CURRICULUM GUIDE

Physics

Providence Schools

Printed by students at the Providence Career and Technical Academy

Background

Providence Schools teachers and administrators worked collaboratively with consultants from the Charles A. Dana Center at the University of Texas at Austin to develop the mathematics and science curriculum frameworks. The curriculum frameworks encompass two critical questions:

- Content Standards that establish clearly defined expectations for all students, helping to answer the question, ***What do students have to learn?***
- Performance Standards that determine performance expectations for content standards, helping to answer the question, ***How well do the students have to learn it?***

The curriculum framework provides a work plan that directs the instruction delivered in every classroom in every school in the district. Instruction—the way the curriculum is presented to students—will focus on the needs of students.

Purpose and Use of Curriculum Guides

Curriculum Guides for the curriculum for each grade and subject outline the approximate number of days that each unit in the curriculum will be taught; describe the content to be learned; and list the essential questions that students should be able to answer by the end of the unit.

Parents should become familiar with the Curriculum Guides. You should know when your child is being taught different topics. You should also know the essential questions that your child should be able to answer by the end of each unit.

It is important that you understand that you do not have to be familiar with the content that your child is learning in order to help them with their studies. There are basic questions that you can ask to determine if your child understands the content.

Ask your child what she is learning in each subject

Does she understand the topic? Is the unit exciting or boring? What specifically does she like or dislike about the topic? Does she understand how the topic relates to the real world?

You know your child better than anyone. You will be able to tell if she or he is benefiting from the instruction and understanding the content of the material by the way they answer you. Speak to your child's teacher if you suspect there is a problem.

Ask your child about his assignments

What is the required work? Has he finished the work on time? Is he having difficulty? If he is having difficulty, why?

Encourage your child to talk to her teachers if she is having difficulty understanding a concept or completing an assignment. If your child continues to experience difficulty, speak to the teacher yourself so that the two of you can work together to support your child.

Even if you do not understand the content that your child is learning, the fact that you are showing interest in his or her school work and believe that it is important that he or she does well sends a powerful message.

Sharon Contreras
Chief Academic Officer
Providence Public School Department

QUARTER 1

Content students will be learning	Essential questions students should be able to answer by end of unit
Unit 1.1 - Kinematics: One-Dimensional Motion (18 days) • Understand the mathematical relationships between speed, velocity, acceleration, distance, and time for an object in motion. • Model, illustrate, and describe one-dimensional motion. • Collect and use quantitative data to make predictions about the motion of an object.	» How does motion change under the influence of gravity? » How does frame of reference affect the description of an object's motion? » What information can be gathered from displacement vs. time and velocity vs. time graphs?
Unit 1.2 - Kinematics: Two-Dimensional Motion (11 days) • Understand the mathematical relationships between speed, velocity, acceleration, distance, and time for an object in motion. • Model, illustrate, and describe two-dimensional motion. • Collect and use quantitative data to make predictions about the motion of an object.	» How can the range of a projectile be determined? » How can velocity vectors be used to diagram the horizontal and vertical path of a projectile?
Unit 1.3 - Forces and Equilibrium (11 days) • Understand that there are multiple methods for finding a resultant vector. • Know how to use and construct a free-body diagram. • Understand the similarities and differences between types of forces.	» What are the parameters for defining coordinate systems? » How is a free-body diagram constructed to represent the forces acting on an object in equilibrium? » Which method is most appropriate for determining a resultant vector?

QUARTER 2

Content students will be learning	Essential questions students should be able to answer by end of unit
Unit 2.1 - Introduction to Newton's Laws (9 days) • Recognize everyday examples of Newton's laws of motion. • Understand that net forces cause accelerations. • Understand the difference between motion caused by an applied force and motion that results from an object's inertia. • Recognize the action-reaction pairs in a given situation.	» How does an object's inertia affect its motion? » If the forces are equal and opposite in an action-reaction pair, why are the motions of the objects different? » How can the motion of an object be described if the net forces acting on the object are equal to 0? » How can the motion of an object be described when unbalanced forces are acting on the object?
Unit 2.2 - Applications of Newton's Laws (8 days) • Recognize all the forces acting on an object. • Determine the direction and magnitude of the acceleration of an object acted upon by a net force. • Recognize how the force of friction changes the net force acting on an object. • Determine how different surfaces and surface area affect the force of friction.	» Why is friction considered a beneficial force, yet a force that needs to be overcome? » At the microscopic level and in terms of force, what causes friction and how is friction reduced? » Why is air resistance considered a form of friction? » Why is the normal force not always equal to the weight of the object?
Unit 2.3 - Newton's Law of Universal Gravitation (9 days) • Recognize that satellite motion results from the interactions between centripetal force and inertia. • Recognize that centripetal acceleration and centripetal force are special cases of Newton's first and second laws of motion. • Understand how the mass of two objects and the distance between them affect the force of gravity between the objects.	» If gravity is no longer acting on a satellite, what is the resulting motion of the satellite? » How does the force of gravity vary by distance? » Why is the effect of gravity between two objects on earth negligible? » When astronauts are in space and weightless, does a force of gravity act on them?
Unit 2.4 - Work and Energy (13 days) • Describe the conditions that result in work being done. • Use the work-energy theorem to determine (investigate and calculate) how much work is transferred to mechanical energy. • Investigate and compare two or more systems in terms of efficiency for completing the same amount of work.	» How can friction affect the efficiency of a system? » What is the relationship between the work done on a system and the energy of that system?

QUARTER 3

Content students will be learning	Essential questions students should be able to answer by end of unit
Unit 3.1 - Energy Conservation (10 days) • Understand that energy is conserved in a system. • Recognize the forms that mechanical energy takes when it is conserved and when it is not conserved. • Recognize the relationships among power, work, time, and energy.	» Why does power have no effect on the amount of work or energy being transformed? » Why have engineers not been successful in constructing a perpetual motion machine? » How are work and energy transformed during the period of a swing in a system, such as a playground swing?
Unit 3.2 - Impulse and Momentum (16 days) • Recognize the relationship between impulse and change in momentum. • Differentiate between elastic and inelastic collisions. • Show that momentum is conserved during a collision.	» Using the concepts of impulse, momentum, and force, how does an air bag prevent injuries? » What changes to an object's velocity, momentum, and energy can occur as a result of a collision? » How are Newton's second and third laws related to conservation of momentum during a collision?
Unit 3.3 - Mechanical Waves and Wave Properties (17 days) • Know the characteristics of transverse and longitudinal waves. • Understand the mathematical relationship between frequency, wavelength, and wave speed. • Understand the relationship between period and frequency. • Recognize and explain mechanical wave interactions. • Apply the characteristics of mechanical waves to the study of seismic waves.	» What are the factors that affect the speed and frequency of a sound wave? » How can seismic waves be used to determine the epicenter of an earthquake? » What are some applications of the Doppler effect, and how is the apparent change in wave frequency being measured?

QUARTER 4

Content students will be learning	Essential questions students should be able to answer by end of unit
Unit 4.1 - Electromagnetic Waves (11 days) • Identify components of the electromagnetic spectrum. • Calculate the frequency or wavelength of electromagnetic radiation. • Recognize that the energy of an electromagnetic wave is related to its frequency. • Recognize that the speed of light is a finite speed. • Compare and contrast electromagnetic waves.	» Why is the sky blue when clouds are white? » How is a rainbow formed? » What are the differences and similarities between electromagnetic waves and mechanical waves?
Unit 4.2 - Nuclear Physics (9 days) • Determine the structural properties of the nucleus. • Explain the relationship between mass and energy. • Describe nuclear stability and decay. • Balance nuclear reactions and determine daughter elements. • Distinguish between nuclear fission and nuclear fusion.	» What role do fundamental forces play in nuclear stability? » Why is the mass of a nucleus always less than the combined mass of its constituents? » How can the factors that determine nuclear instability be used to predict the decay rate and product of nuclear decay? » What is the distinction between nuclear fission and nuclear fusion?
Unit 4.3 - Astronomy (12 days) • Interpret information from the Hertzprung-Russell (H-R) diagram about star evolution. • Explain why stars have a life cycle. • Determine the composition of a star based on line spectra analysis and explain how this can be used to date the star. • Use the knowledge of the electromagnetic spectra to examine the structure and movement of stars and galaxies. • Understand how the development of technology has provided evidence for the Big Bang Theory.	» What evidence supports the Big Bang Theory? » What information can be inferred by studying the light produced by a star? » Why do astronomers talk about looking back in time? » What forces are involved in the formation and aging of a star?
Unit 4.4 - Electromagnetism (12 days) • Know the basic law of electrostatics. • Investigate the ways that an object can transfer electric charge. • Compare and contrast the force of gravity to the force of electromagnetism. • Use Coulomb's law to find the electric force between two objects. • Investigate the relationship between magnetic fields and electric currents.	» How is lightning formed and why does it strike the ground? » How does Newton's third law apply to electrostatics? » How can the charge of an object be determined? » What information can be inferred from a magnetic field drawing?

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