

HMH Earth & Space Science: Embedded Labs

Unit	Lesson	Title	Description	Materials	Lab Minutes
1	1	Observing the Sky	Students will design, test, and revise a method for observing an aspect of the sky, such as weather or astronomical objects.	<ul style="list-style-type: none"> ● Binoculars (optional) ● Telescope (optional) 	90
1	1	What's Before Your Eyes?	Students will make and record observations about multiple samples of salt solution.	<ul style="list-style-type: none"> ● Distilled water ● Plastic wrap ● Salt ● Beaker ● 100 mL graduated cylinder ● Hot plate ● Petri dish ● Rubber band ● Stirring rod 	90
1	2	GPS and Earth's Circumference	Students will use angles obtained from GPS measurements to estimate Earth's size.	<ul style="list-style-type: none"> ● Masking tape ● Calculator ● GPS receiver (or smartphone with a GPS app) ● Local map (optional) ● Magnetic compass (optional) ● Tape measure (optional) 	60
1	2	Map Projections	Students will make and compare shapes from multiple map projections.	<ul style="list-style-type: none"> ● Marker- fine-tip ● White paper ● Flashlight ● Bowl 	30
1	2	Contour Maps: Island Construction	Students will build a scale model and identify contour intervals and landscape features based on a map.	<ul style="list-style-type: none"> ● Basin , flat, 8 cm deep ● Knife ● White paper ● Topographic map (in lab printout) ● Modeling clay ● Dowel or rolling pan ● Metric ruler ● Scissors ● Water 	90
1	2	Remote Sensing	Students will model a landscape with distinct features, determine elevation of surface features of the model using a probe and map the topography of a model landscape.	<ul style="list-style-type: none"> ● Aluminum foil ● Colored pencils ● Graph paper ● Shoebox ● Clear tape ● Modeling clay ● Meter stick ● Metric ruler ● Scissors 	90
2	1	Energy Transfer	Students will measure the results of conduction between metal and water	<ul style="list-style-type: none"> ● Balance ● Plastic sandwich bags ● Cup, plastic and foam ● Paper towels ● Water ● Double-sided tape 	90

				<ul style="list-style-type: none"> ● Timer ● Freezer ● 250 mL graduated cylinder ● Screws ● Thermometer 	
2	1	Energy of the Sun	Students will estimate the sun's energy output and evaluate the differences between known values and experimental values.	<ul style="list-style-type: none"> ● Aluminum foil ● Modeling clay ● Black paint or marker ● Masking tape ● Desk lamp ● Glass jar with lid ● Metric ruler ● Thermometer 	90
2	1	Light and Latitude	Students will explore how latitude impacts the intensity of solar radiation.	<ul style="list-style-type: none"> ● White paper 	30
2	1	Density Currents	Students will model the movement of a fluid, such as ocean water, due to differences in density.	<ul style="list-style-type: none"> ● Clear plastic pan at least 5 cm deep ● Yellow and blue food coloring ● Water, warm ● Paper ● Colored pencils ● Salt (optional) 	45
2	2	Growing Crystals	Students will observe the formation of a crystal, identify variables that affect crystal growth and evaluate the shapes of crystals.	<ul style="list-style-type: none"> ● Balance ● 250 mL beaker ● Ammonium alum ● Distilled water ● Marking pencil ● Filter paper ● Paper towel ● Masking tape ● Thread ● Seed crystals of ammonium alum ● Wood splint ● 250 mL graduated cylinder ● Hot plate ● Graph paper ● Scissors ● Stirring rod 	45
2	2	Mineral Identification	Students will observe, describe, and compare the properties of minerals and identify a set of minerals by their properties.	<ul style="list-style-type: none"> ● Bar magnet ● Hydrochloric acid solution (<10%) ● Glass plate ● Mineral samples: biotite, calcite, galena, gypsum, halite, hematite, magnetite, muscovite, olivine, orthoclase, pyrite, quartz, and talc ● Penny ● Nail ● Streak plate 	45
2	3	Classification of Rocks	Students identify igneous, sedimentary, and metamorphic rocks, and compare and contrast their features.	<ul style="list-style-type: none"> ● Hydrochloric acid (10% dilute) ● Hand lens ● Medicine dropper ● Rock samples 	90

2	3	Magma in Earth's Crust	Students model magma rising through Earth's crust from the asthenosphere, observe how pressure affects magma's ability to rise to the surface, and identify features formed by solidified magma within Earth's crust.	<ul style="list-style-type: none"> ● Chisel ● Plaster of Paris ● Plastic container 20 x 30 x 15 cm ● Hammer ● Oven mitts ● Cloth towel 	45
2	4	The Blue-Green Ocean	Students will predict how the amount of daylight will affect the growth of phytoplankton and the color of water.	<ul style="list-style-type: none"> ● Timer ● Cardboard box ● Grass ● Leaves ● Hay ● Construction paper ● Water ● Glass jars ● Grow lights ● Video or still camera (optional) 	45
2	4	A Simple Model	Students explore initial conditions, steady state and influx/outflux in an ocean/atmosphere model.	<ul style="list-style-type: none"> ● Large piece of paper ● Marker ● Pennies ● Clear plastic pan ● Yellow and blue food coloring ● Water ● Paper ● Colored pencils ● Salt (optional) 	45
2	4	Modeling a Biogeochemical Cycle	Students will design a model to show chemical cycling among Earth's spheres.	<ul style="list-style-type: none"> ● Paper ● Vinegar ● Paper cups ● pH strips ● Potting soil ● Sand ● Crushed limestone ● Coffee filters ● Grease pencil ● Silt ● Timer ● 500 mL beaker 	90
3	1	New Light: Criteria and Constraints	Students rank criteria by importance for entrance lighting, including the cost, effect on wildlife, etc.	<ul style="list-style-type: none"> ● Pencil ● Sticky notes 	30
3	1	Practice Run	Students use coins to explore iteration.	<ul style="list-style-type: none"> ● Coins 	20
3	1	Brightness and Color	Students compare light bulbs in terms of energy use and environmental impact.	<ul style="list-style-type: none"> ● Light bulbs ● Lamps (4) ● LED light bulbs (800 lumens-daylight and warm light) ● 60 W incandescent light bulb ● 100 W incandescent light bulb ● Photometer 	45
3	2	Copper Recovery	Students recover copper from an aqueous solution, and explain how the chemical reaction that occurs between	<ul style="list-style-type: none"> ● Balance ● 400 mL beaker ● Copper sulfate ● Water 	45

			the copper sulfate solution and the iron produces solid copper metal.	<ul style="list-style-type: none"> ● 100 mL graduated cylinder ● Hand lens ● Nails ● Stirring rod, glass ● Tongs 	
3	2	Reclamation	Students explore restoration and reclamation of land using gelatin.	<ul style="list-style-type: none"> ● Small bowl ● Gelatin dessert cup ● Plastic spoon 	30
3	2	Investigating Ore Deposits	Students model ore exploration, improve their methods, and evaluate their model.	<ul style="list-style-type: none"> ● Wooden block ● Calculator ● Coins ● Pizza box, unused ● Door key ● Duct tape ● Graph paper ● Fine point marker ● Steel magnet ● Paper clips ● Foam block ● Plastic objects ● Metric ruler ● Stud finder 	45
3	3	Solar Cooker	Students design and build a solar cooker, test the solar cooker, and analyze results to identify ways that the design could be improved.	<ul style="list-style-type: none"> ● Cereal bowls ● Timer ● Plastic containers with lids ● Aluminum foil ● Small plastic bags ● Cardboard or poster board ● Lack construction paper ● White construction paper ● Drawing paper ● Flat black paint ● Foam cups ● Plastic foam insulation ● Plastic wrap ● Shoebox ● Soda can ● Straws ● Masking or duct tape ● Water ● Measuring cup ● Mirror ● Scissors ● Small pieces of food (marshmallows, apple slices, bell peppers) ● Thermometer 	90
3	3	Generation of Natural Gas from Biomass	Students build a waste material digester to produce and gather methane gas, and research the practicality of methane as a fuel in the agriculture industry and other industries.	<ul style="list-style-type: none"> ● 250 mL beaker ● Beans ● 2 L plastic bottle with cap ● Candle ● Litmus paper ● Marking pen ● Matches ● Silicone caulk or modeling clay 	45

				<ul style="list-style-type: none"> ● Starter bacteria culture of anaerobically decayed organic material ● Distilled water ● 50 mL glass beaker ● Hose or aquarium tubing ● Nail 	
3	3	Oil Well	Students model the drilling process used to extract oil from underground.	<ul style="list-style-type: none"> ● Beaker ● Modeling clay ● Funnel ● Gravel ● Sand ● Straws ● Plastic tubing ● Water ● Food coloring 	45
4	1	Simulation of Nuclear Decay	Students simulate nuclear decay, generate and analyze data, and compare the results of two simulation procedures.	<ul style="list-style-type: none"> ● Colored paper strips 65 cm x 2.5 cm ● Graph paper ● Poster Board ● Tape ● Shoebox with lid ● Meter stick ● Pennies ● Scissors ● String-30 cm 	45
4	1	Modeling Impact Craters	Students analyze how mass affects the appearance of impact craters, and model the process of a comet or meteor colliding with a planet.	<ul style="list-style-type: none"> ● Balance ● Flour ● Graph paper ● Marbles of different masses ● Tempera paint powder ● Meter stick ● Aluminum pan 25 x 33 x 7.5 cm ● Ruler ● Sieve 	90
4	2	Modeling Orbits	Students use a model to study the elliptical orbits of planets.	<ul style="list-style-type: none"> ● Cork board ● Graphing calculator ● Graphing paper ● String- 16 cm ● Tape ● Push pins 	45
4	2	Moons of Jupiter	Students learn how Kepler's third law explains the orbits of the moons of Jupiter.	<ul style="list-style-type: none"> ● Calculator ● Metric ruler 	90
4	3	Earth-Sun Motion	Students design an experiment to measure the movement of Earth, analyze the effectiveness of an experimental design, and demonstrate how shadows can be used to measure time.	<ul style="list-style-type: none"> ● Wooden board- 20 x 30 cm ● Timer ● Magnetic compass ● Dowel 30 cm x 0.64 diameter ● Lined paper ● Masking tape ● Metric ruler ● Scissors 	45

4	3	Positions of Sunrise and Sunset	Students collect and analyze data describing the positions of sunrise and sunset, and then make predictions for future months.	<ul style="list-style-type: none"> • Magnetic compass • Glue • Paper • Graphing paper • Poster Board • Pipe cleaner • Scissors 	45
5	1	Modeling Parallax	Students use objects around them to model and observe parallax.	<ul style="list-style-type: none"> • Thread • Masking tape • Red paper plates • Blue paper plates • Ladder • Metric ruler • Scissors 	10
5	1	Blackbody Radiation	Students view the colors and brightnesses produced by incandescent light bulb filaments as they vary the temperature.	<ul style="list-style-type: none"> • Electric lamp • 100 W incandescent light bulb • 50 W incandescent light bulb 	45
5	1	Make and Use a Spectroscope	Students make a simple spectroscope and use it to observe various light sources.	<ul style="list-style-type: none"> • Flashlight • Incandescent light bulb • Aluminum foil • Cardboard tube • Colored pencils • Index card • Candle • Diffraction grating, mounted, 1 x 2 cm • Projector light • Scissors • Light, sodium vapor 	45
5	2	Modeling Fusion	Students use coins to model the process of nuclear fusion.	<ul style="list-style-type: none"> • Coins • Wax pencil 	30
5	2	Thermal Spectra	Students use household objects to investigate the relationships among energy, color, and temperature.	<ul style="list-style-type: none"> • D- cell batteries • Wire, insulated, stripped at each end • Light bulb- flashlight size 	30
5	3	It's a Long Way to Neptune	Students convert and apply data to create a model of the solar system and relative orbital positions of the planets, and create an accurate scale representation of the solar system.	<ul style="list-style-type: none"> • Calculator • Paper tape • Meter stick 	45
5	4	Modeling the Expanding Universe	Students model the expansion of the universe in two different ways.	<ul style="list-style-type: none"> • Binder clip • Balloon • Marker • Thick rubber band • String • Metric ruler • Scissors 	30
6	1	Liquid and Solid Cores	Students model and investigate solid and liquid cores.	<ul style="list-style-type: none"> • Small bowl • Gelatin dessert cup • Plastic spoon 	15

6	1	Modeling Earthquake Waves	Students use a spring toy to model earthquake waves and observe their behavior.	<ul style="list-style-type: none"> ● Spring toy 	30
6	2	Where do Earthquakes Happen?	Students collect data and identify patterns in the occurrence of earthquakes.	<ul style="list-style-type: none"> ● Markers, assorted colors 	90
6	2	Eggshell Tectonics	Students model Earth's tectonic plates using a hard-boiled egg and investigate plate movements using the model.	<ul style="list-style-type: none"> ● Plastic knife ● Hard-boiled egg ● Markers ● Napkin (optional) ● Paper plate ● Wax paper (optional) 	45
6	3	Earthquakes and Subduction Boundaries	Students construct profiles across two subduction zones and compare and contrast the behavior of two subducting plates.	<ul style="list-style-type: none"> ● Graph paper 	45
6	3	Design a Plate Boundary	Students examine different static and dynamic ways to model plate boundaries, and then choose one concept to implement, one to modify, or one to develop their own.	<ul style="list-style-type: none"> ● Newspaper ● Sticky notes (2 colors) ● Wax paper ● Clay (2 colors) ● Plastic knife ● Paper ● Marking pens ● Toothpicks ● Clear tape ● Rolling pin (optional) ● Ruler ● Scissors 	90
6	4	Explore Volcanoes	Students develop and design a method to explore and model volcanoes.	<ul style="list-style-type: none"> ● Beakers ● Heat resistant blocks ● Cell Phone camera ● Cooking pot ● Graduated cylinder ● Hot plate ● Newspaper ● Grease pencil ● Liquid soap ● Fine sand ● Hot water bath ● Cold water bath ● Straws ● Plastic plates ● Mixing bowls ● Craft sticks ● Spatula ● Timer ● Tablespoons 	90
6	4	Earthquake-Safe Buildings	Students will investigate the effects of an earthquake on an unreinforced building and a reinforced building.	<ul style="list-style-type: none"> ● Building blocks ● Rubber band 	15
6	4	Finding and Epicenter	Students analyze P-waves and S-waves to determine the distance from a city to the epicenter of an	<ul style="list-style-type: none"> ● Calculator ● Drawing compass ● Ruler 	45

			earthquake, and determine the location of an earthquake epicenter using the distance from three different cities to the epicenter.		
7	1	Weathering of Rock Materials	Students observe and measure some effects of chemical weathering on rock samples and relate observations to chemical weathering in nature.	<ul style="list-style-type: none"> ● Balance ● 400 mL beaker ● 50 mL beaker ● 100 mL graduated cylinder ● Limestone chips ● Water ● Marking Pen ● Rock chips - 2 types ● Vinegar ● Strainer 	90
7	1	Soil Chemistry	Students test the acidity of the soil samples and identify the composition of soil samples.	<ul style="list-style-type: none"> ● Dropper ● Ammonia solution ● Hydrochloric acid, dilute ● pH paper ● Subsoil sample ● Topsoil sample ● Water ● Cork stoppers ● Test tubes ● Test tube rack 	45
7	1	Modeling Surface Processes	Students design a model of surface processes such as sorting of sediments by water, controlling soil erosion, or determining the effects of wind and waves on a coastline.	<ul style="list-style-type: none"> ● Plastic buckets ● Timer ● Hair dryer ● Meter stick ● Modeling clay ● Earth materials: fine sand, coarse sand, gravel, pebbles, soil ● Moss ● Tubing and connectors ● Bottles (1 or 2L) ● Stream table ● Watering can or spray bottle 	90
7	2	Slipping Ice	Students model the formation of a glacier using snow or shaved ice.	<ul style="list-style-type: none"> ● Snow or shaved ice ● Tray ● Weight (over 3 kg) 	30
7	2	Modeling Desert Winds	Students investigate how wind moves sand and gravel to form various landforms.	<ul style="list-style-type: none"> ● Electric fan ● Filter mask ● Dust, sand, and gravel 	30
7	3	Model Rising and Sinking	Students model rising and sinking by placing weights on a floating wooden block.	<ul style="list-style-type: none"> ● 1 L beaker ● Wooden block ● Small mass (about 1 g) ● Grease pencils 	45
7	3	Model Forces	Students model different types of stresses on rock and make observations of the effects.	<ul style="list-style-type: none"> ● Gloves ● Putty- frozen ● Putty- warm 	45
7	3	Model Faulting and Folding	Students will construct models of different fault and fold structures, and	<ul style="list-style-type: none"> ● Shoebox ● Wax paper ● Tape 	45

			evaluate differences in tectonic features.	<ul style="list-style-type: none"> ● Board- 30 x 30 x 5 cm ● Newspaper ● Sand ● Modeling clay ● Plastic Knife ● Scissors 	
8	1	Water Solubility	Students compare the solubility of different substances.	<ul style="list-style-type: none"> ● Balance ● 600 mL beaker ● Graduated cylinder ● Flour ● Salt ● Sand ● Sugar ● Stirring rod ● Water- room temperature 	45
8	1	Water Density	Students measure the temperature and density of water and analyze the effects of temperature and salinity on the density of water.	<ul style="list-style-type: none"> ● 250 mL beaker ● Freezer (optional) ● Gloves- heat resistant ● 100 mL graduated cylinder ● Hot plate ● Modeling clay ● Red grease pencil ● Yellow grease pencil ● Metric ruler ● Plastic straw ● Salt ● Distilled water ● Scissors ● Teaspoon ● Thermometer 	90
8	1	Water and Energy	Students measure the specific heat of water.	<ul style="list-style-type: none"> ● Balance ● 100 mL plastic container ● Metal- either copper (pennies), aluminum, or iron (nails) ● Foam cups with lids ● Hot water ● Masking tape ● Weighing paper ● Stopwatch ● Test tube ● Thermometer 	45
8	2	Water and CO ₂	Students investigate the effects of temperature on the ability of dissolved gases to stay in a liquid.	<ul style="list-style-type: none"> ● 500 mL beaker ● Can of soda- warm ● Can of soda- cold ● Graph paper ● Stopwatch ● Thermometer 	45
8	2	Porosity, Permeability, and Capillarity	Students will measure the porosity, permeability, and capillarity of several particle sizes.	<ul style="list-style-type: none"> ● 400 mL beaker ● 100 mL graduated cylinder ● Metric ruler ● Coarse sand, medium sand, fine sand ● Filter paper ● Water ● Scissors 	90

				<ul style="list-style-type: none"> ● Stopwatch ● Test Tube brush ● Glass tube- 1 cm x 15 cm 	
8	2	Quality of Water	Students examine important qualities of water and how the properties of water affect them.	<ul style="list-style-type: none"> ● Soft brush ● Bucket ● Field guide to invertebrates ● Hand lens ● Shallow, white pan ● String ● Secchi disk ● Paper ● Colored pencils ● Tweezers 	45
9	1	Temperature Trends	Students will plot temperature changes with altitude on a graph.		15
9	1	Measuring Particulates	Students will measure the rate at which solid materials are deposited around your school, compare the amount of particulates in the air at different places around your school, and determine the sources of those particulates.	<ul style="list-style-type: none"> ● Microscope slides ● Compound light microscope ● Petri dish ● Marking pens ● Clear tape 	90
9	1	Curved Motion	Students will explore the Coriolis effect using a lazy Susan to model Earth's rotation.	<ul style="list-style-type: none"> ● Globe ● Lazy susan ● Ruler ● Paper plate ● Tape ● Marker 	30
9	2	Measuring Cloud Cover	Students will estimate cloud cover in units of oktas.		45
9	2	Correlating Weather Variables	Students measure and record weather variables twice every day and predict weather conditions based on collected data.	<ul style="list-style-type: none"> ● Barometer ● Magnetic compass ● Graph paper ● Thermometer 	90
9	2	Weather Forecasting	Students observe and record locations of weather fronts, and predict weather conditions based on collected data.	<ul style="list-style-type: none"> ● Daily weather maps for connective days ● Colored pencils 	90
9	2	Forecast Limitations	Students will compare predicted weather to observed weather to figure out the accuracy of their local weather forecast.	<ul style="list-style-type: none"> ● Colored pencils ● Thermometer ● Weather page from newspaper ● Weather app for phone 	60
9	3	Microclimates	Students compare weather conditions from three different areas, and relate differences in the plants and animals observed to the microclimates of the areas.	<ul style="list-style-type: none"> ● Anemometer ● Field guides ● Hand lens ● Light meter ● Rain gauge ● Thermometer, dry bulb ● Thermometer, wet bulb ● Thermometer-maximum-minimum 	45

				<ul style="list-style-type: none"> ● Wind vane 	
9	3	Comparing Climate Features	Students record, graph, and analyze temperature and precipitation data for multiple regions.	<ul style="list-style-type: none"> ● Almanac (optional) ● Graph paper 	90
9	3	Factors that Affect Climate	Students determine whether land or water absorbs heat faster, and explain how the properties of land and water affect climate.	<ul style="list-style-type: none"> ● Container ● Heat lamp ● Meter stick ● Soil ● Water ● Thermometer 	45
10	1	History in the Rocks	Students demonstrate the use of index fossils for determining relative and absolute ages.	<ul style="list-style-type: none"> ● Paper 	45
10	1	Determining the Relative Age of Rock Strata	Students model how large-scale forces change rock strata.	<ul style="list-style-type: none"> ● Scissors ● Modeling clay- 5 colors ● Clear straw ● Uncooked rice ● Thread ● Small seeds 	45
10	1	Modeling Molds and Casts	Students model how different types of fossils form.	<ul style="list-style-type: none"> ● Plastic container ● Shell, key, paper clip or coin ● Modeling clay ● Leaf ● Newspaper ● Paper ● Plaster of Paris ● Plastic spoon ● Water ● Wax paper ● Tweezers 	45
10	2	Matching Lines of Evidence	Students model the lines of evidence for the age of the Atlantic Ocean.	<ul style="list-style-type: none"> ● Calculator ● Note cards ● Paper ● Colored pencils ● Clay 	45
10	2	Build Your Own Timescale	Students make a model to show the scale of time since Earth's creation.	<ul style="list-style-type: none"> ● Meter stick ● Metric ruler ● Paper tape ● Colored pencils 	90
10	3	Glaciers and Sea Level Change	Students model the melting of an ice sheet and analyze the effects of melting ice on sea level.	<ul style="list-style-type: none"> ● Wooden bloc-k 5 x5 x 5 cm ● Pan- 30 x 40 x 10 cm ● Pebbles ● Metric ruler ● Ice block- 5 x 5 x 5 cm ● Sand ● Water 	90
10	3	Design Your Own Timeline	Students design timelines for the Cenozoic era- or longer alone- and extend them into the future.	<ul style="list-style-type: none"> ● Calculator ● Meter stick ● Metric ruler ● Paper tape ● Colored pencils 	30

11	1	Tsunami	Students model the movement of a tsunami and compare the impact of a tsunami on different types of shorelines.	<ul style="list-style-type: none"> ● Plastic container ● Meter sticks ● Corrugated cardboard, file folders or clipboards ● Masking tape ● Construction paper ● Water ● Tray (wallpaper type) ● Weights (rock, baseball, golf ball) 	45
11	1	Building a Weather Station	Students build a weather station, observe and record information, and make predictions based on the data.	<ul style="list-style-type: none"> ● Barometer ● Cloud chart ● Cardboard box ● Colored pencils ● Poster board ● Glue 	45
11	2	Ocean Acidification	Students demonstrate how increased concentrations of dissolved carbon dioxide lead to the increased acidity of water.	<ul style="list-style-type: none"> ● 200 mL beaker ● Heat source ● pH probe (optional) ● Thermometer ● Indicator solution ● Straw ● Candle and matches (optional) ● Baking soda and vinegar (optional) ● Yeast (optional) ● Salt 	45
11	2	Energy Absorption	Students test materials to determine how much energy they absorb and decide which material would work best to keep the inside of a house cool.	<ul style="list-style-type: none"> ● Metal- 4 x 4 x 1 cm ● Rubber, beige or tan, 4 x 4 x 1 cm ● Thermometers ● Timer ● Cardboard 4 x 4 x 1 cm ● Black, white, and light blue tempera paint ● Sandpaper- 4 x 4 x 1 cm ● Wood- 4 x 4 x 1 cm 	45
11	2	Design a Water Filtration System	Students design a water filtration system using an engineering design process.	<ul style="list-style-type: none"> ● Cloth or screen (optional) ● Containers ● Sand or pebbles (optional) ● Water ● Charcoal (optional) ● Alum solution, 10% ● Filter paper ● Bleach 	45

Total Possible Lab Minutes = 4,560