Space and Telecommunications core content for Information Technology Curriculum

These Kentucky Core Content activities will be incorporated into the Information Technology classes during the school year leading up to the Space Station contact to be followed up by related space and communications activities. If the Radio contact is scheduled early in the school year, any tasks remaining incomplete will be delivered in the period following the contact. These lessons are broken down into disciplines they are associated with. Some may be combined or separate lessons with the judgment of the instructor.

Kentucky Core Content	**Topic**	**Science**	**Technology**	**Engineering**	**Math**
SC-HS-1.2.1 SC-HS-2.3.1 SC-HS-4.6.2 MA-HS-3.1.1 PL-HS-4.3.2	How Space communication satellites work and how they are continuing to change our everyday lives.	Discuss the challenges of space flight. Explain space environments impact on communications satellites and ISS. Use field strength meter to measure energy transmitted from Amateur radio transceiver to simulate radiated energy from the sun impacting a satellite. Use a simple dipole antenna to light up a small lamp to further illustrate energy radiated in free space.	Explain how space communication systems deliver news and information. Students will setup and aim a Dish Network antenna and receiver to watch NASA TV.	Discuss launch methods for satellites, orbit types, and tracking systems. Watch Discovery channel Video Eyes in the Sky. Demonstrate and allow students to track satellites with the use of SatPC32 and computer controlled G5500 rotator and antenna system.	Introduce the concepts of orbit types, semi-minor axis, semi-major axis, focus, and eccentricity. Include period, inclination, apogee, perigee, and Kepler Data in presentation and explain. Students will use Kepler's laws to calculate the Eccentricity of an orbit. Students will use a printout to measure an orbit and calculate the eccentricity from these measurements.

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SC-HS-4.6.2 *SC-HS-4.6.3* *MA-HS-2.2.1*	How radio frequencies, antennas, and radios systems apply to communications systems.	Explain Doppler shift and polarization changes in radio frequencies. Students will use a portable satellite antenna to detect Doppler shift and polarization changes in radio frequencies transmitted from Low Earth Orbit satellites.	Students learn setup and operate an Amateur radio transceiver, TNC, and communication receiver with antenna.	Explain differences in antenna systems to include linear vs circular polarization. Explain different types of receiving antennas, radio pattern and gain. Students will observe differences in receiving antenna capability between dipole vs Yagi Uda antennas.	Discuss the Metric system and explain how this relates to data bandwidth and frequency. Students will convert frequencies between Khz, Mhz, and Ghz and use a communication receiver to listen to frequencies across the Mhz to the Ghz range.
SC-HS-1.1.4 SC-HS-4.6.2 MA-HS-1.3.1 PL-HS-4.3.2	Antenna systems used on terrestrial and space platforms. Part1	Explain Electromagnetic Spectrum, Wavelength, Frequency, Speed of light in a vacuum, and their relationship. Discuss Conductors and insulators. Students will use an oscilloscope to observe the relationship between wavelength and frequency with an audio tone.	Explain why many space communication systems use a circularly polarized antenna system and why. Students will compare received signal strength from terrestrial and satellite stations on a homebrew CP 4 element yagi vs a Linear 4 element yagi.	Students will build a half wave dipole on 2 meter amateur radio frequency using measurements from mathematic activity. Students will build a 3 element tape measure beam antenna	Explain formulas for calculating antenna length with and without velocity factor. Students will use mathematical formulas to calculate length of a half wave dipole and 3 element Yagi antenna.

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MA-HS-1.2.1 MA-HS-1.3.1 MA-HS-2.2.1 SC-HS-4.6.2 SC-HS-4.6.3 PL-HS-4.3.2	Antenna systems used on terrestrial and space platforms. Part2	Discuss Ohms Law, Power, and Impedance. Discuss why these factors are important in constructing an antenna system. Explain safe procedures for using a multi-meter . Students will use a meter to measure Volts, Amps, and Resistance from AC and DC sources and other electronic components.	Discuss types of feed lines, connectors, and matching systems. Discuss amplifiers, pre-amplifiers, and filters. Students will use a portable dual band antenna and radio to receive and send signals to a satellite in Low Earth Orbit. Two radios will initially be used then students will use a Diplexer and preamplifier and observe results.	Antennas created in previous activity will be tuned with a network analyzer, and tested. Student will observe as length changes, the resonant frequency of the antenna changes. Students will observe the Standing wave ratio and output power after loss and reflected energy of their antennas systems.	Using formulas for Ohm's law and power calculations, students will use measurements from science activity to obtain results. Discuss Decibels and Gain. Students will estimate effective radiated power based on input power and gain of the antenna system and loss of a feed line. Discuss Standing Wave Ratio.

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SC-HS-1.2.1 SC-HS-1.2.2 *SC-HS-1.2.3* SC-HS-2.3.1 SC-HS-4.6.1 SC-HS-4.6.2 SC-HS-4.6.8 SC-HS-4.6.9 MA-HS-1.3.1	Satellites and the atmosphere of the Earths impact on space communications.	Discuss the layers of earth's atmospheres and their impact on terrestrial and space communications. With the use of a portable HF antenna system, students will observe propagation changes in the atmosphere based on the charged state of the Ionosphere.	Explain modulation modes such as FM, AM, SSB, and encoding schemes such as AFSK and PSK. Explain how satellites such as weather satellites provided some of the earliest information about the earth's atmosphere and new satellites are being used to monitor changes in to atmosphere. Students will use Low Earth Orbit communication satellites to transfer packet data, receive telemetry, and weather fax data.	Discuss basics of satellite design, construction, attitude control systems, subsystems, and orbits. Students will brainstorm as teams to design the next generation of cubesats and present their designs to the class by making a mockup from cardboard with subsystems inside.	Explain power generation on satellites with the use of photovoltaic cells. Students will use a photovoltaic trainer to measure output power of panels and estimate power supply requirements of household items.
SC-HS-1.1.4 PL-HS-4.3.1 SC-HS-4.6.2 MA-HS-1.2.1	The history, hazards and future of Space communications and travel.	Explain safety around RF systems and how the non-ionizing energy can cause cell damage. Explain how to measure MPE with FCC guidelines based and frequency and duty cycle. Explain how Astronauts and satellites suffer similar consequences is exposed to excessive radiation. Students will observe safe use of radio transmitters.	Explain how automated systems are making space exploration more accessible and how the future for demand of jobs in the Space industry will continue to grow. Show Imax movie *Roving Mars* Show Imax movie *Space Station* and other movies in the Imax space collection (The other movies can be played time permitting.)	Discuss microcontrollers and automated systems. Students will use a BOE-Bot kit to build and program an autonomous explorer. They will use basic sensors such as the ultrasonic and touch sensor to assist the robot to navigate. (This activity can be made as in-depth as needed and could take from several days to several weeks to complete.)	Student will use the MPE computer calculator for Maximum Permissible Exposure on the 2 meter and 70cm Amateur radio bands for safe working conditions.

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