Michigan District Lutheran School Curriculum *SCOPE & SEQUENCE*

Grade Level: 8	**Curricular Area: Earth Science**			
Unit 1: **Inquiry, Reflection and Social Implications**	**Unit 2:** **Earth Systems**	**Unit 3:** **The Solid Earth**	**Unit 4:** **The Fluid Earth**	**Unit 5:** **The Earth in Space and Time**
• **Scientific Inquiry**	• **Earth Systems Overview**	• **Advanced Rock Cycle**	• **Hydrogeology**	• **The Earth in Space**
• **Scientific Reflection and Social Implications**	• **Energy in Earth Systems**	• **Interior of the Earth**	• **Oceans and Climates**	• **The Sun**
• **Conservation/Recycling**	• **Biogeochemical Cycles**	• **Plate Tectonics Theory**	• **Severe Weather**	• ***Stellar Evolution**
	• **Resources and Human Impacts on Earth Systems**	• **Earthquakes and Volcanoes**	• **Technology**	• **Earth History and Geologic Time**
				• ***Geologic Dating**
				• **Climate Change**

Michigan District Lutheran School Curriculum *OUTCOMES*

Curricular Area: Earth Science (8th grade)

Unit 1: Inquiry, Reflection, and Social Implications

Outcome 1A:
(E1) Students will understand the nature of science and demonstrate an ability to practice scientific reasoning by applying it to the design, execution, and evaluation of scientific investigations. Students will demonstrate their understanding that scientific knowledge is gathered through various forms of direct and indirect observations and the testing of this information by methods including, but not limited to, experimentation. They will be able to distinguish between types of scientific knowledge (e.g. hypotheses, laws, theories) and become aware of areas of active research in contrast to conclusions that are part of established scientific consensus. They will use their scientific knowledge to assess the costs, risks, and benefits of technological systems as they make personal choices and participate in public policy decisions. These insights will help them analyze the role science plays in society, technology, and potential career opportunities.

High School Content Expectations (HSCEs)	Content Statement	Teaching the Faith Activities (I.F.)
E1.1A Generate new questions that can be investigated in the laboratory or field. E1.1B Evaluate the uncertainties or validity of scientific conclusions using an understanding of sources of measurement error, the challenges of controlling the variables, accuracy of data analysis, logic of argument, logic of experimental design, and/or the dependence on underlying assumptions. E1.1C Conduct scientific investigations using appropriate tools and techniques(e.g. selecting an instrument that measures the desired quantity). E1.1D Identify patterns in data and relate them to theoretical models. E1.1E Describe a reason for a given conclusion using evidence from an investigation. E1.1f Predict what would happen if the variables, methods, or timing of an investigation were	Science is a way of understanding nature. Scientific research may begin by generation new scientific questions that can be answered through replicable scientific investigations that are logically developed and conducted systematically. Scientific conclusions and explanations result from careful analysis of empirical evidence and the use of logical reasoning. Some questions in science are addressed through indirect rather than direct observation, evaluating the consistency of new evidence with results predicted by models of natural processes. Results from investigations are communicated in reports that are scrutinized through a peer review process.	

changed. E1.1g Based on empirical evidence, explain and critique the reasoning used to draw a scientific conclusion or explanation. E1.1h Design and conduct a systematic scientific investigation that tests a hypothesis. Draw conclusions from data presented in charts or tables. E1.1i Distinguish between scientific explanations that are regarded as current scientific consensus and the emerging questions that active researchers investigate.		

Outcome 1B:
(E1) Students will understand the nature of science and demonstrate an ability to practice scientific reasoning by applying it to the design, execution, and evaluation of scientific investigations. Students will demonstrate their understanding that scientific knowledge is gathered through various forms of direct and indirect observations and the testing of this information by methods including, but not limited to, experimentation. They will be able to distinguish between types of scientific knowledge (e.g. hypotheses, laws, theories) and become aware of areas of active research in contrast to conclusions that are part of established scientific consensus. They will use their scientific knowledge to assess the costs, risks, and benefits of technological systems as they make personal choices and participate in public policy decisions. These insights will help them analyze the role science plays in society, technology, and potential career opportunities.

High School Content Expectations (HSCEs)	**Content Statement**	**Teaching the Faith Activities (I.F.)**
E1.2A Critique whether or not specific questions can be answered through scientific investigations. E1.2B Identify and critique arguments about personal or societal issues based on scientific evidence. E1.2C Develop an understanding of a scientific concept by assessing information from multiple sources. Evaluate the scientific accuracy and significance of the information. E1.2D Evaluate scientific explanations in a peer review process or discussion format. E1.2E Evaluate the future career and occupational prospects of science fields. E1.2f Critique solutions to problems , given criteria and scientific constraints. E1.2g Identify scientific tradeoffs in design decisions and choose among alternative solutions. E1.2h Describe the distinctions between scientific theories, laws, hypotheses, and observations. E1.2i Explain the progression of ideas and explanations that lead to science theories that are	The integrity of the scientific process depends on scientists and citizens understanding and respecting the ”Nature of Science.” Openness to new ideas, skepticism, and honesty are attributes required for good scientific practice. Scientists must use logical reasoning during investigation design, analysis, conclusion, and communication. Science can produce critical insights on societal both aids in the development of technology and provides tools for assessing the costs, risks, and benefits of technological systems. Scientific conclusions and arguments play a role in personal choice and public policy decisions. New technology and scientific discoveries have had a major influence in shaping human history. Science and technology continue to offer diverse and significant career opportunities.	

part of the current scientific consensus or core knowledge. E1.2j Apply science principles or scientific data to anticipate effects of technological design decisions. E1.2k Analyze how science and society interact from a historical, political, economic, or social perspective.		

Michigan District Lutheran School Curriculum *TEACHER ACCOUNTABILITY RECORD*

Unit 1 Inquiry, Reflection and Social Implications **Teacher Name: _____** **Grade Level: 8 Earth Science (1 HS credit)**	**Curricular Area: Science** **School Year:**				
Standards Benchmark or *HSCE* **(Italics Indicate the One Used)**	**Dates Taught (month/day/initials):**				
MME ESSENTIAL MATERIAL					
E1.1A Generate new questions that can be investigated in the laboratory or field.					
E1.1B Evaluate the uncertainties or validity of scientific conclusions using an understanding of sources of measurement error, the challenges of controlling the variables, accuracy of data analysis, logic of argument, logic of experimental design, and/or the dependence on underlying assumptions.					
E1.1C Conduct scientific investigations using appropriate tools and techniques (e.g. selecting an instrument that measures the desired quantity).					
E1.1D Identify patterns in data and relate them to theoretical models.					
E1.1E Describe a reason for a given conclusion using evidence from an investigation.					
E1.2A Critique whether or not specific questions can be answered through scientific investigations.					
E1.2B Identify and critique arguments about personal or societal issues based on scientific evidence.					
E1.2C Develop an understanding of a scientific concept by assessing information from multiple sources. Evaluate the scientific accuracy and significance of the information.					
E1.2D Evaluate scientific explanations in a peer review process or discussion format.					
E1.2E Evaluate the future career and occupational prospects of science fields.					

MME CORE MATERIAL FOLLOWS (NOT MANDATORY)					
E1.1f Predict what would happen if the variables, methods, or timing of an investigation were changed.					
E1.1g Based on empirical evidence, explain and critique the reasoning used to draw a scientific conclusion or explanation.					
E1.1h Design and conduct a systematic scientific investigation that tests a hypothesis. Draw conclusions from data presented in charts or tables.					
E1.1i Distinguish between scientific explanations that are regarded as current scientific consensus and the emerging questions that active researchers investigate.					
E1.2f Critique solutions to problems, given criteria and scientific constraints.					
E1.2g Identify scientific tradeoffs in design decisions and choose among alternative solutions.					
E1.2h Describe the distinctions between scientific theories, laws, hypotheses, and observations.					
E1.2i Explain the progression of ideas and explanations that lead to science theories that are part of the current scientific consensus or core knowledge.					
E1.2j Apply science principles or scientific data to anticipate effects of technological design decisions.					
E1.2k Analyze how science and society interact from a historical, political, economic, or social perspective.					

Unit 2: Earth Systems

Outcome 2A:
(E2) Students describe the interactions within and between Earth systems. Students will explain how both fluids (water cycle) and solids (rock cycle) move within Earth systems and how these movements form and change their environment. They will describe the relationship between physical process and human activities and use this understanding to demonstrate an ability to make wise decisions about land use.

High School Content Expectations (HSCEs)	Content Statement	Teaching the Faith Activities (I.F.)
E2.1A Explain why the earth is essentially a closed system in terms of matter. E2.1B Analyze the interactions between the major systems (geosphere, atmosphere, hydrosphere, biosphere) that make up the Earth. E2.1C Explain, using specific examples, how a change in one system affects other Earth systems.	The Earth is a system consisting of four major interacting components: geosphere (crust, mantle, and core), atmosphere (air), hydrosphere (water), and biosphere (the living part of Earth). Physical, chemical, and biological processes act within and amount the four components on a wide range of time scales to continuously change Earth's crust, oceans, atmosphere, and living organisms. Earth elements move within and between the lithosphere, atmosphere, hydrosphere, and biosphere as part of geochemical cycles.	• Discuss, in detail, the Flood and its effects. Use examples like the Dakota Badlands, Mt. St. Helens, and the Grand Canyon to confirm the biblical account.

Outcome 2B:
(E2) Students describe the interactions within and between Earth systems. Students will explain how both fluids (water cycle) and solids (rock cycle) move within Earth systems and how these movements form and change their environment. They will describe the relationship between physical process and human activities and use this understanding to demonstrate an ability to make wise decisions about land use.

High School Content Expectations (HSCEs)	Content Statement	Teaching the Faith Activities (I.F.)
E2.2A Describe the Earth's principle sources of internal and external energy (e.g. radioactive decay, gravity, solar energy). E2.2B Identify differences in the origin and use of renewable (solar, wind, water, biomass) and nonrenewable (fossil fuels, nuclear) sources of energy. E2.2C Describe natural processes in which heat transfer in the earth occurs by conduction, convection, and radiation. E2.2D Identify the main sources of energy to the climate system. E2.2e Explain how energy changes form throughout Earth systems. E2.2f Explain how elements exist in different compounds and states as they move from one reservoir to another.	Energy in Earth systems can exist in a number of forms (e.g., thermal energy as heat in the Earth, chemical energy stored as fossil fuels, mechanical energy as delivered by tides) and can be transformed from one state to another and move from on reservoir to another. Movement of matter and its component elements, through and between Earth's systems, is driven by Earth's internal (radioactive decay and gravity) and external (Sun as primary) sources of energy. Thermal energy is transferred by radiation, convection, and conduction. Fossil fuels are derived from plants and animals of the past, are nonrenewable and, therefore, are limited in availability. All sources of energy for human consumption (e.g., solar, wind, nuclear, ethanol, hydrogen, geothermal, hydroelectric) have advantages and disadvantages.	

Outcome 2C:
(E2) Students describe the interactions within and between Earth systems. Students will explain how both fluids (water cycle) and solids (rock cycle) move within Earth systems and how these movements form and change their environment. They will describe the relationship between physical process and human activities and use this understanding to demonstrate an ability to make wise decisions about land use.

High School Content Expectations (HSCEs)	Content Statement	Teaching the Faith Activities (I.F.)
E2.3A Explain how carbon exists in different forms such as limestone (rock), carbon dioxide (gas), carbonic acid (water), and animals (life) within Earth systems and how those forms can be beneficial or harmful to humans. E2.3b Explain why small amounts of some chemical forms may be beneficial for life but are poisonous in large quantities (e.g. dead zone in Gulf of Mexico, Lake Nyos in Africa, fluoride in drinking water). E2.3c Explain how the nitrogen cycle is part of the Earth system. E2.3d Explain how carbon moves through the Earth system (including the geosphere) and how it may benefit(e.g. improve soils for agriculture) or harm (e.g. act as a pollutant) society.	The Earth is a system containing essentially a fixed amount of each stable chemical atom or element. Most elements can exist in several different states and chemical forms; they move within and between the geosphere, atmosphere, hydrosphere, and biosphere as part of the Earth system. The movements can be slow or rapid. Elements and compounds have significant impacts on the biosphere and have important impacts on human health.	

Outcome 2D:
(E2) Students describe the interactions within and between Earth systems. Students will explain how both fluids (water cycle) and solids (rock cycle) move within Earth systems and how these movements form and change their environment. They will describe the relationship between physical process and human activities and use this understanding to demonstrate an ability to make wise decisions about land use.

High School Content Expectations (HSCEs)	Content Statement	Teaching the Faith Activities (I.F.)
E2.4A Describe renewable and nonrenewable sources of energy for human consumption (electricity, fuels), compare their effects on the environment, and include overall costs and benefits. E2.4B Explain how the impact of human activities on the environment (e.g. deforestation, air pollution, coral reef destruction) can be understood through the analysis of interactions between the four Earth systems. E2.4c Explain ozone depletion in the stratosphere and methods to slow human activities to reduce ozone depletion. E2.4d Describe the life cycle of a product, including the resources, production, packaging, transportation, disposal, and pollution.	The Earth provides resources (including minerals) that are used to sustain human affairs. The supply of non-renewable natural resources is limited and their extraction and use can release elements and compounds into Earth systems. They affect air and water quality, ecosystems, landscapes, and may have effects on long- term climate. Plans for land use and long-term development must include and understanding of the interactions between Earth systems and human activites.	

Michigan District Lutheran School Curriculum *TEACHER ACCOUNTABILITY RECORD*

Unit 2 Earth Systems **Teacher Name: _____** **Grade Level: 8 Earth Science (1 HS credit)**	**Curricular Area: Science** **School Year:**				
Standards Benchmark or *HSCE* **(Italics Indicate the One Used)**	**Dates Taught** **(month/day/initials):**				
MME ESSENTIAL MATERIAL					
E2.1A Explain why the earth is essentially a closed system in terms of matter.					
E2.1B Analyze the interactions between the major systems (geosphere, atmosphere, hydrosphere, biosphere) that make up the Earth.					
E2.1C Explain, using specific examples, how a change in one system affects other Earth systems.					
E2.2A Describe the Earth's principle sources of internal and external energy (e.g. radioactive decay, gravity, solar energy).					
E2.2B Identify differences in the origin and use of renewable (solar, wind, water, biomass) and nonrenewable (fossil fuels, nuclear) sources of energy.					
E2.2C Describe natural processes in which heat transfer in the earth occurs by conduction, convection, and radiation.					
E2.2D Identify the main sources of energy to the climate system.					
E2.3A Explain how carbon exists in different forms such as limestone (rock), carbon dioxide (gas), carbonic acid (water), and animals (life) within Earth systems and how those forms can be beneficial or harmful to humans.					
E2.4A Describe renewable and nonrenewable sources of energy for human consumption (electricity, fuels), compare their effects on the environment, and include overall costs and benefits.					
E2.4B Explain how the impact of human activities on the environment (e.g. deforestation, air pollution, coral reef destruction) can be understood through the analysis of interactions between the four Earth systems.					

MME CORE MATERIAL FOLLOWS (NOT MANDATORY)					
E2.2e Explain how energy changes form throughout Earth systems.					
E2.2f Explain how elements exist in different compounds and states as they move from one reservoir to another.					
E2.3b Explain why small amounts of some chemical forms may be beneficial for life but are poisonous in large quantities (e.g. dead zone in Gulf of Mexico, Lake Nyos in Africa, fluoride in drinking water).					
E2.3c Explain how the nitrogen cycle is part of the Earth system.					
E2.3d Explain how carbon moves through the Earth system (including the geosphere) and how it may benefit (e.g. improve soils for agriculture) or harm (e.g. act as a pollutant) society.					
E2.4c Explain ozone depletion in the stratosphere and methods to slow human activities to reduce ozone depletion.					
E2.4d Describe the life cycle of a product, including the resources, production, packaging, transportation, disposal, and pollution.					

Unit 3: Solid Earth

Outcome 3A:
(E3) Students explain how scientists study and model the interior of the Earth and its dynamic nature. They use the theory of plate tectonics, the unifying theory of geology, to explain a wide variety of Earth features and processes and how hazards resulting from these processes impact society.

High School Content Expectations (HSCEs)	Content Statement	Teaching the Faith Activities (I.F.)
E3.1A Discriminate between igneous, metamorphic, and sedimentary rocks and describe the processes that change one kind of rock into another. E3.1B Explain the relationship between the rock cycle and plate tectonics theory in regard to the origins of igneous, sedimentary, and metamorphic rocks. E3.1c Explain how the size and shape of grains in a sedimentary rock indicate the environment of formation (including climate) and deposition. E3.1d Explain how the crystal size of igneous rocks indicate the rate of cooling and whether the rock is extrusive or intrusive. E3.1e Explain how the texture (foliated, nonfoliated) of metamorphic rock can indicate whether it has experienced regional or contact metamorphic.	Igneous, metamorphic, and sedimentary rocks are indicators of geologic and environmental conditions and processes that existed in the past. These include cooling and crystallization, weathering and erosion, sedimentation and lithification, and metamorphism. In some way, all of these processes are influenced by plate tectonics, and some are influenced by climate.	• Have students work together with about 20 different samples of minerals and a large poster board. Have students develop a mineral identification chart and test their samples. Use Genesis 1:9 and open the discussion to what is in our dry land. • Use a microscope and hand lens to observe the characteristics of rocks and minerals. Use Psalm 77:12, 90:2, and 92:4-5. • 19. Guide a class discussion to develop the following concepts: God has given us a variety of resources, part of subduing the earth (Gen. 1:28) is to make God's resources useful to man, God's provision for us on earth is a testimony to His extravagant love for us. Display work on a bulletin board titled "God's Resources-Our Treasures".

Outcome 3B:
(E3) Students explain how scientists study and model the interior of the Earth and its dynamic nature. They use the theory of plate tectonics, the unifying theory of geology, to explain a wide variety of Earth features and processes and how hazards resulting from these processes impact society.

High School Content Expectations (HSCEs)	Content Statement	Teaching the Faith Activities (I.F.)
E3.2A Describe the interior of the Earth (in terms of crust, mantle, and inner and outer cores) and where the magnetic field of the Earth is generated. E3.2B Explain how scientists infer that the Earth has interior layers with discernable properties using patterns of primary (P) and secondary (S) seismic wave arrivals. E3.2C Describe the differences between oceanic and continental crust (including density, age, composition). E3.2d Explain the uncertainties associated with models of the interior of the Earth and how these models are validated.	The Earth can also be subdivided into concentric layers based on their physical characteristics: (lithosephere, atmosphere, lower mantle, outer core, and inner core). The crust and upper mantle compose the rigid lithosphere (plates) that moves over a "softer" asthenosphere (part of the upper mantle). The magnetic field of the Earth is generated in the outer core. The interior of the Earth cannot be directly sampled and must be modeled using data from seismology.	

Outcome 3C:
(E3) Students explain how scientists study and model the interior of the Earth and its dynamic nature. They use the theory of plate tectonics, the unifying theory of geology, to explain a wide variety of Earth features and processes and how hazards resulting from these processes impact society.

High School Content Expectations (HSCEs)	Content Statement	Teaching the Faith Activities (I.F.)
E3.3A Explain how plate tectonics accounts for the features and processes (sea floor spreading, mid-ocean ridges, subduction zones, earthquakes and volcanoes, mountain ranges) that occur on or near the Earth's surface. E3.3B Explain why tectonic plates move using the concept of heat flowing through mantle convection, coupled with the cooling and sinking of aging ocean plates that result from their increased density. E3.3C Describe the motion history of geologic features (e.g., plates. Hawaii) using equations relating rate, time, and distance. E3.3d Distinguish plate boundaries by the pattern of depth and magnitude of earthquakes.	The Earth's crust and upper mantle make up the lithosphere, which is broken into large mobile pieces called tectonic plates. The plates move at velocities in units of centimeters per year as measured using the global positioning system (GPS). Motion histories are determined with calculations that relate rate, time, and distance of offset geologic features. Oceanic plates are created at mid-ocean ridges by magmatic activity and cooled until they sink back into the Earth as subduction zones. At some localities, plates slide by each other. Mountain belts are formed both by continental collision and as a result of subduction. The outward flow of heat from Earth's interior provides the driving energy for plate tectonics.	

Outcome 3D:
(E3) Students explain how scientists study and model the interior of the Earth and its dynamic nature. They use the theory of plate tectonics, the unifying theory of geology, to explain a wide variety of Earth features and processes and how hazards resulting from these processes impact society.

High School Content Expectations (HSCEs)	Content Statement	Teaching the Faith Activities (I.F.)
E3.4A Use the distribution of earthquakes and volcanoes to locate and determine the types of plate boundaries. E3.4B Describe how the sizes of earthquakes and volcanoes are measured or characterized. E3.4d Explain how the chemical composition of magmas relates to plate tectonics and affects the geometry, structure, and explosivity of volcanoes. E3.4e Explain how volcanoes change the atmosphere, hydrosphere, and other Earth systems. E3.4f Explain why fences are offset after and earthquake, using the elastic rebound theory.	Plate motions result in potentially catastrophic events (earthquakes, volcanoes, tsunamis, mass wasting) that affect humanity. The intensity of volcanic eruptions is controlled by the chemistry and properties of the magma. Earthquakes are the result of abrupt movements of the Earth. They generate energy in the form of the body and surface waves.	

Michigan District Lutheran School Curriculum *TEACHER ACCOUNTABILITY RECORD*

Unit 3 The Solid Earth **Teacher Name: _____** **Grade Level: 8 Earth Science (1 HS credit)**	**Curricular Area: Science** **School Year:**				
Standards Benchmark or *HSCE* **(Italics Indicate the One Used)**	**Dates Taught** **(month/day/initials):**				
Unit 3 The Solid Earth					
MME ESSENTIAL MATERIAL					
E3.1A Discriminate between igneous, metamorphic, and sedimentary rocks and describe the processes that change one kind of rock into another.					
E3.1B Explain the relationship between the rock cycle and plate tectonics theory in regard to the origins of igneous, sedimentary, and metamorphic rocks.					
E3.2A Describe the interior of the Earth (in terms of crust, mantle, and inner and outer cores) and where the magnetic field of the Earth is generated.					
E3.2B Explain how scientists infer that the Earth has interior layers with discernable properties using patterns of primary (P) and secondary (S) seismic wave arrivals.					
E3.2C Describe the differences between oceanic and continental crust (including density, age, composition).					
E3.3A Explain how plate tectonics accounts for the features and processes (sea floor spreading, mid-ocean ridges, subduction zones, earthquakes and volcanoes, mountain ranges) that occur on or near the Earth's surface.					
E3.3B Explain why tectonic plates move using the concept of heat flowing through mantle convection, coupled with the cooling and sinking of aging ocean plates that result from their increased density.					
E3.3C Describe the motion history of geologic features (e.g., plates. Hawaii) using equations relating rate, time, and distance.					
E3.4A Use the distribution of earthquakes and volcanoes to locate and determine the types of plate boundaries.					
E3.4B Describe how the sizes of earthquakes and volcanoes are measured or characterized.					

MME CORE MATERIAL FOLLOWS (NOT MANDATORY)					
E3.1c Explain how the size and shape of grains in a sedimentary rock indicate the environment of formation (including climate) and deposition.					
E3.1d Explain how the crystal size of igneous rocks indicate the rate of cooling and whether the rock is extrusive or intrusive.					
E3.1e Explain how the texture (foliated, nonfoliated) of metamorphic rock can indicate whether it has experienced regional or contact metamorphic.					
E3.2d Explain the uncertainties associated with models of the interior of the Earth and how these models are validated.					
E3.3d Distinguish plate boundaries by the pattern of depth and magnitude of earthquakes.					
E3.4d Explain how the chemical composition of magmas relates to plate tectonics and affects the geometry, structure, and explosivity of volcanoes.					
E3.4e Explain how volcanoes change the atmosphere, hydrosphere, and other Earth systems.					
E3.4f Explain why fences are offset after and earthquake, using the elastic rebound theory.					

Unit 4: Fluid Earth

Outcome 4A:
(E4) Students explain how the ocean atmosphere move and transfer energy around the planet. They also explain how these movements affect climate and weather and how severe weather impacts society. Students explain how long term climatic changes (glaciers) have shaped the Michigan landscape. They also explain features and processes related to surface and groundwater and describe the sustainability of systems in terms of water quality and quantity.

High School Content Expectations (HSCEs)	Content Statement	Teaching the Faith Activities (I.F.)
E4.1A Compare and contrast surface water systems (lakes, rivers, streams, wetlands) and groundwater in regard to their relative sizes as Earth's freshwater reservoirs and the dynamics of water movement (inputs and outputs, residence times, sustainability). E4.1B Explain the features and processes of groundwater systems and how the sustainability of North American aquifers has changed in recent history (e.g., the past 100 years) qualitatively using the concepts of recharge, residence time, inputs, and outputs. E4.1C Explain how water quality in both groundwater and surface systems is impacted by land use decisions.	Fresh water moves over time between the atmosphere, hydrosphere, (surface water, wetlands, rivers, and glaciers), and geosphere (groundwater). Water resources are both critical to and greatly impacted by humans. Changes in water systems will impact quality, quantity, and movement of water. Natural surface water processes shape the landscape everywhere and are affected by human land use decisions.	

Outcome 4B:
(E4) Students explain how the ocean atmosphere move and transfer energy around the planet. They also explain how these movements affect climate and weather and how severe weather impacts society. Students explain how long term climatic changes (glaciers) have shaped the Michigan landscape. They also explain features and processes related to surface and groundwater and describe the sustainability of systems in terms of water quality and quantity.

High School Content Expectations (HSCEs)	Content Statement	Teaching the Faith Activities (I.F.)
E4.2A Describe the major cause for the ocean's surface and deep water currents, including the prevailing winds, the Coriolis effect, unequal heating of the earth, changes in water temperature and salinity in high latitudes, and basin shape. E4.2B Explain how interactions between the oceans and the atmosphere influence global and regional climate. Include the major concepts of heat transfer by ocean currents, thermohaline circulation, boundary currents, evaporation, precipitation, climatic zones, and the ocean as a major CO2 reservoir. E4.2c Explain the dynamics (including ocean-atmosphere interactions) of the EI Nino-Southern Oscillation (ENSO) and its effect on continental climates. E4.2d Identify factors affecting seawater density and salinity and describe how density affects oceanic layering and currents. E4.2e Explain the difference between maritime and continental climates with regard to oceanic currents. E4.2f Explain how the Coriolis effect controls oceanic circulation.	Energy from the Sun and the rotation of the Earth control global atmospheric circulation. Oceans redistribute matter and energy around the Earth through currents, waves, and interaction with other Earth systems. Ocean currents are controlled by prevailing winds, changes in water density, ocean topography, and the shape and location of landmasses. Oceans and large lakes (e.g., Great Lakes) have a major effect on climate and weather because they are a source of moisture and a large reservoir of heat. Interactions between oceanic circulation and the atmosphere can affect regional climates throughout the world.	

Outcome 4C:
(E4) Students explain how the ocean atmosphere move and transfer energy around the planet. They also explain how these movements affect climate and weather and how severe weather impacts society. Students explain how long term climatic changes (glaciers) have shaped the Michigan landscape. They also explain features and processes related to surface and groundwater and describe the sustainability of systems in terms of water quality and quantity.

High School Content Expectations (HSCEs)	Content Statement	Teaching the Faith Activities (I.F.)
E4.3A Describe the various conditions of formation associated with severe weather (thunderstorms, tornadoes, hurricanes, floods, waves, and drought). E4.3B Describe the damage resulting from and the social impact of thunderstorms, tornadoes, hurricanes, and floods. E4.3C Describe severe weather and flood safety and mitigation. E4.3D Describe the seasonal variations in severe weather. E4.3E Describe conditions associated with frontal boundaries that result in severe weather (thunderstorms, tornadoes, and hurricanes). E4.3F Describe how mountains, frontal wedging (including dry lines), convection, and convergence form clouds and precipitation. E4.3g Explain the process of adiabatic cooling and adiabatic temperature changes to the formation of clouds.	Tornadoes, hurricanes, blizzards, and thunderstorms are severe weather phenomena that impacts society and ecosystems. Hazards include downbursts (wind shear), strong winds, hail, lightning, heavy rain, and ois due to differences in air density resulting from variations in temperature. Many weather conditions can be explained by fronts that occur when air masses meet.	

Michigan District Lutheran School Curriculum *TEACHER ACCOUNTABILITY RECORD*

Unit 4 The Fluid Earth **Teacher Name: _____** **Grade Level: 8 Earth Science (1 HS credit)**	**Curricular Area: Science** **School Year:**				
Standards Benchmark or *HSCE* **(Italics Indicate the One Used)**	**Dates Taught** **(month/day/initials):**				
E4.1A Compare and contrast surface water systems (lakes, rivers, streams, wetlands) and groundwater in regard to their relative sizes as Earth's freshwater reservoirs and the dynamics of water movement (inputs and outputs, residence times, sustainability).					
E4.1B Explain the features and processes of groundwater systems and how the sustainability of North American aquifers has changed in recent history (e.g., the past 100 years) qualitatively using the concepts of recharge, residence time, inputs, and outputs.					
E4.1C Explain how water quality in both groundwater and surface systems is impacted by land use decisions.					
E4.2A Describe the major cause for the ocean's surface and deep water currents, including the prevailing winds, the Coriolis effect, unequal heating of the earth, changes in water temperature and salinity in high latitudes, and basin shape.					
E4.2B Explain how interactions between the oceans and the atmosphere influence global and regional climate. Include the major concepts of heat transfer by ocean currents, thermothaline circulation, boundary currents, evaporation, precipitation, climatic zones, and the ocean as a major CO2 reservoir.					
E4.3A Describe the various conditions of formation associated with severe weather (thunderstorms, tornadoes, hurricanes, floods, waves, and drought).					
E4.3B Describe the damage resulting from and the social impact of thunderstorms, tornadoes, hurricanes, and floods.					
E4.3C Describe severe weather and flood safety and mitigation.					
E4.3D Describe the seasonal variations in severe weather.					
E4.3E Describe conditions associated with frontal boundaries that result in severe weather (thunderstorms, tornadoes, and hurricanes).					

E4.3F Describe how mountains, frontal wedging (including dry lines), convection, and convergence form clouds and precipitation.					
MME CORE MATERIAL FOLLOWS (NOT MANDATORY)					
E4.2c Explain the dynamics (including ocean-atmosphere interactions) of the EI Nino-Southern Oscillation (ENSO) and its effect on continental climates.					
E4.2d Identify factors affecting seawater density and salinity and describe how density affects oceanic layering and currents.					
E4.2e Explain the difference between maritime and continental climates with regard to oceanic currents.					
E4.2f Explain how the Coriolis effect controls oceanic circulation.					
E4.3g Explain the process of adiabatic cooling and adiabatic temperature changes to the formation of clouds.					

Unit 5: The Earth in Space and Time

Outcome 5A:
(E5) Students explain theories about how the earth and universe formed and evolved over a long period of time. Students predict how human activities may influence the climate of the future.

High School Content Expectations (HSCEs)	Content Statement	Teaching the Faith Activities (I.F.)
E5.1A Describe the position and motion of our solar system in our galaxy and the overall scale, structure, and age of the universe. E5.1b Describe how the big Bang theory accounts for the formation of the universe. E5.1c Explain how observations of the cosmic microwave background have helped determine the age of the universe. E5.1d Differentiate between the cosmological and Doppler red shift.	Scientific evidence indicates the universe is orderly in structure, finite, and contains all matter and energy. Information from the entire light spectrum tells us about the composition and motion of objects in the universe. Early in the history of the universe, matter clumped together by gravitational attraction to form stars and galaxies. According to the Big Bang theory, the universe has been continually expanding at an increasing rate since its formation about 13.7 billion years ago.	• Assign a small group of students to prepare a visual that illustrates some "strange but true" facts about the solar system. Place work on a wall or bulletin board with the title "Universe Wonders/God's Marvelous Works". • Discuss, in detail, the story of Creation. Remind students of God's Word in a literal form. • Trace a lineage found in the Old Testament to date the earth.

Outcome 5B:
(E5) Students explain theories about how the earth and universe formed and evolved over a long period of time. Students predict how human activities may influence the climate of the future.

High School Content Expectations (HSCEs)	Content Statement	Teaching the Faith Activities (I.F.)
E5.2A Identify patterns in solar activities (sunspot cycle, solar flares, solar wind). E5.2B Relate events on the Sun to phenomena such as auroras, disruption of radio and satellite communications, and power grid disturbances. E5.2C Describe how nuclear fusion produces energy in the Sun. E5.2D Describe how nuclear fusion and other processes in stars have led to the formation of all the other chemical elements.	Stars, including the Sun, transform matter into energy in nuclear reactions. When hydrogen nuclei fuse to form helium, a small amount of matter is converted to energy. Solar energy is responsible for life processes and weather as well as phenomena on Earth. These and other processes in stars have led to the formation of all the other chemical elements.	

Outcome 5C (not tested at present):
(E5) Students explain theories about how the earth and universe formed and evolved over a long period of time. Students predict how human activities may influence the climate of the future.

High School Content Expectations (HSCEs)	Content Statement	Teaching the Faith Activities (I.F.)
E5.2e Explain how the Hertzsprung-Russell diagram can be used to deduce other parameters. E5.2f Explain how you can infer the temperature, life span, and mass of a star from its color. Use the H-R diagram to explain the life cycle of stars. E5.2g Explain how the balance between fusion and gravity controls the evolution of a star. E5.2h Compare the evolution paths of low, moderate, and high mass stars using the H-R diagram.	Stars, including the Sun, transform matter into energy in nuclear reactions. When hydrogen nuclei fuse to form helium, a small amount of matter is converted to energy. These and other processes in stars have led to the formation of all the other chemical elements. There is a wide range of stellar objects of difference sizes and temperatures. Stars have varying life histories based on these parameters.	

Outcome 5D:
(E5) Students explain theories about how the earth and universe formed and evolved over a long period of time. Students predict how human activities may influence the climate of the future.

High School Content Expectations (HSCEs)	Content Statement	Teaching the Faith Activities (I.F.)
E5.3A Explain how the solar system formed from a nebula of dust and gas in a spiral arm of the Milky Way Galaxy about 4.6 GA (billion years ago). E5.3B Describe the process of radioactive decay and explain how radioactive elements are used to date the rocks that contain them. E5.3C Relate major events in the history of the Earth to the geologic time scale, including formation of the Earth, formation of an oxygen atmosphere, rise of life, Cretaceous-Tertiary (K-T) and Permian extinctions, and Pleistocene ice age. E5.3D Describe how index fossils can be used to determine time sequence.	The solar system formed from a nebular cloud of dust and gas 4.6 Ga (billion years ago). The Earth has changed through time and has been affected by both catastrophic (e.g., earthquakes, meteorite impacts, volcanoes) and gradual geologic events (e.g., plate movements, mountain building) as well as the effects of biological evolution (formation of an oxygen atmosphere). Geologic time can be determined through both relative and absolute dating.	

Outcome 5E (not tested at present):
(E5) Students explain theories about how the earth and universe formed and evolved over a long period of time. Students predict how human activities may influence the climate of the future.

High School Content Expectations (HSCEs)	Content Statement	Teaching the Faith Activities (I.F.)
E5.3e Determine the approximate age of a sample, when given the half-life of a radioactive substance along with the ratio of daughter to parent substances present in the sample. E5.3f Explain why C-14 can be used to date a 40,000 year old tree but U-Pb cannot. E5.3g Identify a sequence of geologic events using relative-age dating principles.	Early methods of determining geologic time, such as the use of index fossils and stratigraphic principles. Allowed for the relative dating of geological events. However, absolute dating was impossible until the discovery that certain radioactive isotopes in rocks have known decay rates, making it possible to determine how many years ago a given mineral or rock formed. Different kinds of radiometric dating techniques exist. Technique selection depends on the composition of the material to be dated, the age of the material, and the type of geologic event that affected the material.	• 20. Research some of the methods used to date rock samples or the universe. A closer look shows that some of the requirements could explain inclusive results on dating the earth using many of the methods (clocks) by scientists today. • Research some fallacies that lead to the assumption of an old earth. Find reliable data, the Bible, that teaches a young earth concept.

Outcome 5F:
(E5) Students explain theories about how the earth and universe formed and evolved over a long period of time. Students predict how human activities may influence the climate of the future.

High School Content Expectations (HSCEs)	Content Statement	Teaching the Faith Activities (I.F.)
E5.4A Explain the natural mechanism of the greenhouse effect including comparisons of the major greenhouse gases (water vapor, carbon dioxide, methane, nitrous oxide, and ozone). E5.4B Describe natural mechanisms that could result in significant changes in climate (e.g., major volcanic eruptions, changes in sunlight received by the earth, meteorite impacts). E5.4C Analyze the empirical relationship between the emissions of carbon dioxide, atmospheric carbon dioxide levels and the average global temperature over the past 150 years. E5.4D Based on evidence of observable changes in recent history and climate change models, explain the consequences of warmer oceans (including the results of increased evaporation, shoreline and estuarine impacts, oceanic algae growth, and coral bleaching) and changing climatic zones (including the adaptive capacity of the biosphere). E5.4e Based on evidence from historical climate research (e.g., fossils, varves, ice core data) and climate change models, explain how the current melting of polar ice caps can impact the climatic system. E5.4f Describe geologic evidence that implies climates were significantly colder at times in the geologic record (e.g., geomorphology, striations, and fossils).	Atmospheric gases trap solar energy that has been reradiated from the Earth's surface (the greenhouse effect). The Earth's climate has changed both gradually and catastrophically over geological and historical times frames due to complex interactions between many natural variables and events. The concentration of greenhouse gases (especially carbon dioxide) has increased due to human industrialization which has contributed to a rise in average global atmospheric, and hydrosphere. Climates of the past are researched, usually using indirect indicates, to better understand and predict climate change.	

E5.4g Compare and contrast the heart-trapping mechanisms of major greenhouse gases resulting from emissions (carbon dioxide, methane, nitrous oxide, fluorocarbons) as well as their abundance and heat-trapping capacity.		

Michigan District Lutheran School Curriculum *TEACHER ACCOUNTABILITY RECORD*

Unit 5 The Earth in Space and Time **Teacher Name: _____** **Grade Level: 8 Earth Science (1 HS credit)**	**Curricular Area: Science** **School Year:**				
Standards Benchmark or *HSCE*	**Dates Taught (month/day/initials):**				
MME ESSENTIAL MATERIAL					
E5.1A Describe the position and motion of our solar system in our galaxy and the overall scale, structure, and age of the universe.					
E5.2A Identify patterns in solar activities (sunspot cycle, solar flares, solar wind).					
E5.2B Relate events on the Sun to phenomena such as auroras, disruption of radio and satellite communications, and power grid disturbances.					
E5.2C Describe how nuclear fusion produces energy in the Sun.					
E5.2D Describe how nuclear fusion and other processes in stars have led to the formation of all the other chemical elements.					
E5.3A Explain how the solar system formed from a nebula of dust and gas in a spiral arm of the Milky Way Galaxy about 4.6 GA (billion years ago).					
E5.3B Describe the process of radioactive decay and explain how radioactive elements are used to date the rocks that contain them.					
E5.3C Relate major events in the history of the Earth to the geologic time scale, including formation of the Earth, formation of an oxygen atmosphere, rise of life, Cretaceous-Tertiary (K-T) and Permian extinctions, and Pleistocene ice age.					
E5.3D Describe how index fossils can be used to determine time sequence.					
E5.4A Explain the natural mechanism of the greenhouse effect including comparisons of the major greenhouse gases (water vapor, carbon dioxide, methane, nitrous oxide, and ozone).					
E5.4B Describe natural mechanisms that could result in significant changes in climate (e.g., major volcanic eruptions, changes in sunlight received by the earth, meteorite impacts).					

E5.4C Analyze the empirical relationship between the emissions of carbon dioxide, atmospheric carbon dioxide levels and the average global temperature over the past 150 years.					
E5.4D Based on evidence of observable changes in recent history and climate change models, explain the consequences of warmer oceans (including the results of increased evaporation, shoreline and estuarine impacts, oceanic algae growth, and coral bleaching) and changing climatic zones (including the adaptive capacity of the biosphere).					
MME CORE MATERIAL FOLLOWS (NOT MANDATORY)					
E5.1b Describe how the big Bang theory accounts for the formation of the universe.					
E5.1c Explain how observations of the cosmic microwave background have helped determine the age of the universe.					
E5.1d Differentiate between the cosmological and Doppler red shift.					
E5.2e Explain how the Hertzsprung-Russell diagram can be used to deduce other parameters. (not tested at present)					
E5.2f Explain how you can infer the temperature, life span, and mass of a star from its color. Use the H-R diagram to explain the life cycle of stars. (not tested at present)					
E5.2g Explain how the balance between fusion and gravity controls the evolution of a star. (not tested at present)					
E5.2h Compare the evolution paths of low, moderate, and high mass stars using the H-R diagram. (not tested at present)					
E5.3e Determine the approximate age of a sample, when given the half-life of a radioactive substance along with the ratio of daughter to parent substances present in the sample. (not tested at present)					
E5.3f Explain why C-14 can be used to date a 40,000 year old tree but U-Pb cannot. (not tested at present)					

E5.3g Identify a sequence of geologic events using relative-age dating principles. (not tested at present)					
E5.4e Based on evidence from historical climate research (e.g., fossils, varves, ice core data) and climate change models, explain how the current melting of polar ice caps can impact the climatic system.					
E5.4f Describe geologic evidence that implies climates were significantly colder at times in the geologic record (e.g., geomorphology, striations, and fossils).					
E5.4g Compare and contrast the heart-trapping mechanisms of major greenhouse gases resulting from emissions (carbon dioxide, methane, nitrous oxide, fluorocarbons) as well as their abundance and heat-trapping capacity.					