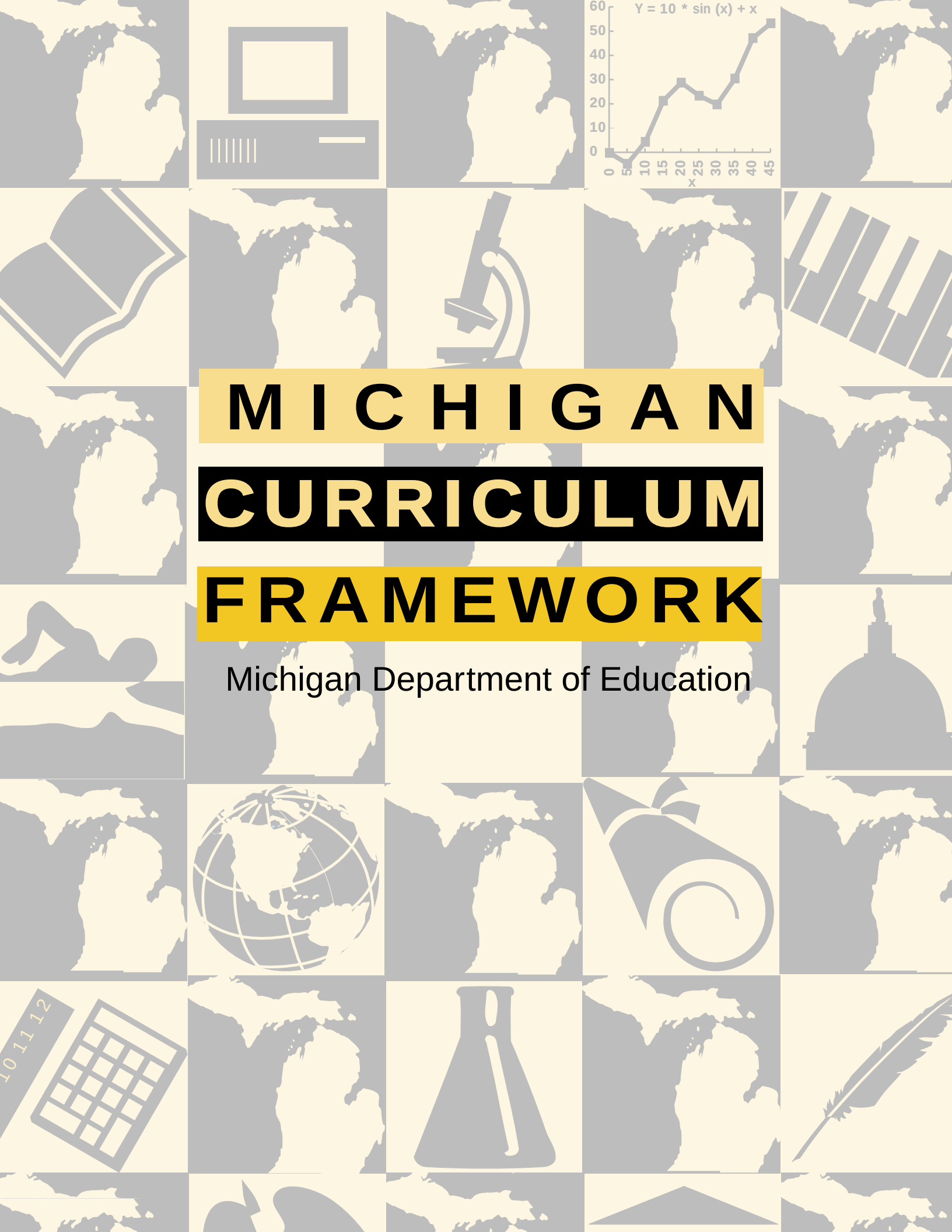

MICHIGAN CURRICULUM FRAMEWORK

Michigan Department of Education

Strand V. Using Scientific Knowledge in Earth Science

*In the earth sciences, real-world contexts are often described in terms of **systems** and **subsystems**, such as atmospheric systems, crustal systems, solar systems, or galaxies, which are useful in explaining **phenomena,** including volcanic eruptions, earthquakes, thunderstorms, and eclipses.*

Four standards are under the broad heading of Using Scientific Knowledge in Earth Science:

Standard V.1 The Geosphere
All students will describe the earth's surface; describe and explain how the earth's features change over time; and analyze effects of technology on the earth's surface and resources.

The geosphere includes earth's surface and geological processes.

Standard V.2 The Hydrosphere
All students will demonstrate where water is found on earth; describe the characteristics of water and how water moves; and analyze the interaction of human activities with the hydrosphere.

The Hydrosphere includes all forms of water. Of particular interest in Michigan is the water environment in the Great Lakes region.

Standard V.3 The Atmosphere and 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; explain what causes different kinds of weather; and analyze the relationships between human activities and the atmosphere.

Weather is composed of patterns of moisture, temperature and pressure which move through the atmosphere.

Standard V.4 The Solar System, Galaxy and Universe
All students will compare and contrast our planet and sun to other planets and star systems; describe and explain how objects in the solar system move; explain scientific theories as to the origin of the solar system; and explain how we learn about the universe.

We learn about neighboring and remote celestial bodies through our observations and exploration of space.

Note: Essays associated with each of these standards can be found in the 1991 publication *Michigan Essential Goals and Objectives for Science Education*, available from The Center for Career and Technical Education at Michigan State University, (800) 292-1606. Each essay describes how learners encounter the standard in real-world contexts, key characteristics of scientifically literate performance of the standard, and how, with successful teaching, learners' performance of the standard becomes more sophisticated over time.

Solar System, Galaxy and Universe (ES) V.4

Elementary	Middle School	High School

All students will compare and contrast our planet and sun to other planets and star systems.

1. Compare and contrast characteristics of the sun, moon and earth.

   Key concepts: Planet, star, sphere, space, solar system, larger/smaller, closer/farther, heat, light.

   Real-world contexts: Observations of the moon, earth, and safe observations of the sun.

1. Compare the earth to other planets and moons in terms of supporting life.

   Key concepts: Surface conditions—gravity, atmospheres, temperature. Relative distances, relative sizes. Sun produces the light and heat for each planet. Molecules necessary to support life—water, oxygen, nitrogen, carbon; see LC-III.1 m.2 (cell processes), LO-III.2 m.3 (photosynthesis), LEC-III.5 m.2 (light needed for energy).

   Real-world contexts: Examples of local and extreme conditions on earth vs. conditions on other planets; exploration of planets and their satellites.

1. Compare our sun to other stars.

   Key concepts: Temperatures, colors, sizes, apparent and absolute brightness; double stars.

   Real-world contexts: Observing color and brightness of stars, observing double stars.

All students will describe and explain how objects in the solar system move.

2. Describe the motion of the earth around the sun and the moon around the earth.

   Key concepts: Spin, orbit, length of day, nighttime, month, year, observed movement of the sun and stars across the sky, observed movement of the moon from day to day, calendar.

   Real-world contexts: Outdoor observing of the sun's and star's motions during the night and moon's motions over several days.

2. Describe, compare, and explain the motions of solar system objects.

   Key concepts: Orbit, rotation (spin), axis, gravity, planets, moons, comets, asteroids, seasons. Tilt of the earth on its axis, direct/indirect rays. See PMO-IV.3 m.2 (force and change in motion) and PMO-IV.3 m.3 (gravity).

   Real-world contexts: 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.

3. Describe and explain common observations of the night skies.

   Key concepts: Perceived and actual movement of the moon and planets across the sky, moon phases, eclipses, stars and constellations, planets, Milky Way, comets, comet tails, meteors. Sun is light source for all solar system objects (except meteors; friction with atmosphere), emitted light, reflected light (see PWV-IV.4 m.3 and m.4.)

   Real-world contexts: Outdoor observing of the skies, using telescopes and binoculars when available, as well as "naked-eye" viewing; viewing with robotic telescopes via the World Wide Web; telescopic and spacecraft-based photos of planets, moons, and comets; news reports of planetary and lunar exploration.

2. Describe the position and motion of our solar system in our galaxy and the overall scale, structure and age of the universe.

   Key concepts: Stars, galaxies, Milky Way, spiral structure, speed of light, light year, travel times, big bang, red shift.

   Tools: Telescopes, binoculars, *spectroscopes*

   Real-world contexts: 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

(No elementary benchmark for this strand.)	(No middle school benchmark for this strand.)	3. Explain how stars and planetary systems form and how stars produce energy. *Key concepts:* 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 systems may form during this process—heavy and light elements, hot interiors of earth-like planets. Age of the solar system. *Real-world contexts:* Nebulas considered to be star-forming regions, supernovas, nuclear fusion research.

All students will explain how we learn about the universe.

(No elementary benchmark for this strand.)	(No middle school benchmark for this strand.)	4. Explain how technology and scientific inquiry have helped us learn about the universe. *Key concepts:* 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 (see PWV-IV.4 h.4.) Problems for investigation—geology and weather of planets and moons, origins, extraterrestrial life. *Real-world contexts:* 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.