Curriculum Map: Practical Physics

MASH

Science

Course Description: This course is a hands-on approach to the physical principals of science. The content of this class is designed for the vocational technical student and the student who will pursue an associate degree. Topics discussed will be: 1.) Force; 2.) Work; 3.) Rate; 4.) Resistance; and 5.) Energy

Summary of Topics & Pacing

		Suggested Timing		Running Total	
Unit Title:	Units and Standards	3	weeks	3	week
Unit Title:	Force as a Prime Mover in Mechanical Systems	2	week	5	weeks
Unit Title:	Pressure as a Prime Mover in Fluid Systems	2	weeks	7	weeks
Unit Title:	Voltage as a Prime Mover in Electrical Systems	2	weeks	9	weeks
Unit Title:	Temperature as a Prime Mover in Thermal Systems	2	weeks	11	weeks
Unit Title:	Work in Mechanical Systems	2	weeks	13	weeks
Unit Title:	Work in Fluid Systems	2	weeks	15	weeks
Unit Title:	Work in Electrical Systems	2	weeks	17	weeks
Unit Title:	Rate in Mechanical Systems	2	weeks	19	weeks
Unit Title:	Rate in Fluid Systems	1	weeks	20	weeks
Unit Title:	Rate in Electrical Systems	1	weeks	21	weeks
Unit Title:	Rate in Thermal Systems	1	weeks	22	weeks
Unit Title:	Resistance in Mechanical Systems	2	weeks	24	weeks
Unit Title:	Resistance in Fluid Systems	1	weeks	25	weeks
Unit Title:	Resistance in Electrical Systems	2	weeks	27	weeks
Unit Title:	Resistance in Thermal Systems	1	weeks	28	weeks
Unit Title:	Kinetic Energy in Mechanical Systems	2	weeks	30	weeks
Unit Title:	Potential Energy in Mechanical Systems	2	weeks	32	weeks
Unit Title:	Energy in Fluid Systems	1	week	33	weeks
Unit Title:	Energy in Electrical Systems	1	week	34	weeks
Unit Title:	Energy in Thermal Systems	1	weeks	35	weeks

Unit Title: Units and Standards

Suggested time frame: 3 weeks

Standards: Course - 3.2.P.B: PHYSICS

Standard - 3.2.P.B1: Differentiate among translational motion, simple harmonic motion, and rotational motion in terms of position, velocity, and acceleration. Use force and mass to explain translational motion or simple harmonic motion of objects. Relate torque and rotational inertia to explain rotational motion.

Essential Questions:

1. How do we measure quantities in the world/universe

Competency	Vocabulary	Strategy	Resource
For theoretical systems and laboratory procedures: 1. State and use the SI units and English units for length, mass, and time 2. Convert units between SI and English units and within a system of units 3. State the meaning of standard scientific unit prefixes 4. Convert units using scientific unit prefixes 5. Convert numbers between fraction and decimal notation 6. Convert numbers to scientific notation 7. Input numbers in scientific notation into a calculator 8. Perform basic mathematical operations with numbers in scientific notation 9. Use Pythagorean theorem to determine the missing length of the side of a right triangle 10. Define what a scalar and a vector are	dimension; units; magnitude; standard units; scientific notation; time; distance; length; mass; weight; metric system; SI units; English units; mks; cgs; mass; gram; slug; meter; second; unit prefix; dimensional analysis; significant figures; conversion of units; right triangle; Pythagorean theorem	Notes, example problems, labs, readings, homework, online simulations, formative assessment, summative assessment, differentiated instructions, cooperative learning.	• Physics in Context, An Integrated Approach, Cord Communications (2005) • Simulation Websites • Labs • Online Demos and Videos

Unit Title: Force as a Prime Mover in Mechanical Systems

Suggested time frame: 2 weeks

Standards: Course - 3.2.P.B: PHYSICS

Standard - 3.2.P.B1: Differentiate among translational motion, simple harmonic motion, and rotational motion in terms of position, velocity, and acceleration. Use force and mass to explain translational motion or simple harmonic motion of objects. Relate torque and rotational inertia to explain rotational motion.

Essential Questions:

1. How do objects interact?
2. What is a force?
3. In what ways can forces be used to alter a system?

Competency	Vocabulary	Strategy	Resource
For theoretical systems and laboratory procedures: 1. State the definition of a prime mover 2. State the definition of a mechanical system 3. Define what a force is 4. Describe methods to measure force 5. Define mass 6. Describe how mass and force are related through gravity 7. State Newton's first law of motion 8. Describe balanced and unbalanced systems 9. State what the concept of translational equilibrium is 10. State what the concept of rotational equilibrium 11. Determine whether systems are in translational equilibrium	force; newton; weight; mass; gram; slug; scalar; vector; magnitude; spring scale; acceleration due to gravity; system; balanced system; unbalanced system; translational equilibrium; rotational equilibrium; torque; leverage; lever arm; mechanical advantage; pulley; gear	Notes, example problems, labs, readings, homework, online simulations, formative assessment, summative assessment, differentiated instructions, cooperative learning.	• Physics in Context, An Integrated Approach, Cord Communications (2005) • Simulation Websites • Labs • Online Demos and Videos

Competency	Vocabulary	Strategy	Resource
12. Define torque, define lever arm; and leverage 13. Define the three types of simple machines 14. Define mechanical advantage 15. Calculate mechanical advantage for a system 16. Determine whether a system is in rotational equilibrium 17. Determine where a force needs to be applied to cause a system to be in rotational equilibrium			

Unit Title: Pressure as a Prime Mover in Fluid Systems

Suggested time frame: 2 weeks

Standards: Course - 3.2.P.B: PHYSICS

Standard - 3.2.P.B1: Differentiate among translational motion, simple harmonic motion, and rotational motion in terms of position, velocity, and acceleration. Use force and mass to explain translational motion or simple harmonic motion of objects. Relate torque and rotational inertia to explain rotational motion.

Essential Questions:

1. What is matter?
2. What are the states of matter?
3. How does matter interact?
4. What are the properties of fluids?
5. How can fluids be used to alter a system?

Competency	Vocabulary	Strategy	Resource
For theoretical systems and laboratory procedures: 1. Describe the four states of matter 2. Define a fluid 3. Define a fluid system 4. Define the density of an object 5. Define the weight density of an object 6. Describe methods to determine the density and weight density of a substance 7. Define pressure 8. State the SI and US units for pressure 9. Calculate the pressure being applied to an object 10. Define buoyant force 11. State Archimedes' principle in terms of how pressure is related to the depth in a fluid	states of matter; solid; liquid; gas; plasma; fluid; fluid system; density; volume; mass; weight; pressure; Pascal; atmosphere; buoyant force; buoyancy; Archimedes' principle; buoyant force; atmospheric pressure; gage pressure; absolute pressure; barometer; Pascal's principle	Notes, example problems, labs, readings, homework, online simulations, formative assessment, summative assessment, differentiated instructions, cooperative learning.	• Physics in Context, An Integrated Approach, Cord Communications (2005) • Simulation Websites • Labs • Online Demos and Videos

Competency	Vocabulary	Strategy	Resource
12. Calculate the buoyant force on an object 13. Describe the origins of atmospheric pressure 14. Describe how a barometer measures atmospheric pressure 15. State Pascal's principle in terms of how pressure is distributed in a fluid 16. Define and compare absolute pressure and gauge pressure 17. Determine the pressure applied to a system using Pascal's principle			

Unit Title: Voltage as a Prime Mover in Electrical Systems

Suggested time frame: 2 weeks

Standards: Course – 3.2.P.B: PHYSICS

Standard - 3.2.P.B4: Explain how stationary and moving particles result in electricity and magnetism. Develop qualitative and quantitative understanding of current, voltage, resistance, and the connections among them. Explain how electrical induction is applied in technology.

Essential Questions:

1. What are charges?
2. How do charges interact?
3. How do charges affect the space around them?
4. How can charges be used to alter a system?

Competency	Vocabulary	Strategy	Resource
For theoretical systems and laboratory procedures: 1. State the three basic components of an atom 2. State the charge of the three basic components of an atom 3. State how like and unlike charges interact 4. State Coulomb's law and use it to determine the force between two charges 5. Describe how an electric field is created 6. Show electric field lines for simple charge configurations 7. Define electric potential difference/voltage 8. Define the basic components of an electrical system 9. Differentiate between AC and DC electrical systems	atom; electron; proton; neutron; charge; fundamental charge; force; attract; repel; Coulomb's law; electric field; field lines; electric potential; emf; voltage; volts; circuit; source; load; current; ampere; amp; alternating current (AC); direct current (DC); battery	Notes, example problems, labs, readings, homework, online simulations, formative assessment, summative assessment, differentiated instructions, cooperative learning.	• Physics in Context, An Integrated Approach, Cord Communications (2005) • Simulation Websites • Labs • Online Demos and Videos

Competency	Vocabulary	Strategy	Resource
10. Describe what a battery is 11. Describe how to configure batteries so that their voltages add			

Unit Title: Temperature as a Prime Mover in Thermal Systems

Suggested time frame: 2 weeks

Standards: Course – 3.2.P.B: PHYSICS

Standard - 3.2.P.B3: Analyze the factors that influence convection, conduction, and radiation between objects or regions that are at different temperatures.

Essential Questions:

1. What is thermal energy
2. What is temperature
3. What is heat
4. How can heat be used to perform work on a system?

Competency	Vocabulary	Strategy	Resource
For theoretical systems and laboratory procedures: 1. Define thermal energy 2. Define kinetic energy 3. Name the property of an object that determines its temperature 4. Convert temperatures between Celsius and Fahrenheit scales 5. Explain the difference between and thermal energy 6. Explain how heat is transferred from one object to another object 7. Explain the relationship between heat transfer and change in temperature for an object 8. Define specific heat 9. Define heat of fusion and heat of vaporization 10. Calculate changes in temperature of an object via heat transfer	thermal energy; joules; kinetic energy; temperature; Celsius; Fahrenheit; heat; heat transfer; specific heat; heat of fusion; heat of vaporization	Notes, example problems, labs, readings, homework, online simulations, formative assessment, summative assessment, differentiated instructions, cooperative learning.	• Physics in Context, An Integrated Approach, Cord Communications (2005) • Simulation Websites • Labs • Online Demos and Videos

Unit Title: Work in Mechanical Systems

Suggested time frame: 2 weeks

Standards: Course – 3.2.P.B: PHYSICS

Standard - 3.2.P.B1: Differentiate among translational motion, simple harmonic motion, and rotational motion in terms of position, velocity, and acceleration. Use force and mass to explain translational motion or simple harmonic motion of objects. Relate torque and rotational inertia to explain rotational motion.

Standard - 3.2.P.B2: Explain the translation and simple harmonic motion of objects using conservation of energy and conservation of momentum. Describe the rotational motion of objects using the conservation of energy and conservation of angular momentum. Explain how gravitational, electrical, and magnetic forces and torques give rise to rotational motion.

Standard - 3.2.P.B6: PATTERNS SCALE MODELS CONSTANCY/CHANGE Use Newton's laws of motion and gravitation to describe and predict the motion of objects ranging from atoms to the galaxies.

Essential Questions:

1. What is the scientific definition of work?
2. How is the concept of work applied to mechanical systems
3. What is the efficiency, in terms of work, for a mechanical system?

Competency	Vocabulary	Strategy	Resource
For theoretical systems and laboratory procedures: 1. Distinguish between physics concept of work and the commonly accepted concept of work 2. Define displacement 3. State the SI and English units 4. Calculate the work done by a force on an object 5. Define kinetic energy 6. Define potential energy 7. Explain how work can change an objects kinetic and/or potential energy	work; joule; displacement; Newton-meter; foot-pound; kinetic energy; gravitational potential energy; reference level; mechanical energy; input work; output work; efficiency; percent efficiency; torque; radian; degree	Notes, example problems, labs, readings, homework, online simulations, formative assessment, summative assessment, differentiated instructions, cooperative learning.	• Physics in Context, An Integrated Approach, Cord Communications (2005) • Simulation Websites • Labs

Competency	Vocabulary	Strategy	Resource
8. Define input work and output work of a mechanical system 9. Define the efficiency of a mechanical system 10. Define radian measure of an angle 11. Convert angle measures between degrees and radians 12. Calculate the work done by a torque			• Online Demos and Videos

Unit Title: Work in Fluid Systems

Suggested time frame: 2 weeks

Standards: Course – 3.2.P.B: PHYSICS

Standard - 3.2.P.B1: Differentiate among translational motion, simple harmonic motion, and rotational motion in terms of position, velocity, and acceleration. Use force and mass to explain translational motion or simple harmonic motion of objects. Relate torque and rotational inertia to explain rotational motion.

Standard - 3.2.P.B2: Explain the translation and simple harmonic motion of objects using conservation of energy and conservation of momentum. Describe the rotational motion of objects using the conservation of energy and conservation of angular momentum. Explain how gravitational, electrical, and magnetic forces and torques give rise to rotational motion.

Essential Questions:

1. What is the scientific definition of work?
2. How is the concept of work applied to fluid systems

Competency	Vocabulary	Strategy	Resource
For theoretical systems and laboratory procedures: 1. Describe how open and closed fluid systems are different 2. Relate volume displacement and work in a closed system 3. Relate fluid volume moved and work in an open system 4. Explain the relationship between work, pressure, and volume in a fluid system 5. Explain how 6. Define weight density of a fluid 7. Use weight density to determine the pressure a column of a fluid will apply to a system	fluid; work; joule; open system; closed system; volume displacement; pressure; weight density; rho; Pascal; atmosphere; pounds per square foot;	Notes, example problems, labs, readings, homework, online simulations, formative assessment, summative assessment, differentiated instructions, cooperative learning.	• Physics in Context, An Integrated Approach, Cord Communications (2005) • Simulation Websites • Labs • Online Demos and Videos

Competency	Vocabulary	Strategy	Resource
8. Calculate the work done by a fluid in a closed system 9. Calculate the work done to a fluid in an open system			

Unit Title: Work in Electrical Systems

Suggested time frame: 2 weeks

Standards: Course – 3.2.P.B: PHYSICS

Standard - 3.2.P.B4: Explain how stationary and moving particles result in electricity and magnetism. Develop qualitative and quantitative understanding of current, voltage, resistance, and the connections among them. Explain how electrical induction is applied in technology.

Essential Questions:

1. What is the scientific definition of work?
2. How is the concept of work applied to electrical systems

Competency	Vocabulary	Strategy	Resource
For theoretical systems and laboratory procedures: 1. Define the unit Coulomb 2. Define the relationship between work done in an electrical system, charged moved, and electrical potential 3. Calculate the amount of charge moving past a point in a circuit 4. Define the unit of electric current 5. Describe the effects of work in electric systems 6. Define the efficiency of an electric system 7. Describe how useful work results from electrical systems	atom; electron; proton; neutron; charge; fundamental charge; force; attract; repel; electric field; electric potential; emf; voltage; volts; circuit; source; load; current; ampere; amp; inductor; solenoid; capacitor	Notes, example problems, labs, readings, homework, online simulations, formative assessment, summative assessment, differentiated instructions, cooperative learning.	• Physics in Context, An Integrated Approach, Cord Communications (2005) • Simulation Websites • Labs • Online Demos and Videos

Unit Title: Rate in Mechanical Systems

Suggested time frame: 2 weeks

Standards: Course - 3.2.P.B: PHYSICS

Standard - 3.2.P.B1: Differentiate among translational motion, simple harmonic motion, and rotational motion in terms of position, velocity, and acceleration. Use force and mass to explain translational motion or simple harmonic motion of objects. Relate torque and rotational inertia to explain rotational motion.

Standard - 3.2.P.B2: Explain the translation and simple harmonic motion of objects using conservation of energy and conservation of momentum. Describe the rotational motion of objects using the conservation of energy and conservation of angular momentum. Explain how gravitational, electrical, and magnetic forces and torques give rise to rotational motion.

Standard - 3.2.P.B6: PATTERNS SCALE MODELS CONSTANCY/CHANGE Use Newton's laws of motion and gravitation to describe and predict the motion of objects ranging from atoms to the galaxies.

Essential Questions:

1. How do we measure rates in mechanical systems?

Competency	Vocabulary	Strategy	Resource
For theoretical systems and laboratory procedures: 1. Define distance, displacement, speed, velocity, and acceleration 2. Explain the difference between distance and displacement 3. Explain the difference between speed and velocity 4. Explain the difference between velocity and acceleration 5. Calculate speeds, velocities, and accelerations for objects in motion	distance; displacement; speed; velocity; acceleration; angular displacement; speed; acceleration	Notes, example problems, labs, readings, homework, online simulations, formative assessment, summative assessment, differentiated instructions, cooperative learning.	• Physics in Context, An Integrated Approach, Cord Communications (2005) • Simulation Websites • Labs • Online Demos and Videos

Competency	Vocabulary	Strategy	Resource
6. Define angular displacement, speed, and acceleration 7. Calculate angular speeds, velocities, and accelerations for objects that are rotating			

Unit Title: Rate in Fluid Systems

Suggested time frame: 1 week

Standards: Course - 3.2.P.B: PHYSICS

Standard - 3.2.P.B2: Explain the translation and simple harmonic motion of objects using conservation of energy and conservation of momentum. Describe the rotational motion of objects using the conservation of energy and conservation of angular momentum. Explain how gravitational, electrical, and magnetic forces and torques give rise to rotational motion.

Essential Questions:

1. How do we measure rates in fluid systems?

Competency	Vocabulary	Strategy	Resource
For theoretical systems and laboratory procedures: 1. Define volume flow rate 2. State typical flow rate units in SI and English units 3. State the volume flow rate equation 4. Solve problems using the volume flow rate equation 5. Define mass flow rate 6. State the mass flow rate equation 7. Solve problems using the mass flow rate equation 8. Explain how volume and mass flow rates can be measured	flow rate; volume flow rate; mass flow rate; mass flow rate	Notes, example problems, labs, readings, homework, online simulations, formative assessment, summative assessment, differentiated instructions, cooperative learning.	• Physics in Context, An Integrated Approach, Cord Communications (2005) • Simulation Websites • Labs • Online Demos and Videos

Unit Title: Rate in Electrical Systems

Suggested time frame: 1 week

Standards: Course - 3.2.P.B: PHYSICS

Standard - 3.2.P.B4: Explain how stationary and moving particles result in electricity and magnetism. Develop qualitative and quantitative understanding of current, voltage, resistance, and the connections among them. Explain how electrical induction is applied in technology.

Essential Questions:

1. How do we measure rates in electrical systems?

Competency	Vocabulary	Strategy	Resource
For theoretical systems and laboratory procedures: 1. Define flow rate in thermal systems 2. State typical SI and English units for flow rate in thermal systems 3. Describe the heat transfer processes for conduction, convection, and radiation 4. Define thermal conductivity 5. Describe how thermal conductivity is related to the type of material involved in the process 6. State the heat conduction equation 7. Solve problems using the heat conduction equation	heat; heat flow rate; heat transfer; calorie; Calorie; Btu; joules; thermal conductivity; radiation; convection; conduction	Notes, example problems, labs, readings, homework, online simulations, formative assessment, summative assessment, differentiated instructions, cooperative learning.	• Physics in Context, An Integrated Approach, Cord Communications (2005) • Simulation Websites • Labs • Online Demos and Videos

Unit Title: Rate in Thermal Systems

Suggested time frame: 1 week

Standards: Course - 3.2.P.B: PHYSICS

Standard - 3.2.P.B3: Analyze the factors that influence convection, conduction, and radiation between objects or regions that are at different temperatures.

Essential Questions:

1. How do we measure rates in thermal systems?

Competency	Vocabulary	Strategy	Resource
For theoretical systems and laboratory procedures: 9. Define volume flow rate 10. State typical flow rate units in SI and English units 11. State the volume flow rate equation 12. Solve problems using the volume flow rate equation 13. Define mass flow rate 14. State the mass flow rate equation 15. Solve problems using the mass flow rate equation 16. Explain how volume and mass flow rates can be measured	flow rate; volume flow rate; mass flow rate; mass flow rate	Notes, example problems, labs, readings, homework, online simulations, formative assessment, summative assessment, differentiated instructions, cooperative learning.	• Physics in Context, An Integrated Approach, Cord Communications (2005) • Simulation Websites • Labs • Online Demos and Videos

Unit Title: Resistance in Mechanical Systems

Suggested time frame: 2 weeks

Standards: Course – 3.2.P.B: PHYSICS

Standard - 3.2.P.B1: Differentiate among translational motion, simple harmonic motion, and rotational motion in terms of position, velocity, and acceleration. Use force and mass to explain translational motion or simple harmonic motion of objects. Relate torque and rotational inertia to explain rotational motion.

Standard - 3.2.P.B2: Explain the translation and simple harmonic motion of objects using conservation of energy and conservation of momentum. Describe the rotational motion of objects using the conservation of energy and conservation of angular momentum. Explain how gravitational, electrical, and magnetic forces and torques give rise to rotational motion.

Standard - 3.2.P.B6: PATTERNS SCALE MODELS CONSTANCY/CHANGE Use Newton's laws of motion and gravitation to describe and predict the motion of objects ranging from atoms to the galaxies.

Essential Questions:

1. What are the mechanisms that resist motion in mechanical systems?

Competency	Vocabulary	Strategy	Resource
For theoretical systems and laboratory procedures: 1. State Newton's second law of motion 2. Use Newton's second law of motion to solve problems involving mass, force, and acceleration 3. State the definition of the mass of an object 4. State the definition of the weight of an object 5. Explain how mass and weight are different 6. State the definition of friction 7. Explain how friction resists motion 8. State the linear model of friction	Newton's second law of motion; mass; force; acceleration; weight; friction; static friction; kinetic friction; coefficient of friction; rolling friction; lubrication	Notes, example problems, labs, readings, homework, online simulations, formative assessment, summative assessment, differentiated instructions, cooperative learning.	• Physics in Context, An Integrated Approach, Cord Communications (2005) • Simulation Websites • Labs • Online Demos and Videos

Competency	Vocabulary	Strategy	Resource
9. State the definitions of the coefficient of static friction and the coefficient of kinetic friction 10. Calculate the force of friction between two surfaces using the linear model of friction 11. Explain how lubrication and oil reduce friction 12. Compare sliding friction with rolling friction			

Unit Title: Resistance in Fluid Systems

Suggested time frame: 1 week

Standards: Course – 3.2.P.B: PHYSICS

Standard - 3.2.P.B2: Explain the translation and simple harmonic motion of objects using conservation of energy and conservation of momentum. Describe the rotational motion of objects using the conservation of energy and conservation of angular momentum. Explain how gravitational, electrical, and magnetic forces and torques give rise to rotational motion.

Standard - 3.2.P.B6: PATTERNS SCALE MODELS CONSTANCY/CHANGE Use Newton's laws of motion and gravitation to describe and predict the motion of objects ranging from atoms to the galaxies.

Essential Questions:

1. What are the mechanisms that resist motion in mechanical systems?

Competency	Vocabulary	Strategy	Resource
For theoretical systems and laboratory procedures: 1. Define drag 2. Explain the difference between laminar and turbulent flow 3. Define viscosity 4. Explain how viscosity can be measured 5. State Stoke's law 6. Define terminal speed and explain why it occurs 7. State Poiseuille's law 8. Use Stoke's law and Poiseuille's law to solve problems involving resistance 9. Describe the factors that affect the flow of a fluid through a pipe	drag; laminar flow; turbulent flow; viscosity; terminal speed; Stoke's law; Poiseuille's law	Notes, example problems, labs, readings, homework, online simulations, formative assessment, summative assessment, differentiated instructions, cooperative learning.	• Physics in Context, An Integrated Approach, Cord Communications (2005) • Simulation Websites • Labs • Online Demos and Videos

Unit Title: Resistance in Electrical Systems

Suggested time frame: 2 weeks

Standards: Course – 3.2.P.B: PHYSICS

Standard - 3.2.P.B4: Explain how stationary and moving particles result in electricity and magnetism. Develop qualitative and quantitative understanding of current, voltage, resistance, and the connections among them. Explain how electrical induction is applied in technology.

Essential Questions:

1. What are the mechanisms that resist motion in electrical systems?

Competency	Vocabulary	Strategy	Resource
For theoretical systems and laboratory procedures: 1. Explain the differences among conductors, insulators, and semiconductors 2. Define electrical resistance 3. State the unit for electrical resistance 4. State Ohm's law 5. Solve problems using Ohm's law 6. State the definition of resistivity of a material 7. Calculate the resistance of a wire, given the resistivity of the wire's material and the wire's length 8. Describe parallel and series resistor configurations 9. Calculate the currents through and voltage drops across resistors in series and in parallel with a battery	current; charge; conductor; insulator; semiconductor; resistor; ohm (Ω); kilohm (kΩ); amp (A); milliamp (mA); Ohm's law; resistivity; series circuit; parallel circuit; voltage (V); voltage drop	Notes, example problems, labs, readings, homework, online simulations, formative assessment, summative assessment, differentiated instructions, cooperative learning.	• Physics in Context, An Integrated Approach, Cord Communications (2005) • Simulation Websites • Labs • Online Demos and Videos

Unit Title: Resistance in Thermal Systems

Suggested time frame: 1 week

Standards: Course – 3.2.P.B: PHYSICS

Standard - 3.2.P.B3: Analyze the factors that influence convection, conduction, and radiation between objects or regions that are at different temperatures.

Essential Questions:

1. What are the mechanisms that resist motion in thermal systems?

Competency	Vocabulary	Strategy	Resource
For theoretical systems and laboratory procedures: 1. Define thermal conductivity and thermal resistances 2. Describe situations when you would need to use materials with a high thermal conductivity and with a high thermal resistance 3. Explain the analogy among thermal resistance, electrical resistance, and fluid resistance 4. Describe the relationship among temperature drop, thermal resistance, and heat flow rate 5. Solve problems using the relationship among temperature drop, thermal resistance, and heat flow rate involving heat conduction 6. Calculate the thermal resistance for single layer and multiple layers of different materials	thermal conductivity; thermal resistance; heat flow rate	Notes, example problems, labs, readings, homework, online simulations, formative assessment, summative assessment, differentiated instructions, cooperative learning.	• Physics in Context, An Integrated Approach, Cord Communications (2005) • Simulation Websites • Labs • Online Demos and Videos

Unit Title: Kinetic Energy in Mechanical Systems

Suggested time frame: 2 weeks

Standards: Course – 3.2.P.B: PHYSICS

Standard - 3.2.P.B1: Differentiate among translational motion, simple harmonic motion, and rotational motion in terms of position, velocity, and acceleration. Use force and mass to explain translational motion or simple harmonic motion of objects. Relate torque and rotational inertia to explain rotational motion.

Standard - 3.2.P.B2: Explain the translation and simple harmonic motion of objects using conservation of energy and conservation of momentum. Describe the rotational motion of objects using the conservation of energy and conservation of angular momentum. Explain how gravitational, electrical, and magnetic forces and torques give rise to rotational motion.

Standard - 3.2.P.B6: PATTERNS SCALE MODELS CONSTANCY/CHANGE Use Newton's laws of motion and gravitation to describe and predict the motion of objects ranging from atoms to the galaxies.

Essential Questions:

1. What is kinetic energy?
2. How can kinetic energy of a system change?

Competency	Vocabulary	Strategy	Resource
For theoretical systems and laboratory procedures: 1. Define kinetic energy 2. Define moment of inertia 3. Define translational and angular speeds 4. State the equations for kinetic energy for an object in translational and in rotational motion 5. Calculate the kinetic energy when an object is in translational and in rotational motion 6. Describe the similarities between the equations for translational and rotational motion	kinetic energy; moment of inertia; translational motion; rotational motion; translational speed; angular speed; work; work-energy theorem	Notes, example problems, labs, readings, homework, online simulations, formative assessment, summative assessment, differentiated instructions, cooperative learning.	• Physics in Context, An Integrated Approach, Cord Communications (2005) • Simulation Websites • Labs • Online Demos and Videos

Competency	Vocabulary	Strategy	Resource
7. Explain the relationship between work done on an object and the change in the object's kinetic energy 8. State the work-energy theorem 9. Solve problems using the work-energy theorem			

Unit Title: Potential Energy in Mechanical Systems

Suggested time frame: 2 weeks

Standards: Course – 3.2.P.B: PHYSICS

Standard - 3.2.P.B1: Differentiate among translational motion, simple harmonic motion, and rotational motion in terms of position, velocity, and acceleration. Use force and mass to explain translational motion or simple harmonic motion of objects. Relate torque and rotational inertia to explain rotational motion.

Standard - 3.2.P.B2: Explain the translation and simple harmonic motion of objects using conservation of energy and conservation of momentum. Describe the rotational motion of objects using the conservation of energy and conservation of angular momentum. Explain how gravitational, electrical, and magnetic forces and torques give rise to rotational motion.

Standard - 3.2.P.B6: PATTERNS SCALE MODELS CONSTANCY/CHANGE Use Newton's laws of motion and gravitation to describe and predict the motion of objects ranging from atoms to the galaxies.

Essential Questions:

1. What is kinetic energy?
2. How can kinetic energy of a system change?

Competency	Vocabulary	Strategy	Resource
For theoretical systems and laboratory procedures: 1. Define gravitational potential energy 2. Explain how to change an objects gravitation potential energy in a gravitational field 3. Define elastic potential energy 4. Describe how to change the elastic potential energy of a system 5. Describe the relationship between work done on an object and the object's change in gravitational potential energy	gravitational potential energy; work energy theorem; kinetic energy; elastic potential energy; spring constant; conservation of energy	Notes, example problems, labs, readings, homework, online simulations, formative assessment, summative assessment, differentiated instructions, cooperative learning.	• Physics in Context, An Integrated Approach, Cord Communications (2005) • Simulation Websites • Labs • Online Demos and Videos

Competency	Vocabulary	Strategy	Resource
6. State the law of conservation of energy 7. Solve problems using the law of conservation of energy 8. Define moment of inertia 9. Define translational and angular speeds 10. State the equations for kinetic energy for an object in translational and in rotational motion 11. Calculate the kinetic energy when an object is in translational and in rotational motion 12. Describe the similarities between the equations for translational and rotational motion 13. Explain the relationship between work done on an object and the change in the object's kinetic energy 14. State the work-energy theorem 15. Solve problems using the work-energy theorem			

Unit Title: Energy in Fluid Systems

Suggested time frame: 1 week

Standards: Course – 3.2.P.B: PHYSICS

Standard - 3.2.P.B1: Differentiate among translational motion, simple harmonic motion, and rotational motion in terms of position, velocity, and acceleration. Use force and mass to explain translational motion or simple harmonic motion of objects. Relate torque and rotational inertia to explain rotational motion.

Standard - 3.2.P.B2: Explain the translation and simple harmonic motion of objects using conservation of energy and conservation of momentum. Describe the rotational motion of objects using the conservation of energy and conservation of angular momentum. Explain how gravitational, electrical, and magnetic forces and torques give rise to rotational motion.

Essential Questions:

1. How does energy affect fluid systems?

Competency	Vocabulary	Strategy	Resource
For theoretical systems and laboratory procedures: 1. Explain Bernoulli's principle 2. State Bernoulli's equation 3. Use Bernoulli's equation 4. Use Bernoulli's equation to solve problems involving fluid flow	fluid density; Bernoulli's principle; Bernoulli's equation; fluid flow rate; viscosity; nonviscous	Notes, example problems, labs, readings, homework, online simulations, formative assessment, summative assessment, differentiated instructions, cooperative learning.	• Physics in Context, An Integrated Approach, Cord Communications (2005) • Simulation Websites • Labs • Online Demos and Videos

Unit Title: Energy in Electrical Systems

Suggested time frame: 1 week

Standards: Course – 3.2.P.B: PHYSICS

Standard - 3.2.P.B4: Explain how stationary and moving particles result in electricity and magnetism. Develop qualitative and quantitative understanding of current, voltage, resistance, and the connections among them. Explain how electrical induction is applied in technology.

Essential Questions:

1. How is energy stored and transferred in electrical systems?

Competency	Vocabulary	Strategy	Resource
For theoretical systems and laboratory procedures: 1. Define a capacitor 2. Define capacitance 3. State the SI units for capacitance 4. Calculate the energy stored in a capacitor 5. Define an inductor/solenoid 6. Define inductance 7. State the SI unit for inductance 8. Calculate the energy stored in an inductor	capacitor; capacitance; farad (F); microfarad (μF); inductor; stored energy; potential energy; magnetic field; emf; induced emf; electromagnetic inductance; solenoid; inductance; henry (H); millihenry (mH)	Notes, example problems, labs, readings, homework, online simulations, formative assessment, summative assessment, differentiated instructions, cooperative learning.	• Physics in Context, An Integrated Approach, Cord Communications (2005) • Simulation Websites • Labs • Online Demos and Videos

Unit Title: Energy in Thermal Systems

Suggested time frame: 1 week

Standards: Course – 3.2.P.B: PHYSICS

Standard - 3.2.P.B3: Analyze the factors that influence convection, conduction, and radiation between objects or regions that are at different temperatures.

Essential Questions:

1. How is energy stored in a thermal system?
2. How is energy changed in a thermal system?

Competency	Vocabulary	Strategy	Resource
For theoretical systems and laboratory procedures: 1. Define the internal energy of a system 2. Describe how heat transfer and work done on a system can change the system's internal energy 3. Explain the first law of thermodynamics 4. Use the first law of thermodynamics to solve problems involving energy, heat, and work 5. Describe how a heat engine and refrigerator works 6. Define adiabatic processes 7. Explain the second law of thermodynamics 8. Define absolute zero 9. Describe how the second law of thermodynamics prohibits certain processes 10. Convert between Kelvin and Celsius temperature scales 11. Describe a Carnot engine 12. Calculate the Carnot efficiency of a heat engine	Internal energy; kinetic energy; heat; heat transfer; work; first law of thermodynamics; heat engine; adiabatic; refrigerator; refrigerant; Carnot engine; Carnot efficiency; second law of thermodynamics; Kelvin; Celsius; absolute zero	Notes, example problems, labs, readings, homework, online simulations, formative assessment, summative assessment, differentiated instructions, cooperative learning.	• Physics in Context, An Integrated Approach, Cord Communications (2005) • Simulation Websites • Labs • Online Demos and Videos