Cross-Disciplinary Astronomy and Physics Activities for the Classroom
Learning Activities Template

Learning Activity	Cross-discipline Examples	NGSS Standards	NGSS Cross-Cutting Concepts
Distances in Astronomy • Powers of Ten • Parallax	Biology: • Size of microorganisms and atmospheric particles. Chemistry: • Size of atoms, nanotechnology, bonding, atomic scale Physics/Physical Science: • Metric system • Scientific notation Earth/Geology/Environmental Science: • Size and scale and geochemical cycles. Math: • Algebraic computations • Geometric applications Engineering: • Engineering notation	ESS1.A: The Universe and Its Stars Patterns of the apparent motion of the sun, the moon, and stars in the sky can be observed, described, predicted, and explained with models. (MS-ESS1-1) Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe. (MS-ESS1-2) ESS1.B: Earth and the Solar System The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the sun by its gravitational pull on them. (MS-ESS1-2),(MS-ESS1-3) This model of the solar system can explain eclipses of the sun and the moon. Earth's spin axis is fixed in direction over the	• Scale, proportion, and quantity

		short-term but tilted relative to its orbit around the sun. The seasons are a result of that tilt and are caused by the differential intensity of sunlight on different areas of Earth across the year. (MS-ESS1-1) The solar system appears to have formed from a disk of dust and gas, drawn together by gravity. (MS-ESS1-2)	
Light • Light and Color • Spectra and Chemical Composition	Biology: • Color perception, vision • Wavelengths of light traveling through different media (e.g., how different algae types grow in different light). • Bioluminescence Chemistry: • Chemiluminescence, phosphorescence, fluorescence. Physics/Physical Science: • Wave properties, frequency, speed, wavelength • Transmission of light through various media • Filters Earth/Geology/Environmental Science: • Mineral identification • Soil compositions	**ESS1.A: The Universe and Its Stars** The study of stars' light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth. (HS-ESS1-2),(HS-ESS1-3) **PS4.B: Electromagnetic Radiation** Atoms of each element emit and absorb characteristic frequencies of light. These characteristics allow identification of the presence of an element, even in microscopic quantities. (Secondary to HS-ESS1-2).	• Structure and function • Cause and effect: mechanism and explanation • Patterns

	Math: • Inverse relationships Engineering: • Materials science		
Planetarium • Observing the night sky • Optics and Telescopes	Biology: • Night vision/dark adaption • Photoreceptors (cones, rods) Chemistry: • Effects of pollutants/atmosphere on seeing Physics/Physical Science: • Concave/convex lenses • Focal points Earth/Geology/Environmental Science: • Amount of daylight • Seasons • Archaeoastronomy connections Math: • Degrees, arc minutes, arc seconds Engineering: • Satellite trajectories	**ESS1.B: Earth and the Solar System** Kepler's laws describe common features of the motions of orbiting objects, including their elliptical paths around the sun. Orbits may change due to the gravitational effects from, or collisions with, other objects in the solar system. (HS-ESS1-4)	• Patterns • Cause and effect: mechanism and explanation
Thermal Energy • Heat energy	Biology: • Extremophiles • Thermal ocean vents Chemistry: • Endothermic and Exothermic reactions • Burning splint tests Physics/Physical Science: • Conductors and insulators	Mathematical expressions, which quantify how the stored energy in a system depends on its configuration (e.g. relative positions of charged particles, compression of a spring) and how kinetic energy depends on mass and speed, allow the concept of conservation of energy to be	• Energy and matter: Flows, cycles, and conservation • Stability and change • Cause and effect: mechanism and explanation

	Earth/Geology/Environmental Science: • Energy types and sources Math: • Newton's law of cooling • Heat transfer and temperature changes Engineering: • Design spaceship to withstand extreme temperatures in space.	used to predict and describe system behavior. (HS-PS3-1) PS3.D: Energy in Chemical Processes Although energy cannot be destroyed, it can be converted to less useful forms—for example, to thermal energy in the surrounding environment. (HS-PS3-3),(HS-PS3-4) PS3.D: Energy in Chemical Processes Solar cells are human-made devices that likewise capture the sun's energy and produce electrical energy. (secondary to HS-PS4-5) 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)	
Planetary Geology • Detecting Distant Exoplanets • Planetary Geology	Biology: • Environmental Regions • Habitable zones • Detecting life on other planets Chemistry:	**ESS2.A: Earth Materials and Systems** Evidence from deep probes and seismic waves, reconstructions of historical	• Patterns • Systems and system models • Energy and matter: Flows, cycles, and conservation

	• Chemical composition of soils Physics/Physical Science: • Planet properties (mass, volume, density, gravitational field, atmosphere, magnetic field. Earth/Geology/Environmental Science: • Atmospheres—chemical composition • Moon spirals and magnetic forces • Earthquake waves used to model Earth's interior Math: • Kepler's Law of Planetary Motion • Coding/decoding images Engineering: • Designing space probes to fly by or land on other planets	changes in Earth's surface and its magnetic field, and an understanding of physical and chemical processes lead to a model of Earth with a hot but solid inner core, a liquid outer core, a solid mantle and crust. Motions of the mantle and its plates occur primarily through thermal convection, which involves the cycling of matter due to the outward flow of energy from Earth's interior and gravitational movement of denser materials toward the interior. (HS-ESS2-3) **ESS1.B: Earth and the Solar System** pler's laws describe common features of the motions of orbiting objects, including their elliptical paths around the sun. Orbits may change due to the gravitational effects from, or collisions with, other objects in the solar system. (HS-ESS1-4)	• Stability and change • Structure and function
Zooniverse • Galaxy Zoo • Detecting Exoplanets • Climate Change	Biology: • Ocean life • Cancer cell research • Genetics • Plankton	Science investigations use diverse methods and do not always use thesame set of procedures to obtain data. • New technologies advance	• Patterns • Cause and effect: mechanism and explanation • Scale, Proportion and

	• California Condors • Notes from Nature	scientific knowledge. • Scientific inquiry is characterized by a common set of values that include: logical thinking, precision, open-mindedness, objectivity, skepticism, replicability of results, and honest and ethical reporting of findings. • The discourse practices of science are organized around disciplinary domains that share exemplars for making decisions regarding the values, instruments, methods, models, and evidence to adopt and use. • Scientific investigations use a variety of methods, tools, and techniques to revise and produce new knowledge.	quantity • Systems and system models • Energy and matter: Flows, cycles, and conservation • Structure and function • Stability and change
	Chemistry: • Star formation • Explosions in the sun		
	Physics/Physical Science: • Galaxy formation • Sunspots • Planet formation, exoplanets • Blackhole jets		
	Earth/Geology/Environmental Science: • Climate data from ship logs • Tropical cyclone data • Moon's surface • Explore the Red Planet		
	Math: • Modeling/decoding		
	Engineering: • Echolocation		

Links:

NGSS Science Standards:
http://www.nextgenscience.org

NGSS Cross-cutting Concepts:
http://www.nextgenscience.org/sites/ngss/files/Appendix%20G%20%20Crosscutting%20Concepts%20FINAL%20edited%204.10.13.pdf