

Physics Priority Standards: PHYSICAL SCIENCE (EALR 4)

Revised 6/1/2009

Newton's Laws (PS1)

PS1A: *Average velocity* is defined as a change in position with respect to time. Velocity includes both *speed* and direction.

PS1B: *Average acceleration* is defined as a change in velocity with respect to time. *Acceleration* indicates a change in *speed* and/or a change in direction.

PS1C: An object at rest will remain at rest unless acted on by an unbalanced *force*. An object in *motion* at constant velocity will continue at the same velocity unless acted on by an unbalanced *force*. (Newton's 1st *Law of Motion*, the *Law of Inertia*)

PS1D: A net *force* will cause an object to accelerate or change direction. A less massive object will *speed* up more quickly than a more massive object subjected to the same *force*. (Newton's 2nd *Law of Motion*, $F=ma$)

PS1E: Whenever one object exerts a *force* on another object, a *force* of equal magnitude is exerted on the first object in the opposite direction. (Newton's 3rd *Law of Motion*)

PS1F: *Gravitation* is a universal attractive *force* by which objects with *mass* attract one another. The gravitational *force* between two objects is proportional to their *masses* and inversely proportional to the square of the distance between the objects. (Newton's *Law of Universal Gravitation*)

PS1G: Electrical *force* is a *force* of nature, independent of *gravity* that exists between charged objects. Opposite charges attract while like charges repel.

PS1H: Electricity and magnetism are two aspects of a single *electromagnetic force*. Moving electric charges produce magnetic *forces*, and moving magnets produce electric *forces*.

Remember to also address...EALR 1 Systems: Inputs, Outputs, Boundaries and Flows;
EALR 2 Inquiry: Questioning and Investigating;
EALR 3 Application: Science, Technology, and Solving Problems.

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Transformation and Conservation of Energy (PS3)

- PS3A:** Although energy can be *transferred* from one object to another and can be *transformed* from one *form* of energy to another form, the total energy in a *closed system* is constant and can neither be created nor destroyed. (*Conservation of Energy*)
- PS3B:** *Kinetic energy* is the energy of *motion*. The kinetic energy of an object is defined by the equation: $E_k = \frac{1}{2} mv^2$
- PS3C:** *Gravitational potential energy* is due to the separation of mutually attracting *masses*. *Transformations* can occur between *gravitational potential energy* and *kinetic energy*, but the total amount of energy remains constant.
- PS3D:** *Waves* (including sound, seismic, light, and water *waves*) *transfer* energy when they interact with *matter*. *Waves* can have different *wavelengths*, *frequencies*, *amplitudes*, and travel at different *speeds*.
- PS3E:** *Electromagnetic waves* differ from physical *waves* because they do not require a medium and they all travel at the same *speed* in a vacuum. This is the maximum *speed* that any object or *wave* can travel. Forms of *electromagnetic waves* include X-rays, ultraviolet, visible light, infrared, and radio.

Evolution of the Universe (ES1)

- ES1B:** The *Big Bang theory* of the origin of the universe is based on *evidence* (e.g., red shift) that all galaxies are rushing apart from one another. As space expanded, and *matter* began to cool, gravitational attraction pulled clumps of *matter* together, forming the stars and galaxies, clouds of *gas* and dust, and *planetary systems* that we see today. If we were to run time backwards we would find that all of the galaxies were in the same place 14.7 billion years ago.

Energy in Earth Systems (ES2)

- ES2A:** *Global climate* differences result from the uneven heating of Earth's surface by the Sun. Seasonal climate variations are due to the tilt of Earth's axis with respect to the plane of Earth's nearly circular *orbit* around the sun.
- ES2B:** *Climate* is determined by *energy transfer* from the sun at and near Earth's surface. This *energy transfer* is influenced by dynamic processes such as cloud cover and Earth's rotation, as well as static conditions such as proximity to mountain ranges and the ocean. Human activities, such as burning of *fossil fuels*, also affect the *global climate*.