DC Standard Curriculum- Science

First Grade

1. Waves: Light and Sound Students who demonstrate understanding can:

1-PS4-1. Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate.

1-PS4-2. Make observations to construct an evidence-based account that objects can be seen only when illuminated

1-PS4-3. Plan and conduct an investigation to determine the effect of placing objects made with different materials in the path of a beam of light. [Assessment Boundary: Assessment does not include the speed of light.]

1-PS4-4. Use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance [Assessment Boundary: Assessment does not include technological details for how communication devices work.]

Second Grade

K-2-ETS1-1- Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.

Third Grade

3-PS2-1- Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.

-PS2.A: Forces and Motion-Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object' s speed or direction of motion. (Boundary: Qualitative and conceptual, but not quantitative addition of forces are used at this level.) **(3-PS2-1)**

The patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it. (Boundary: Technical terms, such as magnitude, velocity, momentum, and vector quantity, are not introduced at this level, but the concept that some quantities need both size and direction to be described is - developed.) **(3-PS2-2)**

-PS2.B: Types of Interactions- Objects in contact exert forces on each other. (3-PS2-1)

Electric, and magnetic forces between a pair of objects do not require that the objects be in contact. The sizes of the forces in each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other. **(3-PS2-3),(3-PS2-4)**

Fourth Grade

4-PS3-1- Use evidence to construct an explanation relating the speed of an object to the energy of that object.

-PS3.A: Definitions of Energy

The faster a given object is moving, the more energy it possesses. **(4-PS3-1)**

Energy can be moved from place to place by moving objects or through sound, light, or electric currents. **(4-PS3-2),(4-PS3-3)**

-PS3.B: Conservation of Energy and Energy Transfer

Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced. **(4-PS3-2),(4-PS3-3)**
Light also transfers energy from place to place. **(4-PS3-2)**
Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy. **(4-PS3-2),(4-PS3-4)**
-PS3.C: Relationship Between Energy and Forces
When objects collide, the contact forces transfer energy so as to change the objects' motions. **(4-PS3-3)**
-PS3.D: Energy in Chemical Processes and Everyday Life
The expression "produce energy" typically refers to the conversion of stored energy into a desired form for practical use. **(4-PS3-4)**
ETS1.A: Defining Engineering Problems
Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. **(Secondary to 4-PS3-4)**

4-PS4-1- Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move.

-PS4.A: Wave Properties
Waves, which are regular patterns of motion, can be made in water by disturbing the surface. When waves move across the surface of deep water, the water goes up and down in place; there is no net motion in the direction of the wave except when the water meets a beach. (Note: This grade band endpoint was moved from K–2.) **(4-PS4-1)**
Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks). **(4-PS4-1)**
-PS4.B: Electromagnetic Radiation
An object can be seen when light reflected from its surface enters the eyes. **(4-PS4-2)**
-PS4.C: Information Technologies and Instrumentation
Digitized information can be transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information — convert it from digitized form to voice — and vice versa. **(4-PS4-3)**
-ETS1.C: Optimizing the Design Solution
Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. **(Secondary to 4-PS4-3)**

Fifth Grade

5-PS2-1- Support an argument that the gravitational force exerted by Earth on objects is directed down.

PS2.B: Types of Interactions
The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center. **(5-PS2-1)**

3-5-ETS1-1- Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

3-5-ETS1-2- Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

3-5-ETS1-3- Plan and carry out fair tests in which variables are controlled

-ETS1.A: Defining and Delimiting Engineering Problems

Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. **(3-5-ETS1-1)**

-ETS1.B: Developing Possible Solutions

Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. **(3-5-ETS1-2)**

At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. **(3-5-ETS1-2)**

Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. **(3-5-ETS1-3)**

-ETS1.C: Optimizing the Design Solution

Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. **(3-5-ETS1-3)**

<u>Middle School</u>

MS-PS2-1- Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.

-PS2.A: Forces and Motion

For any pair of interacting objects, the force exerted by the first object on the second object is equal in strength to the force that the second object exerts on the first, but in the opposite direction (Newton's third law). **(MS-PS2-1)**

The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change. The greater the mass of the object, the greater the force needed to achieve the same change in motion. For any given object, a larger force causes a larger change in motion. **(MS-PS2-2)**

All positions of objects and the directions of forces and motions must be described in an arbitrarily chosen reference frame and arbitrarily chosen units of size. In order to share information with other people, these choices must also be shared. **(MS-PS2-2)**

-PS2.B: Types of Interactions

Electric and magnetic (electromagnetic) forces can be attractive or repulsive, and their sizes depend on the magnitudes of the charges, currents, or magnetic strengths involved and on the distances between the interacting objects. **(MS-PS2-3)**

Gravitational forces are always attractive. There is a gravitational force between any two masses, but it is very small except when one or both of the objects have large mass—e.g., Earth and the sun. **(MS-PS2-4)**

Forces that act at a distance (electric, magnetic, and gravitational) can be explained by fields that extend through space and can be mapped by their effect on a test object (a charged object, a magnet, or a ball, respectively). **(MS-PS2-5)**

High School

HS-PS2-1- Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.

-PS2.A: Forces and Motion

Newton's second law accurately predicts changes in the motion of macroscopic objects. **(HS-PS2-1)**

Momentum is defined for a particular frame of reference; it is the mass times the velocity of the object. **(HS-PS2-2)**

If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in the momentum of objects outside the system. **(HS-PS2-2),(HS-PS2-3)**

-PS2.B: Types of Interactions

Newton's law of universal gravitation and Coulomb's law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects. **(HS-PS2-4)**

Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields. **(HS-PS2-4),(HS-PS2-5)**

Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects. **(HS-PS2-6),(secondary to HS-PS1-1),(secondary to HS-PS1-3)**

-PS3.A: Definitions of Energy

"Electrical energy" may mean energy stored in a battery or energy transmitted by electric currents. **(secondary to HS-PS2-5)**

-ETS1.A: Defining and Delimiting an Engineering Problem

Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. **(secondary to HS-PS2-3)**

-ETS1.C: Optimizing the Design Solution

Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. **(secondary to HS-PS2-3)**

HS-PS4-1- Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.

-PS4.A: Wave Properties

The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing. **(HS-PS4-1)**

Information can be digitized (e.g., a picture stored as the values of an array of pixels); in this form, it can be stored reliably in computer memory and sent over long distances as a series of wave pulses. **(HS-PS4-2),(HS-PS4-5)**

[From the 3–5 grade band endpoints] Waves can add or cancel one another as they cross, depending on their relative phase (i.e., relative position of peaks and troughs of the waves), but they emerge unaffected by each other. (Boundary: The discussion at this grade level is qualitative only; it can be based on the fact that two different sounds can pass a location in different directions without getting mixed up.) **(HS-PS4-3)**