s over a distance of 4355 m. What was her acceleration?

Instructional Resources/Tools:

• iPad
• Class website
• LabQuest2
• Traditional physics lab equipment

Cross Curricular Connections:

• ELA: Reading is emphasized with written lab instructions and word problems
• Math:
  • Algebra II
  • Trigonometry

**Depth of Knowledge (Section 5)**

DOK: 3
Curriculum: Physics A

Curricular Unit: Projectiles

Instructional Unit: B. Analyze the motion of a projectile
- Analyze a free falling object
- Analyze a horizontally projected projectile
- **Analyze two-dimensional projectile motion**

**Standard Alignments (Section 2)**

| SCCLE: SC2.2.E  
| Knowledge: (SC) 1  
| CCSS: 11-12.RST.3; 11-12.RST.4; 11-12.RST.9  
| NETS: 1c,d; 2d; 4c  
| Performance: 2.2 |

**Unit (Section 3)**

**Learning Targets:**

- Motion of projectiles in a uniform gravitational field:
  - Recognize all free-falling bodies accelerate at the same rate due to gravity regardless of their mass
  - Write down expressions for the horizontal and vertical components of velocity and position as functions of time, and sketch or identify graphs of these components
  - Analyze the motion of a projectile that is projected with an arbitrary initial velocity using these expressions

**Instructional Strategies:**

- Strategies for every standard taught:
  - Each day’s objectives are taught using a lab, worksheet, quiz cycle
  - All labs are done in groups of 2-3 students
  - Students will start the day by completing a quiz based on the previous day’s worksheet
  - After the members of the lab group complete the quiz, they will use an iPad to access the classroom website which has videos to supplement their written instructions
  - Students will complete the lab at their own pace using the teacher for help where needed
  - The teacher will sign off on their lab when it is completed and the students will complete a worksheet with problems based on the lab
  - The key for the worksheet is available on the website and they can get help from the teacher when necessary
  - Students will complete a quiz based on the worksheet to next class period

Board Approved 8-3-15
• The students will:
  • determine the acceleration due to gravity
  • generate an equation for the position of a vertical projectile
  • find the muzzle velocity of a projectile launcher
  • determine the relationship between horizontal and vertical velocity of a projectile
  • determine the relationship between the launch height and range of a projectile
  • demonstrate velocity and acceleration are vector quantities
  • determine the relationship between the launch angle and range of a projectile

Assessments/Evaluations:

• Formative – Students will:
  • complete lab reports for each lab in the unit
  • take a quiz based on the worksheet associated with each lab in the unit. The students may retake each quiz as often as they wish
• Summative: District developed unit test

Sample Assessment Questions:

• Brooke shoots an arrow horizontally off of the top of a 30 m building. How fast did the arrow leave the bow if it landed 250 m away from the building?
• The Cole county sheriff is trying to determine the speed of a car that slid off a small bridge on a snowy Missouri night and landed in a snow pile 4.00 m below the level of the road. The tire tracks in the snow show that the car landed 12.0 m measured horizontally from the bridge. How fast was the car going when it left the road?

Instructional Resources/Tools:

• iPad
• Class website
• LabQuest2
• Traditional physics lab equipment

Cross Curricular Connections:

• ELA: Reading is emphasized with written lab instructions and word problems
• Math:
  • Algebra II
  • Trigonometry

Depth of Knowledge  (Section 5)

DOK: 3
Curriculum: Physics A

Curricular Unit: Newton’s Laws and Momentum

Instructional Unit: C. Apply Newton’s three laws and conservation of momentum
• **Analyze a problem using Newton’s second law**
• Analyze a problem using conservation of momentum
• Analyze a problem using vectors

**Standard Alignments (Section 2)**

<table>
<thead>
<tr>
<th>SCCLE: SC2.1.Ca,b; SC2.2.Aa; SC2.2.Da-c,e-i</th>
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</thead>
<tbody>
<tr>
<td>Knowledge: (SC) 2</td>
</tr>
<tr>
<td>CCSS: 11-12.RST.3; 11-12.RST.4; 11-12.RST.9</td>
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<tr>
<td>NETS: 4c</td>
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<tr>
<td>Performance: 1.8, 2.2, 3.1</td>
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</tbody>
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**Unit (Section 3)**

Learning Targets:

• Add, subtract, and resolve displacement and velocity vectors to determine:
  • components of a vector along two specified, mutually perpendicular axes
  • the net displacement of a particle or the location of a particle relative to another
  • the change in velocity of a particle or the velocity of one particle relative to another

• Identify and describe the forces acting on an object (i.e., type of force, direction, magnitude in Newton’s first law of motion)

• Recognize that inertia is a property of matter that can be described as an object’s tendency to resist a change in motion, and is dependent upon the object’s mass (Newton’s first law of motion)

• Describe the effect of a change in mass of an object on the inertia of that object (Newton’s first law of motion)

• Using information about the mass and acceleration of two objects, compare the forces required to move them (force = mass x acceleration) (Newton’s second law of motion)

• Identify forces acting on a falling object and the factors that affect the rate of fall (i.e., mass, volume, shape, or type of material from which the object is made)

• Determine the overall effect (i.e., direction and magnitude) of forces acting on an object at the same time (i.e., net force)

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- Predict and explain the effect of a change in force and/or mass on the motion of an object (Newton’s second law of motion)

- Analyze action/reaction forces acting between two objects (e.g., handball hits concrete wall, shotgun firing) and describe their magnitude and direction (Newton’s third law of motion)

- Predict the change in motion of one object when it is acted upon by the equal and opposite force of another object (i.e., action/reaction forces) (Newton’s third law of motion)

- Compare the momentum of two objects in terms of mass and velocity

- Explain that the total momentum remains constant within a system

**Instructional Strategies:**

- Strategies for every standard taught:
  - Each day’s objectives are taught using a lab, worksheet, quiz cycle
  - All labs are done in groups of 2-3 students
  - Students will start the day by completing a quiz based on the previous day’s worksheet
  - After the members of the lab group complete the quiz, they will use an iPad to access the classroom website which has videos to supplement their written instructions
  - Students will complete the lab at their own pace using the teacher for help where needed
  - The teacher will sign off on their lab when it is completed and the students will complete a worksheet with problems based on the lab
  - The key for the worksheet is available on the website and they can get help from the teacher when necessary
  - Students will complete a quiz based on the worksheet to next class period
  - The students will verify:
    - the force of gravity equals mg
    - Newton’s second law
    - the conservation of momentum
    - forces combine as vectors
    - the force of friction depends on the surfaces and the weight of the object

**Assessments/Evaluations:**

- Formative – students will:
  - complete lab reports for each lab in the unit
  - take a quiz based on the worksheet associated with each lab in the unit. The students may retake each quiz as often as they wish

- Summative: District developed unit test
Sample Assessment Questions:

• Ben and Jerry are standing on an ice rink discussing who has the best skates. Ben says he will go faster due to his superior skates and gives Jerry a shove to prove his point. Ben has a mass of 150 kg and a velocity of 11 m/s after he pushed Jerry. What was Jerry’s mass if he had a velocity of 15 m/s?
• A 30 kg mass on a level, frictionless ramp is connected by a string to a 10 kg mass, which is hanging off the end of the ramp. The string goes over a frictionless pulley. Jesse is holding the 30 kg mass. What will the acceleration of the 10 kg mass be when Jesse lets go?

Instructional Resources/Tools:

• iPad
• Class website
• LabQuest2
• Traditional physics lab equipment

Cross Curricular Connections:

• ELA: Reading is emphasized with written lab instructions and word problems
• Math:
  • Algebra II
  • Trigonometry

Depth of Knowledge (Section 5)

DOK: 4
Curriculum: Physics A

Curricular Unit: Work, Power, Energy and Circular Motion

Instructional Unit: D. Analyze the efficiency of different systems
  • Analyze the efficiency of a ramp system including rotational energy
  • Analyze the efficiency of a spring and weight system
  • Analyze the summation of torque in a static system

Standard Alignments (Section 2)

| SCCLE: SC1.2.Aa,d,f,h; SC2.1.Ba-d; SC2.2.Fa-d |
| Knowledge: (SC) 1,2 |
| CCSS: 11-12.WHST.4; 11-12.RST.3; 11-12.RST.4; 11-12.RST.9 |
| NETS: 4c |
| Performance: 1.2, 1.6, 3.8 |

Unit (Section 3)

Learning Targets:

• Apply the concept of torque to calculate the:
  • magnitude and sense of the torque associated with a given force
  • torque on a rigid body due to gravity

• Analyze problems in statics to:
  • state the conditions for translational and rotational equilibrium of a rigid body
  • apply these conditions in analyzing the equilibrium of a rigid body under the combined influence of a number of coplanar forces applied at different locations

• Relate kinetic energy to an object’s mass and its velocity

• Distinguish between examples of kinetic and potential energy (i.e., gravitational, elastic) within a system

• Describe the effect of work on an object’s kinetic and potential energy

• Describe the relationships between work, applied net force, and the distance an object moves

• Explain how the efficiency of machines can be expressed as a ratio of work output to work input

• Describe power in terms of work and time

• Analyze and describe the relationship among work, power, and efficiency
Instructional Strategies:

- Strategies for every standard taught:
  - Each day’s objectives are taught using a lab, worksheet, quiz cycle
  - All labs are done in groups of 2-3 students
  - Students will start the day by completing a quiz based on the previous day’s worksheet
  - After the members of the lab group complete the quiz, they will use an iPad to access the classroom website which has videos to supplement their written instructions
  - Students will complete the lab at their own pace using the teacher for help where needed
  - The teacher will sign off on their lab when it is completed and the students will complete a worksheet with problems based on the lab
  - The key for the worksheet is available on the website and they can get help from the teacher when necessary
  - Students will complete a quiz based on the worksheet to next class period
- The students will:
  - determine the efficiency of a ramp and a pulley system
  - demonstrate energy is conserved with a ramp, spring, rubber band, rolling objects and an Atwood machine
  - determine the relationship between centripetal force and angular velocity
  - demonstrate torque is balanced if an object is stationary

Assessments/Evaluations:

- Formative – students will:
  - complete lab reports for each lab in the unit
  - take a quiz based on the worksheet associated with each lab in the unit. The students may retake each quiz as often as they wish

Summative: District developed unit test

Sample Assessment Questions:

- Patrick releases a 6.8 kg air disk down a 5.4 m long frictionless board. If it takes 1.4 s to reach the ground, how high above the ground did Patrick release the air disk?
- Leah held a 20 kg weight on a spring in an un-stretched position and then released it. The spring had a spring constant of 35 N/m. How fast was the weight moving after it had fallen 0.9 m?

Instructional Resources/Tools:

- iPad
- Class website
- LabQuest2
- Traditional physics lab equipment

Board Approved 8-3-15
Cross Curricular Connections:

• ELA:
  • Reading is emphasized with written lab instructions and word problems
  • Writing skills are reinforced in the lab reports
• Math:
  • Algebra II
  • Trigonometry

**Depth of Knowledge (Section 5)**

DOK: 3