Internet of Things (IoT) at UCF

UNIVERSITY OF CENTRAL FLORIDA

UCF RET Site: Collaborative Multidisciplinary Engineering Design Experiences for Teachers

AP Physics C and High School Physics

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READ THIS FIRST

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- Remember to do your 3R reflection include an updated copy of your lesson plan, developed assessment tools, presentation materials, to the evaluator. See implementation plan instructions developed by the evaluator. Send within a week after completing the lesson to bonnie.swan@ucf.edu

RET Site: Motion Lesson/Unit Plan

Subject Area(s): Science
Course(s): AP Physics C and High School Physics
Grade Level: 9-12
Suggested Length of Lesson: 250 minutes (5 single block days)

Lesson Summary: Students will be introduced to the topics of motion, mechanical systems, electrical systems, and logic gates, and learn how they are interrelated and work together.

Prerequisite Knowledge:

- Investigate and describe contact and non-contact forces. (SC.6.P.13.1)
- Investigate and describe that an unbalanced force acting on an object changes its speed, or direction of motion, or both. (SC.6.P.13.3)
- Measure and graph distance versus time for an object moving at a constant speed. (SC.6.P.12.1)
- Interpret the relationship between distance and time for an object moving at a constant speed. (SC.6.P.12.1)

Materials/Technology Needed

- Laptops
- Pasco software
- Bluetooth enabled carts/cars
- Track for the carts/cars

Where this Fits/Lesson Dependency

- Activities used to help reinforce the topics of motion, mechanical systems, and electrical systems being learned by the students.

Lesson Objective(s)/Learning Goal(s) (2-4)

- Use kinematic equations to calculate an object's position, velocity, and acceleration at a given time
- Qualitatively and quantitatively explore the relationships among position, velocity, and acceleration
- Use graphs to describe an object's position, velocity, and acceleration as a function of time
- Interpret diagrams of motion in terms of the x and y components of position, velocity, and acceleration

Standard(s)/Benchmark(s) Addressed (2-4)

- *Standards:*
  - *SC.912.P.12.1 - distinguish between scalar and vector quantities and assess which should be used to describe an event. (Content Complexity 3)*
  - *SC.912.P.12.2 - analyze the motion of an object in terms of its position, velocity, and acceleration (with respect to a frame of reference) as functions of time. (Content Complexity Level 3)*
  - *SC.912.P.12.3 - interpret and apply Newton's three laws of motion. (Content Complexity Level 3)*

Standards for Mathematical Practice

- A-REI.2.3 - Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.
- A-CED.1.4 - Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm's law V = IR to highlight resistance R.

Instructional Strategies

- Setting goals or objectives
- Reinforcing Effort/Providing Recognition
- Cooperative Learning
- Summarizing & Note Taking
- Generating & Testing Hypotheses
- Provide opportunities for student practice
- Developing high expectations for each student

Evidence of Learning (Assessment Plan)

- Pre-test
- Online introductory Canvas assignment.
- Quizlet Live group task
- Kahoot! Review

▪ **Post-test**	

Description of Lesson Activity/Experiences

1. Online introductory Canvas assignment
2. Lab activities
3. Quizlet Live
4. Kahoot!

Recommended Assessment(s) and Steps

- A pre and post assessment will be given to assess the students' growth in knowledge of position, velocity, acceleration, mechanical systems, electrical systems, and logic gates.

List of Materials/Resources Used

- Laptops
- Pasco software
- Bluetooth enabled carts/cars
- Track for the carts/cars

Engineering Connection (60-100 words/3 sentences)

It is important to know how things work. Physics like engineering helps to try to explain that. Many things work together (mechanical and electrical systems) to deliver a desirable outcome. Applying the concept of logic gates to properties that the students cans visualize (motion) helps to reinforce the concepts.

Engineering Category (choose one)

x	relating science and/or math concepts to engineering (primarily science & math with some engineering)
	engineering analysis or partial design (primarily engineering with some science/math)
	engineering design process (full engineering design)

Key Words (what words to use in a search)

Motion, mechanical systems, electrical systems, logic gates, sensors.

Introduction/Motivation (written as if talking to students)

It is important to know how things work. Physics like engineering helps to try to explain that. We are going to start off by learning about motion, position, velocity, and acceleration. Then we will learn about logic gates and see how they can be a helpful tool to relate these properties. Lastly, we will learn about mechanical and electrical systems: many things work together (mechanical and electrical systems) to deliver a desirable outcome.

Lesson Closure (written as if talking to students)

Now that we have all learned about motion and the mechanical and electrical systems in depth, we can better relate the principals with confidence.

Lesson Background & Concepts for Teachers

Motion is the change in position of an object with in a given interval of time, and can be described in terms of displacement, distance, velocity, acceleration, and speed. A mechanical systems is energy that comes from position or motion. An electrical system is change in energy per unit charge in an electric field. Electromechanical systems or devices convert electrical energy into mechanical movement and vice versa. Logic gates are how hardware works. Logic circuits allows for the combinations of ON's and OFF's to get either an ON or OFF signal. A logic gate is a simple building block of a digital circuit, which usually has two inputs and one output.

Important Vocabulary

Term	Definition
Acceleration	The rate of change of velocity or the change in velocity divided by the change in time (m/s^2).
Displacement	A vector quantity that represents a change in position (final-initial). Units: (m).
Distance	A scalar quantity that represents the total amount traveled (always positive). Units: (m).
Equilibrium	When all forces are balanced, the net force on the system is zero.
Force	An action on a body/ object. Units: (N).
Inertia	A property of matter that resists changes in speed or direction.
Linear	Motion that occurs in a straight line.
Mass	The quantity of matter, how much space something takes up. Units (kg).
Momentum	The product of velocity and mass. Units ($kg\ m/s\ or\ N\ s$).
Newton (unit)	The SI unit for force($1N = 1kg\ m/s^2$).
Newton's 1st Law of Motion	An object at rest remains at rest, and an object in motion continues with constant velocity, unless acted on by a net force.
Newton's 2nd Law of Motion	Acceleration of an object is proportional to the net force acting on it and inversely proportional to its mass.
Newton's 3rd Law of Motion	Whenever one object exerts a force on another object, the second object exerts an equal and opposite force on the first object.
Position	A point relative to the origin.
Projectile Motion	An object moving only under the influence of gravity.
Reaction	The force that is equal in strength but opposite in direction to the action force.
Rest	An object that is not moving with zero velocity and zero acceleration.
Scalar	A quantity that is always described with a positive value (no direction), it only includes the magnitude.
Speed	A scalar quantity that represents the distance divided by time (always positive). Units: (m/s)
Vector	A quantity that includes both direction and magnitude.
Velocity	A vector quantity of the rate of change of position or the change in position divided by the change in time. Units: (m/s).

Troubleshooting Tips

Other Helpful Information

Attachments

List here any lesson or activity attachments not included within this document, such as the following:

- PowerPoints for lecture
- Handouts (Worksheets, Activities, Quizzes, Visual Aids, etc).
- Answer Keys
- Coding

Remember to send these as separate files along with your unit/lesson plan.

References

PASCO Education. (2018). *Essential Physics*. Retrieved from https://teacher.pasco.com/epub/Physics/eBook-SBTE/FirstPage.html

TeachThought Staff. (2017, November 14). *teachthought WE GROW TEACHERS*. Retrieved from 32 Research-Based Instructional Strategies: https://www.teachthought.com/learning/32-research-based-instructional-strategies/

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