

## Chapter 1: Science Practices

These maths and science practices skills activities are integrated throughout chapters 2-12 where required.

## Chapter 2: The Universe and Its Stars

| Date | Duration Time / No. of periods | Activity number(s) | Notes  | Lab / Practical activity  | Formative or Summative Assessment   |
|------|--------------------------------|--------------------|--|---|---|
|      | 2                              | 11<br>12<br>1 & 4  | <b>Anchoring Phenomenon:</b> Hidden in Plain Sight.<br><b>Key Question (KQ):</b> What caused the Crab Nebula and what is hidden at its center?<br>How can scientists and astronomers study different aspects of the universe by using various devices for gathering data?<br><b>Vocab:</b> EMS (electromagnetic spectrum), visible light, radio waves, infrared light, gamma rays, x-rays, ultraviolet light, VLT (very large telescope), HST (Hubble Space Telescope), VLA (Very Large Array), JWST (James Webb Space Telescope), ISIM (Integrated Science Instrument Module) |   | <ul style="list-style-type: none"> <li>What do your students already know about the topic?</li> <li>Are there any gaps or misconceptions?</li> <li>Cost / Benefit analysis of space telescopes with conclusions.</li> </ul> |
|      | 1                              | 13<br>4            | <b>KQ:</b> How do we know what stars are made of?<br><b>Vocab:</b> parallax, magnitude, apparent v absolute magnitude, luminosity, parsec, absorption spectrum, electron orbitals, Kelvin temperature scale  | Use stairs to help students understand the quantized nature of electron orbitals.   | <ul style="list-style-type: none"> <li>Evaluate the spectra of one (or more) star(s) and describe the characteristics of the star(s).</li> </ul>  |
|      | 1                              | 14<br>5            | <b>KQ:</b> Where exactly are we in the universe, and what is its shape and size?<br><b>Vocab:</b> dark matter, dark energy   | Given various sizes for bodies in the universe, calculate approximate scale sizes and distances.                                      | <ul style="list-style-type: none"> <li>What do we know, and what do we theorize about, regarding the size and shape of the universe?</li> </ul>   |
|      | 1                              | 15<br>5            | <b>KQ:</b> How did the universe begin, and what events occurred as it formed?<br><b>Vocab:</b> singularity, Big Bang, gravity, electromagnetic force, weak nuclear force, strong nuclear force, photon, electron, positron, gravitron, quarks, gluons, atomic nuclei, CMB (cosmic microwave background)  | If you were to create a timeline for the history of the universe, what is the smallest unit of time that you would want to mark? Why? | <ul style="list-style-type: none"> <li>Identify and comment on any errors in the statement: "The universe was formed when a dense ball of material exploded into space, forming the universe we see today."</li> </ul>      |

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|  | 1 | 16              | <b>KQ:</b> What evidence is there for the Big Bang, and the beginning of the universe?<br><b>Vocab:</b> Doppler effect, red-shift, blue-shift,  |                                    | <ul style="list-style-type: none"> <li>Explain how the presence of CMB supports the Big Bang theory.</li> <li>If CMB did not exist, what would the temperature of space be? Why?</li> </ul>  |
|  | 2 | 17<br>4 & 7 & 8 | <b>KQ:</b> What actually happens during the expansion of space, and what does it look like to us on Earth?<br><b>Vocab:</b> Mpc (Megaparsec)  | <b>Inv 2.1:</b> Modeling Expansion | <ul style="list-style-type: none"> <li>Calculate the recessional velocities of one or more galaxies.</li> </ul>  |
|  | 2 | 18<br>19        | <b>KQ:</b> What is the structure of the Sun, and what keeps it shining?<br><b>Vocab:</b> Core, radiative zone, plasma, convection cells, photosphere, chromosphere, corona, solar flare, solar prominence, sunspots<br><b>KQ:</b> How do stars form and change over their life cycle, and how does mass affect the life cycle of stars?<br><b>Vocab:</b> nebula, supernova, white dwarf, red dwarf, blue giant, red giant, black hole |                                    | <ul style="list-style-type: none"> <li>Develop a model that illustrates the life cycle of the Sun – up to the present and up to the end of its life. Be sure to include variations in radiation, sunspot cycles, and non-cyclic variations and changes.</li> </ul> |
|  | 1 | 20<br>21        | <b>KQ:</b> How can we classify stars, and can we determine any relationships between their characteristics?<br><b>Vocab:</b> Hertzsprung-Russell Diagram (HR Diagram), main sequence stars, spectral classes, Supergiants<br><b>KQ:</b> What happens when a Sun-like star uses up its supply of hydrogen and enters the final stage of its life cycle?<br><b>Vocab:</b> planetary nebula, black dwarf                                 |                                    | <ul style="list-style-type: none"> <li>Explain why stars of different sizes tend to follow different lifetimes. Be sure to include changes in luminosity, temperature, color and any other factors that may seem relevant.</li> </ul>                              |
|  | 1 | 22              | <b>KQ:</b> What causes a supernova, and what results from it?<br><b>Vocab:</b> Supernova, neutron star, stellar nucleosynthesis, supernova nucleosynthesis, event horizon, accretion disk   |                                    |  |
|  | 1 | 23              | <b>KQ:</b> How can we study black holes when they release no information?<br><b>Vocab:</b> Doppler beaming  |                                    |  |

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|  | 1 | 24 | <b>KQ:</b> How do elements form inside stars, and what is the limit of this formation?<br><br><b>Vocab:</b> nucleosynthesis, atomic nuclei, stellar nucleosynthesis, supernova nucleosynthesis |  | <ul style="list-style-type: none"> <li>Explain how nucleosynthesis and the formation of different elements relates to a star's mass and life stage.</li> <li><b>PE:</b> HS-ESS1-3</li> </ul> |
|  | 1 | 25 | Review Your Understanding<br><b>Anchoring Phenomenon revisited</b><br><b>Hidden in Plain Sight</b>   |  | Can students fully explain the Key Question for the chapter anchoring phenomenon: What caused the Crab Nebula and what is hidden at its center?  |
|  | 1 | 26 | Summing Up   |  | Summative Assessment<br><b>PE:</b> HS-ESS1-1, HS-ESS1-2  |

## Chapter 3: Earth and the Solar System

| Date | Duration Time / No. of periods | Activity number(s) | Notes   | Lab / Practical activity   | Formative or Summative Assessment   |
|------|--------------------------------|--------------------|---|--|---|
|      | 3                              | 27<br>28           | <b>Anchoring Phenomenon:</b> Solar system relationships.<br><b>Key Question (KQ):</b> What's the relationship between the Sun, the planet that orbit it, and the time they take to complete an orbit?<br><b>Vocab:</b> planets, comets, asteroids, orbiters, flybys, gravity, ellipse, gravity assist |  | <ul style="list-style-type: none"> <li>What do your students already know about the topic?</li> <li>Are there any gaps or misconceptions?</li> <li>Describe the different technology options for exploring the solar system</li> <li>Explain why it is so difficult for a space probe to enter orbit around Mercury.</li> <li>How have we come to know so much about the solar system?</li> </ul> |
|      | 2                              | 29<br>9            | <b>KQ:</b> How did the solar system form and how has it changed over the last 4.5 billion years?<br><b>Vocab:</b> angular momentum, Grand Tack hypothesis, data distribution  |  | <ul style="list-style-type: none"> <li>Relate the evidence of the planets and their composition to the formation of the solar system.</li> </ul>  |
|      | 2                              | 30<br>6            | <b>KQ:</b> What is the structure of the solar system, and what are the significant parts of it?<br><b>Vocab:</b> orbit, AU (astronomical unit), Kuiper belt, Oort cloud   |  | <ul style="list-style-type: none"> <li>What distinguishes a dwarf planet from a planet?</li> <li>The sun contains 90+% of the mass of the solar system. How does this affect the rest of the system?</li> </ul>   |
|      | 3                              | 31                 | <b>KQ:</b> How do planets, moons, comets, and asteroids move, when orbiting a larger mass?<br><b>Vocab:</b> Ellipse, parabola, hyperbola,   | <b>Inv 3.1:</b> Elliptical orbits<br><b>Inv 3.2:</b> Modeling orbits 1   | <ul style="list-style-type: none"> <li>Describe the features of an ellipse.</li> <li>Relate the distance between the foci to the shape of an ellipse.</li> </ul>  |
|      | 2                              | 32                 | <b>KQ:</b> How do Kepler's laws describe the motion of the planets?<br><b>Vocab:</b> Kepler's laws, semimajor axis, semiminor axis, eccentricity, aphelion, perihelion  | $a$ = semimajor axis<br>$b$ = semiminor axis<br>$c$ = distance from center to focus 1<br>$2c$ = distance between both foci | <ul style="list-style-type: none"> <li>Why does a line between a planet and the Sun sweep out equal areas during equal time periods?</li> <li><b>PE: HS-ESS1-4</b></li> </ul>   |
|      | 3                              | 33                 | <b>KQ:</b> What is gravity and how can it be described mathematically?<br><b>Vocab:</b> gravity, $G$ (gravitation constant)   | <b>Inv3.3:</b> Modeling orbits 2   |   |

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|  | 2 | 34       | <b>KQ:</b> By comparing Kepler's and Newton's equations, what new information or insight can we gain?<br><b>Vocab:</b> planet, Kepler's laws, AU (astronomical unit)   | NOTE: the difference between the semimajor axis and the average radius is negligible for orbits with a low eccentricity | <ul style="list-style-type: none"> <li>Calculate the mass of stars and the period of planets orbiting them.</li> <li><b>PE:</b> HS-ESS1-4</li> </ul>  |
|  | 1 | 35       | <b>KQ:</b> How do satellites orbit, and can we apply Newton's and Kepler's laws to them?<br><b>Vocab:</b> satellites, Geostationary orbit (GEO), Low Earth orbit (LEO), Medium Earth orbit (MEO)                     |   | <ul style="list-style-type: none"> <li>Why is a polar orbit useful in surveying a planet?</li> <li><b>PE:</b> HS-ESS1-4</li> </ul>  |
|  | 1 | 36       | <b>KQ:</b> From observations, can we calculate the shape of the orbit of Halley's Comet?   |   | <ul style="list-style-type: none"> <li>Apply Kepler's 3<sup>rd</sup> law</li> <li>Plot the orbit of Halley's comet. Label the sun.</li> </ul>   |
|  | 2 | 37<br>10 | <b>KQ:</b> Why are the movements of planets in the sky different from the stars, and can we use these movements to calculate a planet's distance from Earth?<br><b>Vocab:</b> retrograde, apparent retrograde motion | <b>Inv 3.4:</b> Parallax  | <ul style="list-style-type: none"> <li>Use parallax to calculate the distance to a distant object.</li> </ul>   |
|  | 1 | 38       | <b>KQ:</b> How do the Earth and Moon influence each other?<br><b>Vocab:</b> satellite, solar system, tidal locking, barycenter   |   |   |
|  | 1 | 39       | <b>KQ:</b> What effect do the long term changes in the Earth's orbit have on the Earth's long term climate?<br><b>Vocab:</b> Milankovitch cycles, obliquity, precession, orbital eccentricity                        |   | <ul style="list-style-type: none"> <li>What drives the Milankovitch cycles?</li> <li>Relate the most recent ice age to the Milankovitch cycles.</li> </ul>  |
|  | 1 | 40       | <b>KQ:</b> How can astronomers tell if planets are orbiting other stars?<br><b>Vocab:</b> exoplanets, nebula theory  |   |   |
|  | 1 | 41       | Review Your Understanding<br><b>Anchoring Phenomenon revisited</b><br>Solar system relationships.  |   | Can students fully explain the Key Question for the chapter anchoring phenomenon: What's the relationship between the Sun, the planet that orbit it, and the time they take to complete an orbit? |
|  | 1 | 42       | Summing Up   |   | Summative Assessment<br><b>PE:</b> HS-ESS1-4  |

## Chapter 4: The History of Planet Earth

| Date | Duration<br>Time / No. of<br>periods | Activity<br>number(s) | Notes  | Lab /<br>Practical activity  | Formative or<br>Summative Assessment   |
|------|--------------------------------------|-----------------------|--|--|--|
|      | 2                                    | 43<br><br>44          | <b>Anchoring Phenomenon:</b> An Age Old Puzzle.<br><b>Key Question (KQ):</b> How do you estimate how old something is?<br><b>Vocab:</b> actual, relative<br><b>KQ:</b> How has the Earth's geological activity reshaped its surface?<br><b>Vocab:</b> igneous rock, sedimentary rock, metamorphic rock, tectonic plates, continental drift, convection currents, cyanobacteria |  | <ul style="list-style-type: none"> <li>What do your students already know about the topic?</li> <li>Are there any gaps or misconceptions?</li> </ul>   |
|      | x                                    | 45                    | <b>KQ:</b> What are the different properties of continental and oceanic crust?<br><b>Vocab:</b> continental crust, oceanic crust, basalt, gneiss, continental shield, lava, magma, mid-ocean ridge   |  |  |
|      | x                                    | 46                    | <b>KQ:</b> How do scientists model the age of the Earth?<br><b>Vocab:</b> radioactive decay, half-life   |  | <ul style="list-style-type: none"> <li>For the "Radioactive decay of potassium into calcium and argon" write a short description of what transpires in each step.<br/> <b>Extension:</b> In the first 1.28 billion years (first half-life), half of the potassium atoms (50 atoms) underwent radioactive decay. About 90% (45 atoms) became calcium and about 10% (5 atoms) became argon.</li> </ul> |
|      | 3                                    | 47<br>6, 7, 8         | <b>KQ:</b> How does comparing minerals on Earth and extra-terrestrial bodies help us understand the formation and age of the Earth and Moon?<br><b>Vocab:</b> radiometric dating, Theia, isotopes, deviation   | <b>Inv 4.1:</b> Modeling half-lives (this can also be done with pennies, <i>in lieu</i> of M&Ms) | <ul style="list-style-type: none"> <li>Which dating method makes the most sense to you? Explain.</li> <li><b>PE:</b> HS-ESS1-5, PE: HS-ESS1-6</li> </ul>   |

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|  | 1 | 48 | <b>KQ:</b> How has robotic exploration of Mars helped us understand why it is different from Earth?<br><b>Vocab:</b> organic molecules                |  | <ul style="list-style-type: none"> <li>Was there life on Mars? What do you think the evidence suggests?</li> </ul>                 |
|  | 1 | 49 | <b>KQ:</b> How has the information from space probes helped us understand the earliest history of Earth?<br><b>Vocab:</b> protium, deuterium, aerogel |  | <ul style="list-style-type: none"> <li>What <i>kinds</i> of information have we been able to collect from space probes?</li> </ul> |
|  | 1 | 50 | <b>KQ:</b> What were the events in the formation of the Earth?  |  |  |
|  | 1 | 51 | <b>KQ:</b> What are the conditions that have allowed Earth to be a habitable planet?  |  | <ul style="list-style-type: none"> <li>What are all the factors that make Earth “just right” for the evolution of life?</li> </ul> |
|  | 1 | 52 | Review Your Understanding<br><b>Anchoring Phenomenon revisited</b><br>An Age Old Puzzle.  |  | Can students fully explain the Key Question for the chapter anchoring phenomenon: How do you estimate how old something is?        |
|  | 1 | 53 | Summing Up  |  | Summative Assessment<br><b>PE: HS-ESS1-5</b>   |

## Chapter 5: Earth's Materials and Systems

| Date | Duration<br>Time / No. of<br>periods | Activity<br>number(s) | Notes  | Lab /<br>Practical activity | Formative or<br>Summative Assessment   |
|------|--------------------------------------|-----------------------|--|-----------------------------|--|
|      | 2                                    | 54<br>55              | <b>Anchoring Phenomenon:</b> Constant Changes.<br><b>Key Question (KQ):</b> What processes continually shape the Earth's surface?<br><b>KQ:</b> What do we know about the structure of the Earth?<br><b>Vocab:</b> crust, mantle, upper mantle, lower mantle, core, inner core, outer core, convection, atmosphere, troposphere, stratosphere, mesosphere, thermosphere, exosphere |                             | <ul style="list-style-type: none"> <li>What do your students already know about the topic?</li> <li>Are there any gaps or misconceptions?</li> <li>Identify the layers of the internal structure of the earth</li> </ul> |
|      | 2                                    | 56<br>3 & 6 & 7       | <b>KQ:</b> What does seismic evidence and measurement of magnetic changes in rocks tell us about the structure of the Earth?<br><b>Vocab:</b> seismic waves, P-waves, S-waves, asthenosphere, Mohorovicic discontinuity (the Moho)   |                             | <ul style="list-style-type: none"> <li>Relate seismic data to our understanding of the internal structure of the earth.</li> </ul>   |
|      | 1                                    | 57                    | <b>KQ:</b> What are the properties of the layers of the crust and upper mantle, and how are they able to move about?<br><b>Vocab:</b> lithosphere, asthenosphere, Mohorovicic discontinuity (the Moho), viscous (viscosity), plastic   |                             | <ul style="list-style-type: none"> <li>Describe the structure of the crust. State the evidence to support this model.</li> </ul>   |
|      | 1                                    | 58                    | <b>KQ:</b> How do the interactions between constructive and destructive factors shape the Earth's surface?<br><b>Vocab:</b> constructive factors, orogeny, deposition, uplifting, folding, faulting, tectonic activity, destructive factors, weathering, mass wasting, erosion, subduction   |                             | <ul style="list-style-type: none"> <li>Distinguish between constructive forces and destructive forces.</li> <li><b>PE: HS-ESS2-1</b></li> </ul>  |



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|  | 2 | 59<br>60 | <p><b>KQ:</b> What feedback systems operate on Earth, and how do they affect the climate?</p> <p><b>Vocab:</b> negative feedback systems, positive feedback systems, albedo</p> <p><b>KQ:</b> How can the melting of sea ice cause a positive feedback loop that exposes more heat absorbing surfaces and increases ice sheet melting?</p> | Inv 5.1: Modeling ice sheet melting | <ul style="list-style-type: none"> <li>Describe the differences between negative and positive feedback systems.</li> <li>Is a thermostat in your home a negative or positive feedback mechanism?</li> <li>PE: HS-ESS2-2</li> </ul> |
|  | 1 | 61       | <p><b>KQ:</b> What is the effect of dams on the wider environment?</p> <p><b>Vocab:</b> “knock-on effects” (secondary, indirect or cumulative)</p>   |                                     | <ul style="list-style-type: none"> <li>Complete the cognitive map of dams and their “downstream” effects.</li> </ul>   |
|  | 1 | 62       | <p><b>KQ:</b> How does overexploitation of Earth’s natural systems cause the disruption of those systems?</p>  |                                     | <ul style="list-style-type: none"> <li>What, if any, is the difference between responsible use and over-exploitation?</li> </ul>   |
|  | 1 | 63       | <p><b>KQ:</b> What changes does the dynamic nature of the Earth cause, over both the short and long term?</p>  |                                     | <ul style="list-style-type: none"> <li>What are the three sources of environmental change?</li> </ul>  |
|  | 2 | 64       | <p><b>KQ:</b> How do cyclic, and periodic sporadic changes, such as volcanic eruptions, affect the Earth in the short term?</p> <p><b>Vocab:</b> El Niño Southern Oscillation (ENSO), thermocline, ice ages or glaciations</p>   |                                     |  |
|  | 1 | 65       | <p><b>KQ:</b> What changes occur to the Earth’s environment over hundreds, to millions of years?</p> <p><b>Vocab:</b> glaciations, interglacials, rain shadow</p>  | Review Activity 39 if necessary     |  |
|  | 1 | 66       | <p>Review Your Understanding</p> <p><b>Anchoring Phenomenon revisited</b></p> <p>Constant Changes.</p>   |                                     | Can students fully explain the Key Question for the chapter anchoring phenomenon: What processes continually shape the Earth’s surface?  |
|  | 1 | 67       | Summing Up   |                                     | Summative Assessment<br>PE: HS-ESS2-4  |



## Chapter 6: Plate Tectonics

| Date | Duration Time / No. of periods | Activity number(s) | Notes  | Lab / Practical activity   | Formative or Summative Assessment   |
|------|--------------------------------|--------------------|--|--|---|
|      | 1                              | 68                 | <b>Anchoring Phenomenon:</b> On the Move.<br><b>Key Question (KQ):</b> How do the continents move?   |  | <ul style="list-style-type: none"> <li>What do your students already know about the topic?</li> <li>Are there any gaps or misconceptions?</li> </ul>  |
|      | 1                              | 69                 | <b>KQ:</b> Where does the heat in the interior of the Earth come from?<br><b>Vocab:</b> fission, isotopes, alpha particles, gamma rays, decay chain, convection currents, mantle   |  | <ul style="list-style-type: none"> <li>How does radioactive decay produce heat?</li> <li>How much heat is produced by radioactive decay inside the earth?</li> </ul>  |
|      | 1.5                            | 70                 | <b>KQ:</b> How does the temperature change as we go deeper into the Earth?   | Plot the temperature as one descends through a deep bore hole.   | <ul style="list-style-type: none"> <li>How does the temperature change as we descend into the Earth?</li> <li>How does the temperature underground relate to the layers of the Earth?</li> </ul>  |
|      | 2                              | 71<br>6 & 7        | <b>KQ:</b> How does the theory of plate tectonics explain the movements of the crust and the location of earthquakes and volcanoes?<br><b>Vocab:</b> tectonic plates, continental drift, mantle, convection, mantle plumes, faults, subduction zones, hot spot | Plot distance from Kilauea vs age of volcanoes to determine the rate of movement of the Pacific plate over the hot spot. | <ul style="list-style-type: none"> <li>How are earthquakes explained?</li> <li>What are the 2 primary causes of volcanoes?</li> <li>Explain what “stationary hotspots” reveal about the plates.</li> </ul>                                  |
|      | 1.5                            | 72                 | <b>KQ:</b> What occurs at the boundaries of tectonic plates, and what drives plate movement?<br><b>Vocab:</b> divergent boundaries, convergent boundaries, subduction zones, transform boundaries, fault   |  | <ul style="list-style-type: none"> <li>What are the 3 types of boundaries?</li> <li>Describe what is happening at each one.</li> <li>Develop a model that describes and explains the movement of several of the tectonic plates.</li> </ul> |
|      | 2                              | 73                 | <b>KQ:</b> How has continental drift affected the positions of the continents, over time?  | <b>Inv 6.1:</b> Continental Drift<br><b>Inv 6.2:</b> Modeling Drift over time  | <ul style="list-style-type: none"> <li>What lines of evidence support / explain the existence of the supercontinent Gondwana?</li> </ul>  |
|      | 1                              | 74                 | Review Your Understanding<br><b>Anchoring Phenomenon revisited</b><br>On the Move.   |  | <p>Can students fully explain the Key Question for the chapter anchoring phenomenon: How do the continents move?</p> <p>Explain how the continents move, and relate the evidence to support this idea.</p> <p><b>PE: HS-ESS2-3</b></p>      |
|      | 2                              | 75                 | Summing Up   |  | <p>Summative Assessment</p> <p><b>PE: HS-ESS2-3</b></p>   |

## Chapter 7: The Roles of Water in Earth's Surface Processes

| Date | Duration Time / No. of periods | Activity number(s) | Notes   | Lab / Practical activity                        | Formative or Summative Assessment   |
|------|--------------------------------|--------------------|---|---|---|
|      | 2                              | 76<br><br>77       | <b>Anchoring Phenomenon:</b> Lets Go Spelunking!<br><b>Key Question (KQ):</b> What processes helped to form the Mammoth Caves?<br><b>Vocab:</b> limestone, spelunker, stalactites, stalagmites,<br><b>KQ:</b> How do the unique physical and chemical properties of water make it a central chemical in many biological and geological systems?<br><b>Vocab:</b> dipole, hydrogen bond, cohesion, adhesion (adhere), heat capacity, surface tension |   | <ul style="list-style-type: none"> <li>• What do your students already know about the topic?</li> <li>• Are there any gaps or misconceptions?</li> <li>• Relate the polarity and hydrogen bonding in water to several properties:</li> <li>• Heat capacity / thermal stability</li> <li>• Surface tension</li> <li>• High boiling point</li> <li>• Solvent</li> </ul> |
|      | 1                              | 78                 | <b>KQ:</b> What processes allow water to cycle from the oceans to the land, and back?<br><b>Vocab:</b> hydrologic cycle, evaporation, transpiration, condensation, precipitation, infiltration, percolation   |   | <ul style="list-style-type: none"> <li>• What are the primary reservoirs of water in its different forms?</li> <li>• What are the processes that move water from one reservoir to another?</li> </ul>   |
|      | 2                              | 79                 | <b>KQ:</b> How do the processes of erosion, burial, melting, and reforming allow Earth's rocks to form a continuous cycle?<br><b>Vocab:</b> igneous, metamorphic, sedimentary, magma, lava, weathering, rock cycle  | <b>Inv 7.1:</b> Determining properties of rocks | <ul style="list-style-type: none"> <li>• What are the processes that form igneous rock? sedimentary rock? metamorphic rock?</li> <li>• Use a rock key to identify samples.</li> <li>• <b>PE:</b> HS-ESS2-5</li> </ul>   |
|      | 1                              | 80<br>4 & 7        | <b>KQ:</b> How does water allow rocks in the solid lithosphere and asthenosphere to melt into liquid magma?   |   | <ul style="list-style-type: none"> <li>• How does the amount of solute in a solution impact its melting point?</li> <li>• How does this relate to the formation of magma?</li> </ul>  |
|      | 1                              | 81                 | <b>KQ:</b> How do the processes of weathering and erosion shape the Earth's surface?<br><b>Vocab:</b> weathering, chemical, physical, biological, erosion, frost wedging, deposition, delta   |   | <ul style="list-style-type: none"> <li>• What is the difference between weathering and erosion?</li> <li>• Explain how weathering and erosion, each, can cause the breakdown of rocks as part of the rock cycle.</li> </ul>   |

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|  | 1 | 82 | <b>KQ:</b> How does frost wedging contribute to the weathering of rocks?   |   | <ul style="list-style-type: none"> <li>Describe the process of frost wedging.</li> <li>Evaluate the frost wedging model that you used. What are its strengths and what are its limitations?</li> </ul> <b>PE:</b> HS-ESS2-5  |
|  | 1 | 83 | <b>KQ:</b> How does modeling help us to understand how erosion shapes the landscape?<br><br><b>Vocab:</b> landforms, flow velocity, sediment, oxbow, oxbow lakes | <b>Inv 7.3:</b> Modeling the process of erosion | <ul style="list-style-type: none"> <li>How does flow velocity impact erosion?</li> <li>In a meander, where does the erosion occur?</li> <li>In a meander, where does the deposition occur?</li> <li>How can this process create productive agricultural lands?</li> </ul> <b>PE:</b> HS-ESS2-5 |
|  | 1 | 84 | <b>KQ:</b> How do the cohesive and adhesive properties of water influence the rate of erosion in soils?<br><br><b>Vocab:</b> saturation                          |   | <ul style="list-style-type: none"> <li>Which properties of water affect soil stability? How?</li> <li>Link the moisture content of soil to the rate of erosion.</li> </ul>   |
|  | 1 | 85 | Review Your Understanding<br><b>Anchoring Phenomenon revisited</b><br>Lets Go Spelunking!  |   | Can students fully explain the Key Question for the chapter anchoring phenomenon: What processes helped to form the Mammoth Caves?   |
|  | 1 | 86 | Summing Up   |   | Summative Assessment   |

## Chapter 8: Weather, Climate and Biogeology

| Date | Duration Time / No. of periods | Activity number(s) | Notes   | Lab / Practical activity  | Formative or Summative Assessment  |
|------|--------------------------------|--------------------|---|---|--|
|      | 1                              | 87                 | <b>Anchoring Phenomenon:</b> Its Getting Hot in Here.<br><b>Key Question (KQ):</b> Why is the world heating up?   |   | <ul style="list-style-type: none"> <li>What do your students already know about the topic?</li> <li>Are there any gaps or misconceptions?</li> <li>Describe your belief regarding global warming.</li> </ul>                                   |
|      | 1                              | 88                 | <b>KQ:</b> How is the energy from the Sun distributed over the Earth?<br><b>Vocab:</b> atmosphere, oblique, Tropic of Capricorn, Tropic of Cancer, season,  | Project a square grid onto a globe and trace the “squares” at different latitudes. Each “square” represents the same amount of solar energy, and the amount of surface it is spread across. | <ul style="list-style-type: none"> <li>Why are the poles colder than the equator?</li> <li>Calculate the amount of solar energy received at specific points.</li> <li><b>PE:</b> HS-ESS2-4</li> </ul>  |
|      | 2                              | 89<br>9            | <b>KQ:</b> How does the Earth’s tilt cause alternate heating (summer) and cooling (winter)?<br><b>Vocab:</b> (summer or winter) solstice, (spring or fall) equinox  | <b>Inv 8.1:</b> Measuring energy  | <ul style="list-style-type: none"> <li>Why does the sun’s apparent position in the sky change over the course of a year?</li> <li>How does the angle of the sun impact the amount of energy received?</li> <li><b>PE:</b> HS-ESS2-4</li> </ul> |
|      | 1                              | 90                 | <b>KQ:</b> How does the atmosphere help to carry energy from the Sun around the globe?<br><b>Vocab:</b> troposphere, stratosphere, mesosphere, thermosphere, exosphere, aurora (borealis or australis)  |   | <ul style="list-style-type: none"> <li>How does the atmosphere circulate the sun’s energy?</li> <li>How does an aurora occur?</li> </ul>   |
|      | 1                              | 91                 | <b>KQ:</b> How does the rotation and differential heating of the Earth effect the circulation of the planet’s atmosphere, and therefore climate?<br><b>Vocab:</b> tricellular model, Hadley cell, Ferrel cell, Polar cell, Coriolis effect, prevailing winds, trade winds, westerlies, polar easterlies, biomes |   | <ul style="list-style-type: none"> <li>Explain why the relationship between the biomes and the latitudes exists.</li> <li>What role does the atmosphere play in this relationship?</li> <li><b>PE:</b> HS-ESS2-4</li> </ul>                    |
|      | 1                              | 92                 | <b>KQ:</b> How did the Earth and life on it evolve together, and shape each other?<br><b>Vocab:</b> coevolution   |   | <ul style="list-style-type: none"> <li>Describe a specific example of life modifying the environment.</li> <li><b>PE:</b> HS-ESS2-7</li> </ul>   |

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|  | 1 | 93 | <b>KQ:</b> How have the concentrations of gases in the Earth's atmosphere changed over time?  |  | <ul style="list-style-type: none"> <li>What is the cause of seasonal changes in the concentration of CO<sub>2</sub>?</li> <li>What are some of the causes of long-term changes in the concentration of CO<sub>2</sub>?</li> <li>PE: HS-ESS2-7</li> </ul> |
|  | 1 | 94 | <b>KQ:</b> How did oxygen, produced as the waste product of oxygenic photosynthesis, fundamentally change the Earth's atmosphere and lead to a snowball Earth?<br><br><b>Vocab:</b> carbon fixation, cyanobacteria, oxygen sink, Great Oxygenation Event (GOE), greenhouse effect, Snowball Earth |  | <ul style="list-style-type: none"> <li>When and how did the atmosphere become rich in oxygen?</li> <li>What evidence do we have for the "GOE"?</li> <li>PE: HS-ESS2-7</li> </ul>   |
|  | 1 | 95 | <b>KQ:</b> How have changes to the Earth affected the biodiversity of life throughout Earth's history?<br><br><b>Vocab:</b> climate, biodiversity   |  | <ul style="list-style-type: none"> <li>Identify one change in the environment that led to a change in biodiversity.</li> <li>PE: HS-ESS2-7</li> </ul>  |
|  | 1 | 96 | <b>KQ:</b> How do microbes play an important role in producing soil from weathered rock and organic material?   |  | <ul style="list-style-type: none"> <li>List and explain the steps of soil development.</li> <li>Discuss how plants co-evolved with soil development.</li> <li>PE: HS-ESS2-7</li> </ul>   |
|  | 1 | 97 | <b>KQ:</b> How can the development of landforms be influenced by living organisms?<br><br><b>Vocab:</b> reef, estuary   |  | <ul style="list-style-type: none"> <li>Explain the relationship between coral reefs and mangroves.</li> <li>Explain how these structures can lead to the development of new surface features.</li> </ul>   |
|  | 2 | 98 | <b>KQ:</b> How does carbon cycle between the atmosphere, biosphere, geosphere, and hydrosphere?<br><br><b>Vocab:</b> oxidation, photosynthesis, respiration, combustion, dissolving, fossilization, sedimentation, peat, methane, reservoir, atmosphere, hydrosphere, geosphere, biosphere        |  | <ul style="list-style-type: none"> <li>Use a diagram model to describe the movement of carbon into different reservoirs.</li> <li>Identify the processes that move the carbon.</li> <li>PE: HS-ESS2-6</li> </ul>   |
|  | 2 | 99 | <b>KQ:</b> How can modeling be used to show us the cycling of carbon through the hydrosphere, geosphere, and biosphere?   |  | <ul style="list-style-type: none"> <li>Use a mathematical model to quantify the movement of carbon into different reservoirs.</li> <li>PE: HS-ESS2-6</li> </ul>  |

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|  | 1 | 100 | <b>KQ:</b> How does the combustion of fossil fuels, which returns ancient carbon to the atmosphere, cause warming?<br><br><b>Vocab:</b> greenhouse effect, greenhouse gases, ice-albedo effect |  | <ul style="list-style-type: none"> <li>Discuss the relationship between the concentration of greenhouse gases in the atmosphere and the average global temperatures.</li> </ul> |
|  | 1 | 101 | Review Your Understanding<br><b>Anchoring Phenomenon revisited</b><br>Its Getting Hot in Here.   |  | Can students fully explain the Key Question for the chapter anchoring phenomenon: Why is the world heating up?  |
|  | 1 | 102 | Summing Up   |  | Summative Assessment<br><b>PE: HS-ESS2-6, PE: HS-ESS2-7</b>   |



## Chapter 9: Natural Resources

| Date | Duration<br>Time / No. of<br>periods | Activity<br>number(s) | Notes   | Lab /<br>Practical activity   | Formative or<br>Summative Assessment  |
|------|--------------------------------------|-----------------------|---|---|---|
|      | 1                                    | 103                   | <b>Anchoring Phenomenon:</b> What do we do with all the dead batteries?<br><b>Key Question (KQ):</b> How can recycling or reusing lithium in lithium-ion batteries reduce the impact of mining on the environment?<br><b>Vocab:</b> fossil fuel, lithium, lithium-ion |   | <ul style="list-style-type: none"> <li>What do your students already know about the topic?</li> <li>Are there any gaps or misconceptions?</li> <li>How can recycling benefit both humans and the environment?</li> </ul>          |
|      | 1                                    | 104                   | <b>KQ:</b> What are Earth's resources, and out are they important to human society?<br><b>Vocab:</b> resources, renewable, non-renewable, natural resources, minerals, fossil fuels, soil, water  |   | <ul style="list-style-type: none"> <li>What qualities have made fossil fuels so widely used?</li> </ul>   |
|      | 1                                    | 105                   | <b>KQ:</b> What is the link between human civilization and settlement and the location of important resources such as water, minerals, and fossil fuels?<br><b>Vocab:</b> reserve   |   | <ul style="list-style-type: none"> <li>Historically, how were resource locations and population centers related?</li> <li>How and why has that changed in the last 200 years?</li> <li><b>PE:</b> HS-ESS3-1</li> </ul>            |
|      | 1                                    | 106                   | <b>KQ:</b> How are the use of resources, transformation of energy, and development of technology, integrally linked with human history?<br><b>Vocab:</b> horsepower, electrical energy  |   | <ul style="list-style-type: none"> <li>Describe the developmental progression of energy sources.</li> <li>How has that progression affected the amount of resources needed? the amount of work a single person can do?</li> </ul> |
|      | 1                                    | 107                   | <b>KQ:</b> How do rivers, lakes and aquifers act as key water sources to provide water, transport routes and energy for human use?<br><b>Vocab:</b> aquifer   |   | <ul style="list-style-type: none"> <li>List three uses of rivers</li> <li>Are there other human uses of water?</li> <li>What are the general categories and specific uses?</li> </ul>   |
|      | 2                                    | 108                   | <b>KQ:</b> What are some of the important uses of water to humans?<br><b>Vocab:</b> potable water   | Create a list or log of all the ways you use water for 1 week. Calculate an average volume of daily water use per person. | <ul style="list-style-type: none"> <li>What factors are limiting the amount of available clean water for people to use?</li> <li>What are the costs and benefits of using rivers for hydroelectric power?</li> </ul>              |

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|  |   |     |   |  | <ul style="list-style-type: none"> <li>What costs and benefits may be difficult to quantify in financial terms?</li> <li>PE: HS-ESS3-1, PE: HS-ESS3-2</li> </ul>  |
|  | 1 | 109 | <b>KQ:</b> What are Earth's non-renewable resources, and where do we find them?<br><b>Vocab:</b> crude oil, natural gas   |  | <ul style="list-style-type: none"> <li>How are coal and oil extracted from the ground differently?</li> <li>What is fracking?</li> <li>PE: HS-ESS3-2</li> </ul>   |
|  | 1 | 110 | <b>KQ:</b> How does the location of non-renewable resources determine the type of extraction used and the subsequent environmental costs?<br><b>Vocab:</b> oil sands (tar sands), oil shales, <i>in situ</i> extraction         |  | <ul style="list-style-type: none"> <li>Develop a cost / benefit analysis for an <i>in situ</i> oil extraction scenario.</li> <li>PE: HS-ESS3-2</li> </ul>   |
|  | 2 | 111 | <b>KQ:</b> How does the location and type of oil influence extraction costs and returns on investment?<br><b>Vocab:</b> hydrocarbons, liquid natural gas (LNG), fractional distillation, EROEI, peak oil, reserves vs resources |  | <ul style="list-style-type: none"> <li>Relate the term "peak oil" to efficient oil extraction</li> <li>Develop a cost / benefit analysis on two different extraction methods for an oil sand deposit.</li> <li>Draft an environmental impact statement.</li> <li>PE: HS-ESS3-2</li> </ul> |
|  | 2 | 112 | <b>KQ:</b> What are the costs and benefits of coal mining?<br><b>Vocab:</b> syngas, subsidence, overburden  |  | <ul style="list-style-type: none"> <li>Develop a cost / benefit analysis on two different coal deposits, and make a recommendation on which site is the better choice.</li> <li>PE: HS-ESS3-2</li> </ul>  |
|  | 1 | 113 | <b>KQ:</b> How can agriculture produce the maximum yield possible from minimum land use?<br><b>Vocab:</b> sustainability, factory farming, industrial intensive agriculture, monoculture  |  | <ul style="list-style-type: none"> <li>List at least three issues or factors that intensive agriculture addresses to maximize production while minimizing land use.</li> <li>What is ALWAYS used to increase productivity?</li> <li>PE: HS-ESS3-2</li> </ul>                              |
|  | 1 | 114 | <b>KQ:</b> How can sustainable agricultural practices focus on maintaining crop yields while still maintaining ecosystem health?  |  | <ul style="list-style-type: none"> <li>Define sustainable agriculture.</li> <li>Relate specific agricultural practices to maintaining biodiversity, and managing water and soil sustainability.</li> <li>PE: HS-ESS3-2</li> </ul>   |

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|  |   |          | <b>Vocab:</b> biophysical issues, socio-economic issues, crop rotation, terracing, catchments, GMOs, Haber process  |  |   |
|  | 2 | 115<br>8 | KQ: How does the type of soil make a difference to how it should be used and managed?<br><b>Vocab:</b> soil, sand, silt, clay, loam, desertification, humus, no-till farming,   | <b>Inv 9.1:</b> Identifying soil type – part 1<br><b>Inv 9.1:</b> Identifying soil type – part 2 | <ul style="list-style-type: none"> <li>Describe how poor soil management can lead to soil degradation.</li> <li>Classify exemplar soil types</li> <li>Compare and contrast no-till and intensive tillage farming practices.</li> </ul>  |
|  | 1 | 116      | KQ: How can different farming practices lead to sustainability?<br><b>Vocab:</b> carbon sequestration, cover crops, conservation tillage, organic agriculture, grazing land management, sustainable forest management, on-farm anaerobic digesters, native ecosystems, grazing strategies | Jigsaw activity  | <ul style="list-style-type: none"> <li>Evaluate various farming practices in terms of environmental sustainability.</li> <li><b>PE: HS-ESS3-2</b></li> </ul>  |
|  | 1 | 117      | KQ: How can soil conservation practices ensure valuable topsoil resources are not lost?<br><b>Vocab:</b> contour planting, irrigation, windbreaks, agroforestry, cover crops  |  | <ul style="list-style-type: none"> <li>Identify three soil preservation practices and explain how each practice reduces soil loss.</li> </ul>   |
|  | 2 | 118      | KQ: How can we manage fragile rangeland ecosystems?<br><b>Vocab:</b> rangeland, meristem, cropping, selective grazing   |  | <ul style="list-style-type: none"> <li>What is the relationship between rangeland management and productivity?</li> </ul>   |
|  | 2 | 119      | KQ: What practices can we use in our daily lives to live sustainably?<br><b>Vocab:</b> recycling, incineration – waste-to-energy, landfill  |  | <ul style="list-style-type: none"> <li>Explore: “Reusing sometimes takes a while” and the table of Energy cost.</li> <li>How is recycling related to managing Earth’s non-renewable resources?</li> <li><b>PE: HS-ESS3-2</b></li> </ul> |
|  | 1 | 120      | Review Your Understanding<br><b>Anchoring Phenomenon revisited</b><br>What do we do with all the dead batteries?  |  | Can students fully explain the Key Question for the chapter anchoring phenomenon: How can recycling or reusing lithium in lithium-ion batteries reduce the impact of mining on the environment?   |
|  | 1 | 121      | Summing Up  |  | Summative Assessment<br><b>PE: HS-ESS3-1, PE: HS-ESS3-2</b>   |

## Chapter 10: Natural Hazards

| Date | Duration Time / No. of periods | Activity number(s) | Notes   | Lab / Practical activity | Formative or Summative Assessment   |
|------|--------------------------------|--------------------|---|--------------------------|---|
|      | 1                              | 122                | <b>Anchoring Phenomenon:</b> Weather Whiplash<br><br><b>Key Question (KQ):</b> What influences the frequency and extremity of weather events?<br><br><b>Vocab:</b> weather whiplash, flood, drought   |                          | <ul style="list-style-type: none"> <li>What do your students already know about the topic?</li> <li>Are there any gaps or misconceptions?</li> <li>Identify a weather whiplash event, either from the reading or from your personal experience.</li> </ul>      |
|      | 1                              | 123                | <b>KQ:</b> How can Earth's natural hazards be classified?<br><br><b>Vocab:</b> natural hazards, natural disaster, eruption, lahars, fluvial flooding, levees, stopbanks, blizzards, avalanches, cyclone, typhoon, hurricane, storm surge, tsunami, sea walls, earthquakes |                          | <ul style="list-style-type: none"> <li>What is the difference between a natural hazard and a natural disaster?</li> <li>Identify a natural hazard in your home area and list at least 2 steps that can be taken to reduce the risk from this hazard.</li> </ul> |
|      | 2                              | 124                | <b>KQ:</b> What are some factors influencing the impact of natural hazards?<br><br><b>Vocab:</b> natural features, magnitude, frequency, level of development, preparedness, accessibility  |                          | <ul style="list-style-type: none"> <li>Identify a natural hazard and then describe a natural feature that can impact effects of that hazard.</li> </ul>   |
|      | 1                              | 125                | <b>KQ:</b> How is migration used as a survival response by people facing the prospect, impact or aftermath of natural hazards and disasters?<br><br><b>Vocab:</b> natural hazards, natural disasters, migration, displacement, SPI (Social Progress Index) score, atoll   |                          | <ul style="list-style-type: none"> <li>Suggest at least two reasons why displaced people may not return to their homeland after a hazard has displaced them.</li> </ul>   |
|      | 1                              | 126                | <b>KQ:</b> How is the likelihood of increasing frequency and severity of droughts influencing decision-making and behavior in human populations?<br><br><b>Vocab:</b> mega drought  |                          | <ul style="list-style-type: none"> <li>How is the drought in the western US likely to impact the people that live there?</li> <li><b>PE:</b> HS-ESS3-1</li> </ul>   |

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|  | 1 | 127 | <b>KQ:</b> How can forecasting and preparing for drought reduce the impact of its effect?<br><b>Vocab:</b> creeping natural hazard  |  | <ul style="list-style-type: none"> <li>Identify at least three actions that could mitigate the effects of a drought.</li> <li><b>PE:</b> HS-ESS3-1</li> </ul>            |
|  | 2 | 128 | <b>KQ:</b> What is the impact of wildfires, locally and globally?<br><b>Vocab:</b> wildfires, deforestation, tundra fires   |  | <ul style="list-style-type: none"> <li>Describe the relationship between wildfires, climate change and human activity</li> </ul>   |
|  | 1 | 129 | <b>KQ:</b> How does the 2021 Louisiana flooding help us understand the link between extreme weather events, a changing climate, and future migrational shifts?<br><b>Vocab:</b> climate change, fluvial floods, pluvial flood |  | <ul style="list-style-type: none"> <li>Use evidence to identify actions that could lessen the impact of floods in the future.</li> <li><b>PE:</b> HS-ESS3-1</li> </ul>   |
|  | 1 | 130 | Review Your Understanding<br><b>Anchoring Phenomenon revisited</b><br>Weather Whiplash  |  | Can students fully explain the Key Question for the chapter anchoring phenomenon: What influences the frequency and extremity of weather events?<br><b>PE:</b> HS-ESS3-1 |
|  | 1 | 131 | Summing Up  |  | Summative Assessment<br><b>PE:</b> HS-ESS3-1   |

## Chapter 11: Human Impacts on Earth Systems

| Date | Duration Time / No. of periods | Activity number(s) | Notes   | Lab / Practical activity | Formative or Summative Assessment  |
|------|--------------------------------|--------------------|---|--------------------------|--|
|      | 1                              | 132                | <b>Anchoring Phenomenon:</b> Room for More<br><b>Key Question (KQ):</b> How can our Earth and its resources sustain more people?  |                          | <ul style="list-style-type: none"> <li>What do your students already know about the topic?</li> <li>Are there any gaps or misconceptions?</li> </ul>   |
|      | 1                              | 133                | <b>KQ:</b> What ecosystem services do humans depend on?<br><b>Vocab:</b> resources, minerals, food, processes, purification, biodiversity                                       |                          | <ul style="list-style-type: none"> <li>What are the four ecosystem services that we rely on?</li> <li>Give an example of each.</li> <li><b>PE:</b> HS-ESS3-3</li> </ul>  |
|      | 2                              | 134<br>6 & 7       | <b>KQ:</b> How can human sustainability be used to manage finite resources, in the face of a continually growing population?<br><b>Vocab:</b> sustainability, longevity         |                          | <ul style="list-style-type: none"> <li>How would an equation that predicts global population be different from an equation that predicts country's population?</li> <li>How does resource use align with population?</li> </ul>                              |
|      | 1                              | 135                | <b>KQ:</b> What impact has human activity had on ocean environments?  |                          | <ul style="list-style-type: none"> <li>Summarize the key impacts the human population has had on ocean environments?</li> </ul>  |
|      | 1                              | 136                | <b>KQ:</b> How can fishing be managed so that fish stocks are maintained?<br><b>Vocab:</b> bycatch, maximum sustainable yield (MSY)   |                          | <ul style="list-style-type: none"> <li>What information is needed to calculate the MSY?</li> <li>What happens if this information is incorrect?</li> <li><b>PE:</b> HS-ESS3-4</li> </ul>   |
|      | 2                              | 137                | <b>KQ:</b> How has plastic waste from human activity impacted the environment, and in what ways can it be remediated?<br><b>Vocab:</b> ocean gyres, micro plastic, nano plastic |                          | <ul style="list-style-type: none"> <li>What are ocean gyres? Why are they important?</li> <li>Why is plastic so durable?</li> <li>How effective is recycling?</li> <li>How effective are plastic "eating" bacteria?</li> <li><b>PE:</b> HS-ESS3-4</li> </ul> |
|      | 1                              | 138                | <b>KQ:</b> What impact do oil spills have on the environment, and how can we prevent or reverse this impact?  |                          | <ul style="list-style-type: none"> <li>Why is petroleum or crude oil important?</li> <li>What factors does a cost analysis evaluate?</li> <li>Is it possible to prevent all oil spills?</li> </ul>   |

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|  |   |     |  |  | <ul style="list-style-type: none"> <li>Is it practical to implement the prevention strategies?</li> <li>PE: HS-ESS3-4</li> </ul>  |
|  | 1 | 139 | <b>KQ:</b> How has human activity impacted the land?<br><b>Vocab:</b> desertification, leaching, salinization, urban sprawl                              |  | <ul style="list-style-type: none"> <li>Identify three potential risks to the land from agricultural practices.</li> </ul>   |
|  | 1 | 140 | <b>KQ:</b> How can we use new technology to help track and reduce deforestation?<br><b>Vocab:</b> deforestation, primary forests, plantation forests     |  | <ul style="list-style-type: none"> <li>In what ways do second-growth temperate forests differ from the primary forests?</li> <li>What is Global Forest Watch 2.0?</li> <li>PE: HS-ESS3-4</li> </ul>                                 |
|  | 2 | 141 | <b>KQ:</b> What solutions can be used so that all humans, our activities, and wildlife have enough room to coexist?<br><b>Vocab:</b> arable              |  | <ul style="list-style-type: none"> <li>What are the potential benefits of increasing the human population density in cities?</li> <li>What are the potential costs of increasing the human population density in cities?</li> </ul> |
|  | 1 | 142 | <b>KQ:</b> How does urbanization impact the environment?<br><b>Vocab:</b> urban area   |  | <ul style="list-style-type: none"> <li>What are the potential benefits of increasing the human population density in cities?</li> <li>What are the potential costs of increasing the human population density in cities?</li> </ul> |
|  | 1 | 143 | <b>KQ:</b> How can new technologies help to remediate contaminated sites?<br><b>Vocab:</b> remediation, <i>in situ</i> , <i>ex situ</i> , bioremediation |  | <ul style="list-style-type: none"> <li>Describe one technology that could be used in remediation.</li> </ul>  |
|  | 2 | 144 | <b>KQ:</b> What are the advantages and disadvantages of different remediation technologies?  |  | <ul style="list-style-type: none"> <li>Select one remediation technique, describe how it is used.</li> <li>Identify its benefits and limitations.</li> <li>PE: HS-ESS3-4</li> </ul>   |
|  | 1 | 145 | Review Your Understanding<br><b>Anchoring Phenomenon revisited</b><br>Room for More?   |  | Can students fully explain the Key Question for the chapter anchoring phenomenon: How can our Earth and its resources sustain more people?  |
|  | 1 | 146 | Summing Up   |  | Summative Assessment<br>PE: HS-ESS3-3   |

## Chapter 12: Global Climate Change

| Date | Duration Time / No. of periods | Activity number(s) | Notes  | Lab / Practical activity                              | Formative or Summative Assessment   |
|------|--------------------------------|--------------------|--|---|---|
|      | 1                              | 147                | <b>Anchoring Phenomenon:</b> Seashells by the sea shore<br><b>Key Question (KQ):</b> Why are seashells getting thinner and more fragile?   |   | <ul style="list-style-type: none"> <li>What do your students already know about the topic?</li> <li>Are there any gaps or misconceptions?</li> </ul>  |
|      | 1                              | 148<br>2           | <b>KQ:</b> How can scientists use climate models to predict long term climate patterns?<br><b>Vocab:</b> climate, model, climate models  |   | <ul style="list-style-type: none"> <li>What are the main purposes of climate modeling?</li> </ul>   |
|      | 1                              | 149<br>2           | <b>KQ:</b> How have climate models changed over time to allow scientists to make better predictions?<br><b>Vocab:</b> aerosols, cryosphere, biogeochemical cycles, biosphere, human activity, greenhouse gases, volcanic eruptions |   | <ul style="list-style-type: none"> <li>Select one component of the climate model and determine its significance on climate change. Report to the class.</li> </ul>  |
|      | 1                              | 150<br>2           | <b>KQ:</b> How can climate models prepare us for future events?<br><b>Vocab:</b> sea level   |   | <ul style="list-style-type: none"> <li>What impact did the volcanoes have on the climate?</li> <li>What two factors are causing the sea level to rise?</li> <li><b>PE:</b> HS-ESS3-5</li> </ul>   |
|      | 2                              | 151<br>3 & 10      | <b>KQ:</b> How does the increasing amount of carbon dioxide in the atmosphere affect the pH of the ocean?<br><b>Vocab:</b> ocean acidification, carbonate ion, bicarbonate ion   | <b>Inv 12.1:</b> Investigating how dry ice affects pH | <ul style="list-style-type: none"> <li>Are the oceans acidic or basic?</li> <li>How is the pH of the oceans been changing over the last 20 years?</li> <li>Develop an evidence-based statement linking dissolved CO<sub>2</sub> and the pH of the ocean.</li> <li><b>PE:</b> HS-ESS3-6</li> </ul> |
|      | 1                              | 152                | <b>KQ:</b> How is climate change contributing to shifts in the distribution, behavior and viability of plant and animal species?   |   | <ul style="list-style-type: none"> <li>Select one of the three species pictured on the bottom of page 307 and explain how the observed change in population reflects the change in climate.</li> </ul>  |



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|  |   |     | <b>Vocab:</b> vector-borne diseases, saltwater intrusion   |  |   |
|  | 1 | 153 | <b>KQ:</b> How will climate change influence where crops can be grown, as well as the impact of pest and diseases on them?<br><b>Vocab:</b> horticulture |  | <ul style="list-style-type: none"> <li>• What are the possible effects on the range of crop plants resulting from a rise in global temperature?</li> <li>• What are the possible effects on the range of crop pests resulting from a rise in global temperature?</li> </ul> |
|  | 1 | 154 | <b>KQ:</b> How can technology and innovation help slow climate change?<br><b>Vocab:</b> greenhouse gas, carbon capture                                   |  | <ul style="list-style-type: none"> <li>• Compare and contrast two of the carbon capture methods.</li> </ul>   |
|  | 1 | 155 | Review Your Understanding<br><b>Anchoring Phenomenon revisited</b><br>Seashells by the sea shore   |  | Can students fully explain the Key Question for the chapter anchoring phenomenon: Why are seashells getting thinner and more fragile?   |
|  | 1 | 156 | Summing Up   |  | Summative Assessment<br>PE: HS-ESS3-5, PE: HS-ESS3-6  |