UNIT TITLE	CORE TOPICS (Key Concepts & Real World Contexts)	UNIT BENCHMARKS	SUGGESTED ASSESSMENT	POSSIBLE RESOURCES
Construct New Scientific and Personal Knowledge				
	KC: Scientific questions can be answered by gathering and analyzing evidence about the world. **RWC:** Any in the sections on Using Scientific Knowledge.	**I.1.MS.1:** Generate scientific questions about the world based on observation.		**Measurement tools:** balancing devices measuring tape thermometer graduated cylinder
	KC: The process of scientific investigation: test, fair test, hypothesis, evidence, observations, measurements, data, conclusion. Forms for: recording data, reporting data, tables, graphs, journals. **RWC:** In sections on Using Scientific Knowledge; also, recognizing differences between observations and inferences; recording observations and measurements of everyday phenomena.	**I.1.MS.2:** Design and conduct scientific investigations.		
	KC: Various data collection tools suitable for this level, including computers. **RWC:** Any suggested in Using Scientific Knowledge benchmarks for which students would design and/or conduct investigations.	**I.1.MS.3:** Use Tools and equipment appropriate to scientific investigations.		
	KC: Documentation: laboratory instructions; **Measurement units**: milliliters, liters, millimeter, centimeter, meter, gram. **RWC:** Conducting investigations, following or altering laboratory instructions for mixing chemicals.	**I.1.MS.4:** Use metric measurement devices to provide consistency in an investigation.		
	KC: Tools: periodicals, reference books, trade books, web sites, computer software. Forms for presenting scientific information: figures, tables, graphs. **RWC:** Library projects where research is needed.	**I.1.MS.5:** Use sources of information in support of scientific investigations.		
	KC: Purpose, procedure, observation, data, conclusion. **RWC:** Listing or creating the directions for completing a task, reporting an investigation.	**I.1.MS.6:** Write and follow procedures in the form of step-by-step instructions, formulas, flow diagrams, and sketches.		

UNIT TITLE	CORE TOPICS (Key Concepts & Real World Contexts)	UNIT BENCHMARKS	SUGGESTED ASSESSMENT	POSSIBLE RESOURCES
Reflect on the Nature, Adequacy, and Connections Across Scientific Knowledge				
	KC: Aspects of arguments such as data, evidence, sampling, alternate explanation, conclusion, inference, and observation. **RWC:** Deciding between alternate explanations or plans for solving problems; evaluating advertising claims or cases made by interest groups; evaluating sources or references.	**II.1.MS.1:** Evaluate the strengths and weaknesses of claims, arguments, or data.		
	KC: Recognizing degrees of confidence in ideas or knowledge from different sources, evaluating data, and reference sources. **RWC:** Any sections on Using Scientific Knowledge.	**II.1.MS.2:** Describe limitations in personal knowledge.		
	Thematic ideas: Systems-subsystems, feedback models, mathematical constancy, scale, conservation, structure, function, adaptation. **RWC:** Any in the sections on Using Scientific Knowledge.	**II.1.MS.3:** Show how common themes of science, mathematics, and technology apply in real-world contexts.		
	KC: Risk; benefit; side effect; advantage; disadvantage. **RWC:** Technological systems for: manufacturing, transportation, energy distribution, housing medicine (such as cloning, genetic engineering).	**II.1.MS.4:** Describe the advantages and risks of new technologies.		
	KC: Appreciation of the balance of nature and the effects organisms have on each other, including the effects humans have on the natural world. **RWC:** Any in the sections on Using Scientific Knowledge appropriate to middle school.	**II.1.MS.5:** Develop an awareness of and sensitivity to the natural world.		
	KC: Cultural contributions made in science, contributions made by people of diverse backgrounds. **RWC:** Biographies of minority and female scientists, histories of cultural contributions to science.	**II.1.MS.6:** Recognize the contributions made in science by cultures and individuals of diverse backgrounds.		

UNIT TITLE	CORE TOPICS (Key Concepts & Real World Contexts)	UNIT BENCHMARKS	SUGGESTED ASSESSMENT	POSSIBLE RESOURCES
Physical Science metrics and density				
	KC: Units of density — grams per cubic centimeter or grams per milliliter. **RWC:** Common objects and substances.	**IV.1.MS.1:** Describe and compare objects in terms of mass, volume, and density.		Measurement tools Balance Measuring cup or graduated cylinder Metric ruler.
	KC: Appropriate metric (SI) units. **RWC:** Common substances, hot and cold substances: ice, snow, cold water; hot water, steam, cold air, hot air.	**IV.1.MS.2:** Explain when length, mass, weight, density, area, volume or temperature are appropriate to describe the properties of an object or substance.		Measurement tools: Balances Spring scales Measuring cups or graduated cylinder Thermometers Metric ruler
MOTION	**KC:** Two-dimensional motion: up, down, curved path. Speed: direction, change in speed, change in direction. **RWC:** Objects in motion: thrown balls, roller coasters, cars on hills, airplanes.	**IV.3.MS.1:** Qualitatively describe and compare motion in two dimensions.		
	KC: Changes in motion and common forces: speeding up, slowing down, turning, pushing, pulling, friction, gravity, magnets. **Additional forces:** attraction, repulsion, action/reaction pair (interaction force), buoyant force. Size of change is related to strength of unbalanced force and mass of object. **RWC: Changing the direction**: changing the direction of a billiard ball; bus turning a corner. **Changing the speed:** car speeding up, a rolling ball slowing down, magnets changing the motion of objects, walking, swimming, jumping, rocket motion, objects resting on a table, tug-of-war.	**IV.3.MS.2:** Relate motion of objects to unbalanced forces in two dimensions.		
	KC: Types of simple machines: lever, pulley, screw, inclined plane, wedge, wheel and axle, gear; direction change; force advantage; speed and distance advantage. **RWC:** Objects being moved by using simple machines: wagons on inclined planes; heavy objects moved by levers; seesaw.	**IV.3.MS.5:** Design strategies for moving objects by application of forces, including the use of simple machines.		

UNIT TITLE	CORE TOPICS (Key Concepts & Real World Contexts)	UNIT BENCHMARKS	SUGGESTED ASSESSMENT	POSSIBLE RESOURCES
GEOSPHERE				
	KC: Glacial processes: ▪ climate change ▪ snow changing to ice ▪ pressure ▪ moving (advance, retreat) ▪ melting Deposits: ▪ features: hills, lakes, Great Lakes Landforms: ▪ plains ▪ deserts ▪ plateaus ▪ basins ▪ Great Lakes ▪ rivers ▪ Continental Divide ▪ mountains ▪ mountain ranges ▪ valleys Tools: ▪ relief map ▪ topographic map ▪ elevation map ▪ geological maps **RWC:** Local examples in Michigan of glacial formations: ▪ moraines ▪ kettles ▪ drumlins ▪ Great Lakes Local topography	**V.1.MS.1:** Describe and identify surface features using maps. **V.1.HS.1:** Explain the surface features of the Great Lakes region using Ice Age theory.		Relief map Topographic map Elevation map
	KC: Earth Composition: ▪ crust ▪ mantle: upper part is able to flow very slowly, ▪ core-interior at high temperature and pressure. Forces: ▪ tension ▪ compression ▪ shearing Rock cycle processes: ▪ melting, cooling, solidification (igneous rocks) ▪ intense heat and pressure creates a new	**V.1.MS.2:** Explain how rocks are formed. **V.1.HS.2:** Use the plate tectonics theory to explain features of the earth's surface and geological phenomena and describe evidence for the plate tectonics theory.		

UNIT TITLE	CORE TOPICS (Key Concepts & Real World Contexts)	UNIT BENCHMARKS	SUGGESTED ASSESSMENT	POSSIBLE RESOURCES
	class of rocks (metamorphic rocks) ▪ weathering, erosion, deposition, and cementation of sediments from igneous, metamorphic, or sedimentary rocks create a new class of rocks (sedimentary rocks) Plates: ▪ continental crust ▪ oceanic crust Features: ▪ faults ▪ trenches ▪ mid-ocean ridges ▪ folded mountains ▪ hot spots, volcanoes Related actions: ▪ earthquakes ▪ volcanic activity ▪ seafloor spreading ▪ mountain building ▪ convection in mantle Evidence of "continental drift" ▪ physical fit of continents ▪ fossil evidence ▪ glacial evidence ▪ measurements of movement ▪ rock layer sequence **RWC:** Recent patterns of earthquake and volcanic activities; maps showing the direction and movement of major plates and associated earthquake and volcanic activity; compressional boundaries—folded mountains, thrust faults, trenches (subduction zones) lines of volcanoes (e.g., Pacific "ring of fire"); tensional boundaries—midocean ridges, rift valleys; shearing boundaries—lateral movement producing faults (e.g., San Andreas Fault)			

Geosphere

All students will analyze the effects of technology on earth surface and resources.

UNIT TITLE	CORE TOPICS (Key Concepts & Real World Contexts)	UNIT BENCHMARKS	SUGGESTED ASSESSMENT	POSSIBLE RESOURCES
	KC: Valuable materials-minerals, metallic ores, iron, copper, aluminum fuels. Types of resources-renewable, nonrenewable. Conservation, limits, recycling, costs for developing more remote supplies. Manufacturing, refining, mining, recycling processes-melting, shredding, dissolving. **RWC:** Manufacturing processes-steel mills, auto assembly lines, paper making; local recycling center for materials, such as glass, plastic, aluminum steel cans, motor oil. Examples of technical and social means for slowing the depletion of earth's resources, such as developing more fuel-efficient cars and mandating their use, disposal in landfills and incinerators.	**V.1.MS.3:** Explain how technology changes the surface of the earth. **V.1.HS.3:** Explain how common objects are made from earth materials and why earth materials are conserved and recycled.		
	KC: Understanding of limitations of knowledge and technology (see R h-2), side effects of resource use (see PME h-1, risk/benefit analysis). Also see R h-5 (new technologies), EAW h-4 (air pollution). **RWC:** Industries for mining, energy production, manufacturing, transportation, housing. Resources including fossil fuels, metals, wood, water.	**V1.HS.4:** Evaluate alternative long-range plans for resource use and by-product disposal in terms of environmental and economic impact.		

UNIT TITLE	CORE TOPICS (Key Concepts & Real World Contexts)	UNIT BENCHMARKS	SUGGESTED ASSESSMENT	POSSIBLE RESOURCES
Hydrosphere				
	All students will describe how water moves			
	KC: Liquid water forms: ▪ lakes ▪ rivers ▪ oceans ▪ springs ▪ seas Frozen water forms: ▪ continental glacier ▪ valley glacier ▪ snow on mountains ▪ polar cap ▪ icebergs Gaseous water in atmosphere. **RWC:** Examples of all of the above. **KC:** Water path: ▪ surface fun-off ▪ creeks ▪ streams ▪ wetlands ▪ rivers ▪ Great Lakes Water cycle Ground water **RWC:** Maps showing: ▪ streams ▪ lakes ▪ rivers ▪ oceans Examples of direction of travel by water in rivers and lakes. Investigations of river and lake temperatures. Examples of groundwater: springs; wells; water soaking into the ground.	**V.2.MS.1:** Use maps of the earth to locate water in its various forms and describe conditions under which they exist.		
	KC: Drainage basins, divides, reservoirs, tributaries, run-off. **RWC:** Local and regional watersheds, Great Lakes Basin, Continental Divide	**V.2.MS.2:** Describe how surface water in Michigan reaches the ocean and returns. **V.2.HS.1:** Identify and describe regional watersheds.		Maps

UNIT TITLE	CORE TOPICS (Key Concepts & Real World Contexts)	UNIT BENCHMARKS	SUGGESTED ASSESSMENT	POSSIBLE RESOURCES
All students will analyze the interaction of human activities with the hydrosphere.				
	KC: Groundwater: water table; spring; porous; saturate; filtration. Sources—snowmelt and rainfall. **RWC:** Examples of groundwater, including springs, artesian wells, seeps, and water soaking into the ground.	**V.2.MS.3:** Explain how water exists below the earth's surface and how it is replenished.		
	KC: Human activities: agriculture, fishing, manufacturing, energy production. Quantity of water rate of use, urbanization. Ocean oil spills, garbage, global warming, marine life. Freshwater pollution industrial waste disposal, agricultural run-off, herbicides, pesticides, sewage, acid rain, nutrient levels. Ground water landfills, leaching, disposal of toxic wastes. Purification technology filtering, chlorination. Limits to natural resources. **RWC:** Examples of local and regional human activities that have measurable effects on water, including farming, industry, sewage disposal, toxic waste disposal.	**V.2.HS.2:** Describe how human activities affect the quality of water in the hydrosphere.		

UNIT TITLE	CORE TOPICS (Key Concepts & Real World Contexts)	UNIT BENCHMARKS	SUGGESTED ASSESSMENT	POSSIBLE RESOURCES
Weather				
All students will investigate and describe what makes up weather and how it changes from day to day, from season to season, and over long periods of time.				
ATMOSPHERE AND WEATHER	**KC:** Average yearly temperatures; ice ages, volcanic dust in atmosphere, greenhouse effect, global air circulation, effects of latitude, effects of landforms, ocean currents. **RWC:** Evidence of short-term climate changes: catastrophic volcanic eruptions; impact sunspot activity. Evidence of long-term climate changes, global warming, El Nino, La Nina. **KC:** Weather patterns: ▪ cold front ▪ warm front ▪ stationary front ▪ air mass ▪ humidity **RWC:** Sudden temperature, pressure, and cloud formation changes; records, charts, and graphs of weather changes over period of days; lake effect snow.	**V.3.HS.1:** Explain how interactions of the atmosphere, hydrosphere and geosphere create climates and how climates change over time. **V.3.MS.1:** Explain patterns of changing weather and how they are measured.		Thermometer Rain gauge Wind direction indicator Anemometer Weather maps Satellite weather images Cloud charts Barometer
All students will explain what causes different kinds of weather.				
	KC: Weather patterns: cold front, warm front, stationary front, air mass, high and low pressure systems. Storms: thunderstorms, lightning and thunder, tornadoes, hurricanes, winds, blizzards. Water cycle buoyancy, thermal expansion, convection. See PCM m-1 (thermal expansion) and PME m-1 (density). **RWC:** Observable daily weather patterns; examples of weather reports from TV, radio, newspapers, including representations on weather maps. Reports of local weather patterns influenced by the jet stream and prevailing winds. **KC:** Composition: ▪ air ▪ molecules ▪ gas ▪ water vapor ▪ dust particles Characteristics: ▪ air pressure changes with altitude	**V.3.HS.2:** Describe patterns of air movement in the atmosphere and how they affect weather conditions. **V.3.MS.2:** Describe the composition and characteristics of the atmosphere. **V.3.HS.3:** Explain and predict general weather patterns and storms.		Weather maps, thermometer, hygrometer, barometer, anemometer, wind, vane, rain gauge, satellite and radar monitoring (see PWV h-4).

UNIT TITLE	CORE TOPICS (Key Concepts & Real World Contexts)	UNIT BENCHMARKS	SUGGESTED ASSESSMENT	POSSIBLE RESOURCES
	▪ temperature changes with altitude ▪ humidity **RWC:** Examples of characteristics of the atmosphere: ▪ water boils at different temperatures at different elevations ▪ pressurized cabins in airplanes ▪ demonstrations of air pressure Examples of airborne particulates: ▪ smoke ▪ dust ▪ pollen ▪ bacteria Effects of humidity: ▪ condensation ▪ dew on surfaces ▪ comfort level of humans **KC:** Water cycle: ▪ evaporation ▪ water vapor ▪ warm air rises ▪ cooling ▪ condensation ▪ clouds Precipitation: ▪ rain ▪ snow ▪ hail ▪ sleet ▪ freezing rain **RWC:** Aspects of the water cycle in weather: ▪ clouds ▪ precipitation ▪ evaporating puddles	**V.3.MS.3:** Explain the behavior of water in the atmosphere.		
All students will analyze relations between human activities and the atmosphere.				
	KC: Effects: ▪ breathing difficulties ▪ irritated eyes Sources (man-made): ▪ car exhaust ▪ industrial emissions ▪ acid rain **RWC:** Locations and times when air quality is poor; local sources of potential air pollution; ozone warnings.	**V.3.MS.4:** Describe health effects of polluted air.		

UNIT TITLE	CORE TOPICS (Key Concepts & Real World Contexts)	UNIT BENCHMARKS	SUGGESTED ASSESSMENT	POSSIBLE RESOURCES
	KC: Air pollution car exhaust, industrial emissions, smog. Related effects breathing problems, acid rain, global warming, deforestation, ozone depletion. See EG h-4 (resource use). **RWC:** Examples of human activities that affect the atmosphere, including use of aerosol spray cans, discharge from smoke stacks, car exhaust, burning leaves and wood in stoves and fireplaces, climate change, global warming; actions, including turning off lights, turning down heat, tuning-up cars, filling tires, driving at a consistent speed, mandating higher fuel efficiencies, energy savings from recycling.	**V.3.HS.4:** Explain the impact of human activities on the atmosphere and explain ways that individuals and society can reduce pollution.		

UNIT TITLE	CORE TOPICS (Key Concepts & Real World Contexts)	UNIT BENCHMARKS	SUGGESTED ASSESSMENT	POSSIBLE RESOURCES
Solar System, Galaxy, Universe				
All students will compare and contrast our planet and sun to other planets and star systems.				
	KC: Surface conditions: ▪ gravity ▪ atmosphere ▪ temperatures ▪ ozone Relative distances; relative sizes. Sun produces light and heat for each planet. Molecules necessary to support life: ▪ water ▪ oxygen ▪ nitrogen ▪ carbon **RWC:** Examples of local and extreme outdoor conditions on Earth vs. conditions on other planets. Exploration of planets and their satellites. **KC:** Temperatures, colors, sizes, apparent and absolute brightness; double stars. **RWC:** Observing color and brightness of stars, observing double stars.	**V.4.MS.1:** Compare the earth to other planets and moons in terms of supporting life. **V.4.HS.1:** Compare our sun to other stars.		
All students will describe and explain how objects in the solar system move.				
	KC: Orbit, rotation (spin), axis, gravity, planets, moons, rings, comets, asteroids, seasons. **Tilt of the Earth on its axis.** Direct/Indirect rays **RWC:** ▪ observations of comet motion over days and weeks ▪ length of day and year on planets ▪ changes in length of daylight and height of sun in sky ▪ changes in daily temperature patterns ▪ summer and winter solstices ▪ spring and fall equinoxes	**V.4.MS.2:** Describe, compare, and explain the motions of solar system objects. **V.HS.2:** Describe the position and motion of our solar system in our galaxy and the overall scale, structure, and age of the universe.		Telescopes, binoculars, spectroscopes.

UNIT TITLE	CORE TOPICS (Key Concepts & Real World Contexts)	UNIT BENCHMARKS	SUGGESTED ASSESSMENT	POSSIBLE RESOURCES
	KC: Stars, galaxies, Milky Way, spiral structure, speed of light, light year, travel times, big bang, red shift. **RWC:** Observations of other stars, star clusters, nebulas, and galaxies, observations of other potential planetary systems, accounts of possible travel to other star systems.			
All students will explain scientific theories as to the origin of the solar system.				
	KC: Perceived/actual movement of moon across sky; moon phases; eclipses; stars and constellations; planets; Milky Way; comets; comet tail, meteors; asteroids. The sun is the light source for all solar system objects except meteors, whose light is due to friction with the atmosphere. Emitted light vs. reflected. **RWC:** Outdoor observing of the skies using: ▪ telescopes ▪ binoculars ▪ "naked-eye" viewing Telescopic and spacecraft-based photos of: ▪ planets ▪ moons ▪ comets News reports of planetary and lunar exploration	**V.4.MS.3:** Describe and explain common observations of the night skies.		
	KC: Processes of formation coalescence from clouds of dust and gases by gravity; explosions of stars producing heavy elements; hydrogen, helium. Production of energy fusion, radiation. Planetary system may form during this process of heavy and light elements, hot interiors of earthlike planets. Age of the solar system. **RWC:** Nebulas considered to be star-forming regions, supernovas, nuclear fusion research.	**V.4.HS.3:** Explain how stars and planetary systems form and how stars produce energy.		

UNIT TITLE	CORE TOPICS (Key Concepts & Real World Contexts)	UNIT BENCHMARKS	SUGGESTED ASSESSMENT	POSSIBLE RESOURCES
All students will explain how we learn about the universe.				
	KC: Information: ▪ radiant energy ▪ radio waves ▪ light ▪ spectra ▪ color of stars ▪ moon and meteor samples. Devices: ▪ radio ▪ optical and other types of telescopes ▪ space probes ▪ satellites ▪ computer imaging/modeling Problems for investigation: geology and weather of planets and moons; origins of extraterrestrial life. **RWC:** Histories of discoveries, stories of exploration, visits to observatories and planetariums; videos showing space exploration; samples of space materials, including moon rocks and meteorites; remote sensing data; SETI (Search for Extraterrestrial Life).	**V.4.HS4:** Explain how technology and scientific inquiry have helped us learn about the universe.		

UNIT TITLE	CORE TOPICS (Key Concepts & Real World Contexts)	UNIT BENCHMARKS	SUGGESTED ASSESSMENT	POSSIBLE RESOURCES
Ecosystems				
All students will investigate and explain how communities of living things change over a period of time:				
	KC: Succession, pioneer, climate/physical conditions, introduction of new/different species, elimination of existing species, biodiversity, cataclysmic changes. **RWC:** Climax forests comprised of: ▪ maple ▪ beech ▪ conifers Effects of urban sprawl or clear cutting forests. Effects of cataclysmic changes such as the eruption of Mount St. Helen. Effects of global warming.	**III.5.HS.4:** Describe responses of an ecosystem to events that cause it to change.		
All students will analyze how humans and the environment interact:				
	KC: Common factors that influence ecosystems: ▪ pollution of ecosystems o fertilizer o insecticides o other chemicals o land management o biodiversity o sustainability o loss of habitat **RWC:** Common factors that influence ecosystems: pollution of ecosystems from—agriculture, industry, urban development.	**III.5.HS.6:** Explain the effects of agriculture and urban development on selected ecosystems.		