

Science 30 Study Guide Living Systems Respond to Their Environment

General Concept #1 – explain field theory and analyze its applications in technologies used to produce, transmit and transform electrical energy.

Multiple choice or numeric response section

C1.1k: define a field as a property of space around a mass, an electric charge or a magnet that causes another mass, electric charge or magnet introduced in to this region to experience a force.	R/Y/G
C1.2k: compare the interaction between static electric charges with the interaction between magnetic poles and with the interaction between two masses at a distance.	R/Y/G
C1.3k: compare the basic properties (source, direction and strength) of vector fields (gravitational, electric and magnetic), as determined by a test object	R/Y/G
C1.4k: describe gravitational and electric field strength at a given distance from a mass or a point charge a. calculate the gravitational field strength using $g = Gm / r^2$ b. calculate the electrical field strength using $E = kq / r^2$	R/Y/G
C1.5k: describe the effect of a conductor moving through a magnetic field & inducing an electrical current	R/Y/G
C1.6k: describe the relationships, among power, current, voltage and resistance using the equations: a. $V = IR$ (ohms law) b. $P = VI$, $P = I^2R$, and $P = V^2/R$ (power law) c. Total resistance in a series circuit: $R_T = R_1 + R_2 + R_3$ d. Total resistance in a parallel circuit: $R_T = (1/R_1 + 1/R_2 + 1/R_3)^{-1}$	R/Y/G
C1.7k: describe electrical energy in kilowatt hours and joules, using the equations: a. $E_e = Pt$ for electrical energy b. $P = VI$ for power	R/Y/G
C1.8k: distinguish between alternating current (AC) and direct current (DC) in terms of electron flow and electric field.	R/Y/G
C1.9k: describe the operation of a transformer, in terms of the relationship among current, voltage & the number of turns in the primary and secondary coils, using the equation $N_p/N_s = V_p/V_s = I_s/I_p$	R/Y/G
C1.10k: describe the advantage of AC over DC for transmitting and using electrical energy C1.11k: compare the general design and function of a DC electric motor and a generator	R/Y/G
C1.12k: describe, in terms of design and electrical energy, the functioning of safety technologies (fuses, circuit breakers and GFCIs)	R/Y/G

Written response section (refer to pg. 14 of your Science Data booklet for scoring guides)

C1.2s: Create an experiment that investigates electrical, magnetic and gravitational fields. Include background information on each field, a problem, variables and a procedure. Use sample data to calculate the electrical and gravitational strength at a given distance.

C1.1s & C1.3s: Draw series & parallel circuits each with power source, switch, conductor, and load (up to 3 Rs). Describe how to measure voltage, current & resistance. Add voltmeter, ammeter & ohmmeter to the drawing) Calculate the total resistance, total voltage, total current and/or power for each circuit.

C1.1ts: Explain how one technology that applies to fields or electricity, has benefited society. Describe the scientific principals used in the technology. Use labeled diagrams and/or mathematical equations to support your answer. Identify any environmental or safety concerns associated with your technology.

e.g., telephones, cellular telephones, CD players, photocopiers, electrostatic filters, electromagnets, motors, generators or transformers

Major Concept #2 - describe the properties of the electromagnetic spectrum and their applications in medical technologies, communication systems & remote-sensing technologies used to study universe.	
C2.1k: describe the range of the electromagnetic spectrum from long, low-frequency radio waves through microwaves, infrared (IR) rays, visible light rays and ultraviolet (UV) radiation to very short, high-frequency waves, such as X-rays and gamma rays	R/Y/G
C2.2k: compare and contrast, to each other, the various constituents of the electromagnetic spectrum, on the basis of source, frequency, wavelength & energy , & effect on living tissue; a. <i>UV radiation on human skin and photosynthetic organisms</i> b. <i>gamma radiation on living cells</i> c. <i>visible light on plants, phytoplankton and humans</i> d. <i>artificial illumination on the growth of plants</i>	R/Y/G
C2.3k: recognize that Earth's atmosphere absorbs certain frequencies of EMR	R/Y/G
C2.4k: investigate and describe, qualitatively, the phenomena of reflection (internal reflection), refraction, diffraction and polarization of visible light.	R/Y/G
C2.5k: compare and contrast the properties of radiation, from any region of the electromagnetic spectrum, with those of visible light; i.e., wavelength, frequency, speed, reflection, refraction, diffraction, and penetrability	R/Y/G
C2.6k: investigate and describe the relationships of the variables in the universal wave equation($v=\lambda f$)	R/Y/G
C2.7k: explain, in general terms, the design of telescopes that are used to gather information about the universe through the collection of as much EMR as possible: a. reflecting optical telescope b. refracting optical telescope c. radio telescope	R/Y/G
C2.8k: explain that nuclear fusion in the sun, represented by the equation ${}^2_1\text{H} + {}^2_1\text{H} \rightarrow {}^3_2\text{He} + {}^1_0\text{n}$, produces a wide spectrum of EMR	R/Y/G
C2.9k: describe, in general terms, how a spectroscope can be used to determine the composition of incandescent objects or substances, and the conditions necessary to produce emission (bright line) and absorption (dark line) spectra, in terms of light source and temperature	R/Y/G
C2.10k: describe technologies used to study stars a. spectroscopes used to analyze the distribution of energy in a star's continuous emission spectrum can be used to estimate the surface temperature of the star b. Doppler-shift (red shift and blue shift) technology used to measure the speed of distant stars provides evidence that the universe is expanding	R/Y/G
C2.11k: describe the evolution of stars, black holes, white dwarves & neutron stars.	R/Y/G

Written response section (refer to pg. 14 of your Science Data booklet for scoring guides)

C2.1s & C2.2s: Create a study that investigates the reflection, refraction or polarization of visible light. Include the manipulated, responding and controlled variables. Create data tables from investigations into polarization, reflection or refraction of visible light or draw diagrams to illustrate these phenomena

C2.3s: Investigate emission, absorption and the continuous spectral lines and identify their sources. Identify the elements present in a source by matching spectral lines. Describe how red or blue shift are identified in a spectra and what each shift represents. List the purposes of spectral lines observed from space.

C2.1sts: Explain one technologies that applies to EMR to solve medical, communication, industrial and environmental problems; e.g., *UV radiation to kill bacteria; diagnostic use of MRIs and X-rays; radio waves, microwaves, fibre optics and infrared communications; remote-sensing technologies, telescopes, space probes, satellites, eye lenses, laser surgery, gamma, etc...*

C2.4s: *take and defend a position in support for or against the location of a communications tower in their local community OR propose solutions to reduce human exposure to EMR, emitted by such devices as radio telephones, laptop computers and video terminals, and identify the strengths and weaknesses of each solution.*