Geneva CUSD 304
Content-Area Curriculum Frameworks
Grades 6-12
Science

Mission Statement	<u>The Mission of Science Education Is:</u> 1) to nurture an active interest in science that continues throughout life. 2) to teach the learning skills and concepts necessary for the scientific process. 3) to develop student understanding of the interrelationships between science, society, and the environment 4) to encourage students to discover and develop their talent in science.
Course Sequence (Grades 6-12)	**6th grade:** Earth Science **7th grade:** Life Science **8th grade:** Physical Science **9th grade:** General Science Earth Science Biology Biology Honors **10th ,11th,12 grade:** Chemistry Chemistry Honors Physics Astronomy Natural Disasters Anatomy and Physiology I and II Horticulture I and II AP Chemistry AP Biology AP Environmental Science

Course Framework

Course Title	**Natural Disasters**
Grade Level	11th/12th
Semesters (1-2-3-4)	1
Prerequisite	Biology, Chemistry
Course Description	This laboratory science course introduces the nature, causes, risks, effects, and prediction of natural disasters including earthquakes, volcanoes, tsunamis, landslides, subsidence, severe weather, global climate change, coastal erosion, floods, droughts, and meteorite impacts. It also covers geologic, atmospheric, oceanic, and astronomic principles, case histories of natural disasters, and human responses to natural disasters including societal impact, mitigation strategies, and public policy. The Science of Natural Disasters is designed to be an upper level science elective for those students who would like to further their knowledge in the Earth Sciences. It also allows those who began their science curriculum in Biology the opportunity to study the Earth Sciences at a deep and challenging level.
District-approved Materials and/or Resources	Natural Hazards and Disasters Publisher: Thompson Brooks/Cole ISBN: 0-534-99760-0 Copy write: 2006

Unit Frameworks

Unit of Study: major topics	**Introduction to Natural Hazards and Disasters**	Resources that will support instruction
Illinois Learning Standards, Benchmarks, **National Standards Assessment Frameworks, or other standards that will be taught in this unit**	**STATE GOAL 11: Understand the processes of scientific inquiry and technological design to investigate questions, conduct experiments and solve problems.** **B. Know and apply the concepts, principles and processes of technological design.** **11.B.4a** Identify a technological design problem inherent in a commonly used product. **11.B.4b** Propose and compare different solution designs to the design problem based upon given constraints including available tools, materials and time. **11.B.4f** Evaluate the test results based on established criteria, note sources of error and recommend improvements. **11.B.5e** Apply established criteria to evaluate the suitability, acceptability, benefits, drawbacks and consequences for the tested design solution and recommend modifications and refinements. **11.B.5f** Using available technology, prepare and present findings of the tested design solution to an audience that may include professional and technical experts. **STATE GOAL 12: Understand the fundamental concepts, principles and interconnections of the life, physical and earth/space sciences.** **B. Know and apply concepts that describe how living things interact with each other and with their environment.** **12.B.4a** Compare physical, ecological and behavioral factors that influence interactions and interdependence of organisms. **12.B.4b** Simulate and analyze factors that influence the size and stability of populations within ecosystems (e.g., birth rate, death rate, predation, migration patterns). **12.B.5a** Analyze and explain biodiversity issues and the causes and effects of extinction. **12.B.5b** Compare and predict how life forms can adapt to changes in the environment by applying concepts of change and constancy (e.g., variations within a population increase the likelihood of survival under new conditions). **E. Know and apply concepts that describe the features and processes of the Earth and its resources.** **12.E.4a** Explain how external and internal energy sources drive Earth processes (e.g., solar energy drives weather patterns; internal heat drives plate tectonics).	

	12.E.4b Describe how rock sequences and fossil remains are used to interpret the age and changes in the Earth. **12.E.5** Analyze the processes involved in naturally occurring short-term and long-term Earth events (e.g., floods, ice ages, temperature, sea-level fluctuations). **STATE GOAL 13: Understand the relationships among science, technology and society in historical and contemporary contexts.** **A. Know and apply the accepted practices of science.** **13.A.4a** Estimate and suggest ways to reduce the degree of risk involved in science activities. **13.A.4c** Describe how scientific knowledge, explanations and technological designs may change with new information over time (e.g., the understanding of DNA, the design of computers). **13.A.5a** Design procedures and policies to eliminate or reduce risk in potentially hazardous science activities. **13.A.5b** Explain criteria that scientists use to evaluate the validity of scientific claims and theories. **13.A.5c** Explain the strengths, weaknesses and uses of research methodologies including observational studies, controlled laboratory experiments, computer modeling and statistical studies. **13.A.5d** Explain, using a practical example (e.g., cold fusion), why experimental replication and peer review are essential to scientific claims. **B. Know and apply concepts that describe the interaction between science, technology and society.** **13.B.4a** Compare and contrast scientific inquiry and technological design as pure and applied sciences. **13.B.4b** Analyze a particular occupation to identify decisions that may be influenced by a knowledge of science. **13.B.4c** Analyze ways that resource management and technology can be used to accommodate population trends. **13.B.4d** Analyze local examples of resource use, technology use or conservation programs; document findings; and make recommendations for improvements. **13.B.4e** Evaluate claims derived from purported scientific studies used in advertising and marketing strategies. **13.B.5a** Analyze challenges created by international competition for increases in scientific knowledge and technological capabilities (e.g., patent issues, industrial espionage, technology obsolescence). **13.B.5b** Analyze and describe the processes and effects of scientific and technological breakthroughs. **13.B.5d** Analyze the costs, benefits and effects of scientific and technological policies at the local, state, national and global levels (e.g., genetic research, Internet access). **13.B.5e** Assess how scientific and techno-logical progress has affected other fields of study, careers and job markets and aspects of everyday life.

Objectives o **Conceptual** o **Factual** o **Procedural**	I. Introduction to Natural Hazards and Disasters (*Chapters 1 & 18)* A. Scientific Misconceptions and Scientific Inquiry 1. Identify and explain the certainty of personal beliefs and expectations. 2. Define, explore, challenge, and revise misconceptions in science. 3. Define the process of scientific inquiry, and analyze examples specific to the study of natural hazards and disasters. 4. Compare and contrast a scientific hypothesis, theory, and law. 5. Examine and generate examples of a scientific hypothesis, theory, and law. B. The Nature of Disasters 1. Evaluate the nature of punctuated and gradual geologic change. 2. Examine the scope of natural disasters with numerous examples. 3. Define natural disasters. C. Natural Hazards 1. Define and compare the types, characteristics, and threat dimensions of environmental hazards. 2. Define and list the types of natural hazards. D. Hazard and Disaster Perspectives 1. Examine, analyze, compare, and discuss hazard perspectives. a. Evaluate the reasons why people live in harm's way. b. Analyze apathy to hazards with a "possible but not probable" sort of mentality, and the misdirected blame that results. 2. Examine the underlying causes of natural hazards. 3. Discuss how the severity of a hazard is impacted by socioeconomics. 4. Evaluate the vulnerability of humans to natural hazards. 5. Evaluate the influence of the media on our perception of natural hazards and disasters. E. Dimensions of Disaster 1. List and compare the most common, the deadliest, and the most costly disasters in the world, the US, and locally. 2. Analyze the difficulties with disaster data. 3. Discuss the nature of human fatalities from natural disasters. 4. Discuss the economic losses from natural disasters. 5. Compare economic losses with fatalities from natural disasters in more developed and less developed countries. 6. Analyze and discuss the magnitude, frequency, return period, patterns and trends of disasters. 7. Outline the reasons for the growth in global impacts from natural disasters. 8. Evaluate the affect of human population growth on the frequency and severity of natural disasters. F. Risk, Response, and Mitigation

	1. Define risk and explain how it relates to natural hazards. 2. Discuss how risk is estimated. 3. Analyze how risk is perceived and applied to natural hazards. 4. Evaluate a risk management plan. 5. Define mitigation. 6. Compare mitigation by control of nature and engineering verses changes in human behavior. 7. Outline the role of developers, companies, and governments in populating hazardous areas. 8. Explain the role of governmental and non-governmental agencies in responding to and recovery from natural disasters. 9. Outline the role of insurance in response to natural disasters. 10. Discuss the importance of land use planning, education, and warning systems in hazard mitigation.	
Assessments	Performance Tasks ▪ Homework completion ▪ Design and carry out a controlled experiment ▪ Lab work and reports ▪ Quizzes ▪ Exams	Other Evidence

Unit Frameworks

Unit of Study: major topics	**Energy For Disasters**	Resources that will support instruction
Illinois Learning Standards, Benchmarks, **National Standards Assessment Frameworks, or other standards that will be taught in this unit**	**STATE GOAL 12: Understand the fundamental concepts, principles and interconnections of the life, physical and earth/space sciences.** **B. Know and apply concepts that describe how living things interact with each other and with their environment.** **12.B.4a** Compare physical, ecological and behavioral factors that influence interactions and interdependence of organisms. **12.B.4b** Simulate and analyze factors that influence the size and stability of populations within ecosystems (e.g., birth rate, death rate, predation, migration patterns). **12.B.5a** Analyze and explain biodiversity issues and the causes and effects of extinction. **12.B.5b** Compare and predict how life forms can adapt to changes in the environment by applying concepts of change and constancy (e.g., variations within a population increase the likelihood of survival under new conditions). **C. Know and apply concepts that describe properties of matter and energy and the interactions between them.** **12.C.4a** Use kinetic theory, wave theory, quantum theory and the laws of thermo-dynamics to explain energy transformations. **12.C.4b** Analyze and explain the atomic and nuclear structure of matter. **12.C.5a** Analyze reactions (e.g., nuclear reactions, burning of fuel, decomposition of waste) in natural and man-made energy systems. **12.C.5b** Analyze the properties of materials (e.g., mass, boiling point, melting point, hardness) in relation to their physical and/or chemical structures. **D. Know and apply concepts that describe force and motion and the principles that explain them.** **12.D.4a** Explain and predict motions in inertial and accelerated frames of reference. **12.D.4b** Describe the effects of electromagnetic and nuclear forces including atomic and molecular bonding, capacitance and nuclear reactions. **12.D.5a** Analyze factors that influence the relative motion of an object (e.g., friction, wind shear, cross currents, potential differences). **12.D.5b** Analyze the effects of gravitational, electromagnetic and nuclear forces on a physical system. **E. Know and apply concepts that describe the features and processes of the Earth and its resources.** **12.E.4a** Explain how external and internal energy sources drive Earth processes (e.g., solar energy drives weather patterns; internal heat drives plate	

	tectonics). **12.E.4b** Describe how rock sequences and fossil remains are used to interpret the age and changes in the Earth. **12.E.5** Analyze the processes involved in naturally occurring short-term and long-term Earth events (e.g., floods, ice ages, temperature, sea-level fluctuations). **F. Know and apply concepts that explain the composition and structure of the universe and Earth's place in it.** **12.F.4a** Explain theories, past and present, for changes observed in the universe. **12.F.4b** Describe and compare the chemical and physical characteristics of galaxies and objects within galaxies (e.g., pulsars, nebulae, black holes, dark matter, stars). **STATE GOAL 13: Understand the relationships among science, technology and society in historical and contemporary contexts.** **B. Know and apply concepts that describe the interaction between science, technology and society.** **13.B.4c** Analyze ways that resource management and technology can be used to accommodate population trends. **13.B.4d** Analyze local examples of resource use, technology use or conservation programs; document findings; and make recommendations for improvements. **13.B.5a** Analyze challenges created by international competition for increases in scientific knowledge and technological capabilities (e.g., patent issues, industrial espionage, technology obsolescence). **13.B.5b** Analyze and describe the processes and effects of scientific and technological breakthroughs. **13.B.5d** Analyze the costs, benefits and effects of scientific and technological policies at the local, state, national and global levels (e.g., genetic research, Internet access). **13.B.5e** Assess how scientific and techno-logical progress has affected other fields of study, careers and job markets and aspects of everyday life.
Objectives o **Conceptual** o **Factual** o **Procedural**	II. Earth's Energy Sources *(Chapter "1.5")* A. Discuss the roles of impacts, gravitation, radioactive decay, and solar radiation on environmental change on Earth. B. Outline how impacts from extraterrestrial bodies and gravitational collapse and differentiation of Earth's layers contributed to Earth's internal heat. 1. Explain how the Solar System, the Earth, and the Moon were formed. 2. Describe how the Earth's lithosphere, hydrosphere, and atmosphere were formed. C. Explain how some of Earth's internal heat is generated from radioactive decay. 1. Discuss how and why elements within the Earth are undergoing radioactive decay. 2. Outline how radioactive decay is used to find the ages of rocks on the Earth.

D. Explain tidal energy and how it works to add energy to the Earth's surface.
E. Describe and discuss the affects of Solar energy on Earth.
F. Compare the processes of construction and destruction due to Earth's internal heat, the processes of destruction due to gravity, and solar energy on the Earth's surface using the rock cycle as an example.
    1. Describe how Earth's internal heat drives tectonic activity, which in turn drives the rock cycle and the construction and destruction of Earth materials.
    2. Explain and identify the Earth materials and processes involved in the rock cycle.
    3. List the different types of minerals, distinguish between minerals using their physical properties, and outline the most common rock forming minerals.
    4. Identify the three major types of rock, and explain how each type forms.
    5. Outline the most common rocks found in each rock type, and differentiate between rocks using their respective textures and compositions.

III. Plate Tectonics *(Chapter 2)*

A0. Geologic Time?

A. Outline the theory of continental drift.
    1. Summarize Wegener's hypothesis of continental drift.
    2. Describe the process of sea-floor spreading.
    3. Identify how paleomagnetism provides support for the idea of sea-floor spreading.
    4. Explain how sea-floor spreading provides a mechanism for continental drift.

B. List and describe the layers of the Earth.
    1. Identify the Earth's four major layers.
    2. Explain what Moho is.
    3. Distinguish the crust and mantle with the lithosphere and the asthenospere.
    4. Explain the principle of isostacy.
    5. Describe how the information about the Earth's interior was determined.

C. Explain the Theory of Plate Tectonics.
    1. Summarize the theory of plate tectonics.
    2. List and describe three causes of plate movement.
    3. List the major lithospheric plates that make up the Earth's surface.
    4. Compare the characteristic geologic features and activities that exist and occur along the three types of plate boundaries.
    5. Give several examples around the world illustrating the geologic hazards that exist due to the presence of each type of

	plate boundary. 6. Explain how hot spots are formed and list various examples of them around	
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	13.B.4c Analyze ways that resource manage-ment and technology can be used to accommodate population trends. **13.B.4d** Analyze local examples of resource use, technology use or conservation programs; document findings; and make recommendations for improvements. **13.B.4e** Evaluate claims derived from purported scientific studies used in advertising and marketing strategies. **13.B.5a** Analyze challenges created by international competition for increases in scientific knowledge and technological capabilities (e.g., patent issues, industrial espionage, technology obsolescence). **13.B.5b** Analyze and describe the processes and effects of scientific and technological breakthroughs. **13.B.5d** Analyze the costs, benefits and effects of scientific and technological policies at the local, state, national and global levels (e.g., genetic research, Internet access). **13.B.5e** Assess how scientific and techno-logical progress has affected other fields of study, careers and job markets and aspects of everyday life.
Objectives o **Conceptual** o **Factual** o **Procedural**	IV. Earthquakes (*Chapters 3 & 4)* A. Earthquake Characteristics 1. Define earthquake. 2. Explain the nature of earthquake vibrations using the principles of wave motions: period, wavelength, amplitude, and frequency. 3. Describe how earthquake waves are detected and recorded using seismographs and seismograms. 4. Compare and contrast P-waves, S-waves, Love waves, and Rayleigh waves. 5. Describe and illustrate why the Earth has shadow zones. B. Earthquake Causes 1. Describe and illustrate the motion involved in normal faults, reverse faults, thrust faults, and strike slip faults. 2. Explain the elastic rebound theory. 3. Differentiate between stress and strain and explain how they are related to earthquakes. C. Studying Earthquakes 1. Explain how seismologists locate earthquakes. 2. Analyze and extrapolate the location of an earthquake using earthquake data. 3. Differentiate between the intensity and magnitude of an earthquake. 4. Explain how the Mercalli Intensity Scale was created, what it measures, and how it is used to determine the strength of an earthquake. 5. Explain how the Richter Magnitude Scale was created, what it measures, and how it is used to determine the strength of an earthquake. 6. Distinguish between the different magnitude scales and explain when they are most appropriately used. 7. Analyze the relationship between earthquake magnitude and

frequency.

D. Earthquake Shaking, Damages, and Mitigation
   1. Compare the relationship between ground acceleration, shaking time, and displacement along a fault during an earthquake.
   2. Outline the different types of ground motion and failure during earthquakes.
   3. List some of the common damages sustained during earthquakes, what causes these damages, and some of the attempts to reduce this damage.
   4. Explain the efforts to mitigate an earthquake hazard such as disaster aid, insurance, protection, adaptation, land use planning, forecasts, and warnings.

E. Earthquake Prediction
   1. Illustrate the usefulness and consequences of earthquake prediction.
   2. Discuss the various precursors leading to an earthquake.
   3. Outline and explain seismic gaps, migrating earthquakes, earthquake regularity, paleoseismology, and triggering mechanisms as relevant to earthquake prediction.
   4. Discuss early warning systems, long-term forecasts, and risk maps.

F. Earthquakes and Tectonics
   1. Outline and illustrate the great earthquake hazards and disasters adjacent to the San Andreas Fault Region.
   2. List the types of faults, severity and depth of earthquakes, and several world examples of earthquakes at transform boundaries, subduction zones, blind thrust faults, continent-continent collision zones, continental spreading zones, divergent plate boundaries, and intraplate fault zones.

V. Tsunamis (*Chapter 5*)

A. The Nature of Tsunamis
   1. Define tsunami and explain the behavior of a tsunami from its beginning to its end by detailing the Sumatra Tsunami, December 2004 and the Chile Tsunami, May 1960.
   2. Outline potential damages and actual damages from tsunamis by detailing the Sumatra Tsunami, December 2004 and the Chile Tsunami, May 1960.

B. Tsunami Characteristics
   1. Define, summarize, illustrate, and give several examples of earthquake-generated, volcano-generated, and landslide-generated, volcano flank collapse, and asteroid impact-generated tsunamis.
   2. Explain the relation between the velocity and height of tsunami waves with water depth and gravity.
   3. Explain the nature of a tsunami wave as it hits the coastline.

4. Compare tsunamis with wind-driven, deepwater waves.
5. Describe and give examples of a seiche.
6. Compare a seiche to a tsunami.

C. Tsunami Vulnerability
1. Discuss why some areas are more vulnerable to tsunamis than others.
2. Evaluate the tsunami threat from great earthquakes in the Pacific Northwest.
3. Detail what to do to recognize and survive a tsunami.
4. Describe the current warning systems for tsunamis.

D. Tsunami Examples
1. Compare the largest recorded tsunamis.
2. Detail several tsunami case studies.
3. Evaluate the potential for a giant tsunami.

V. Volcanoes (*Chapters 6 & 7)*

A. Plate Tectonics and Magma
1. Outline the tectonic environments and activities responsible for volcanic eruptions.
2. Define and compare the mineral composition of magmas.
3. Evaluate the effects of viscosity, temperature, and water content of magmas.
4. Explain how volatiles affect magma.
5. Differentiate between basalt, andesite, and rhyolite magmas.
6. Analyze in the context of magmas the role of plate tectonics in volcanism.

B. Volcanic Eruptions
1. Detail the events that occur to produce a volcanic eruption.
2. List and illustrate the landforms associated with volcanic eruptions.
3. List and describe the various materials produced by volcanic eruptions.
4. Compare and contrast the types of volcanic eruptions in terms of general explosiveness and the Volcanic Explosivity Index (VEI).
5. Compare and contrast the types of volcanoes.
6. Compare the magma composition, viscosity, volatiles, & volume, type of volcano formed, the tectonic setting, and historical examples of disasters for the various types of volcanic eruptions.

C. Volcanic Case Histories
1. Assess and discuss the hazard risk due to volcanic eruptions.
2. Outline and compare the various hazards produced by volcanic eruptions.
3. Describe and compare several volcanic disasters.

D. Volcano Monitoring, Warning, and Mitigation

1. List and discuss the various environmental changes that precede a volcanic eruption.
2. Discuss examples of successful volcanic predictions and predicted eruptions in the near future.
3. Discuss disaster aid, protection, and adaptation in mitigating volcanic disasters.

E. Volcanoes and Climate
1. Describe the effects volcanic eruptions have on the atmosphere, weather, and climate.
2. Discuss the greatest threats to humans by volcanic eruptions in the future.

VI. Mass Movements and Land Subsidence (*Chapters 8 & 9*)

A. Mass movement hazard
1. Define mass movement.
2. Outline the disasters and hazards associated with landslides.
3. List some examples of killer mass movements.
4. Discuss the environments and conditions that increase the mass movement hazard.

B. Landslides
1. List, define, and illustrate the main features of landslides.
2. Describe in detail each of the factors that contribute to landslides including load, slope, slope material, friction, and water content.
3. Explain the activities of humans that increase the risk of slope failure.
4. Discuss the various roles and affects of water on a slope including surface tension and pressure.
5. Explain the ways water is and can be added and subtracted from a slope.
6. List and describe the various ways to stabilize slopes.
7. Explain the role of clays in slope stability.
8. Describe what swelling soils are and how they can exacerbate the risk of landslides.
9. Compare and contrast liquefaction with quick clay behavior.
10. Describe the preexisting geologic structures and conditions that expose and exacerbate the landslide hazard.
11. Describe the main triggers of landslides.

C. Types of Mass Movements
1. Compare and contrast the various types of mass movements.
2. Describe in detail and illustrate with examples falls, slides, flows, snow avalanches, submarine mass movements, and volcanic caused mass movements.

D. Land Subsidence
1. Outline the basic characteristics, details, and examples of slow and catastrophic land subsidence

	2. Explain the role of chemical weathering, earth material composition, and groundwater flow in subsidence. E. Mass Movement Mitigation 1. Analyze a landslide hazard map of the U.S. 2. Explain why people build in landslide prone areas. 3. Discuss disaster aid, insurance, protection, and adaptation in mitigating mass movement disasters. 11.	
Assessments	Performance Tasks ▪ Homework completion ▪ Design and carry out a controlled experiment ▪ Lab work and reports ▪ Quizzes ▪ Exams	Other Evidence

Unit Frameworks

Unit of Study: major topics	**Meteorological Hazards**	Resources that will support instruction
Illinois Learning Standards, Benchmarks, **National Standards Assessment Frameworks, or other standards that will be taught in this unit**	**STATE GOAL 12: Understand the fundamental concepts, principles and interconnections of the life, physical and earth/space sciences.** **B. Know and apply concepts that describe how living things interact with each other and with their environment.** **12.B.4a** Compare physical, ecological and behavioral factors that influence interactions and interdependence of organisms. **12.B.4b** Simulate and analyze factors that influence the size and stability of populations within ecosystems (e.g., birth rate, death rate, predation, migration patterns). **12.B.5a** Analyze and explain biodiversity issues and the causes and effects of extinction. **12.B.5b** Compare and predict how life forms can adapt to changes in the environment by applying concepts of change and constancy (e.g., variations within a population increase the likelihood of survival under new conditions). **C. Know and apply concepts that describe properties of matter and energy and the interactions between them.** **12.C.4a** Use kinetic theory, wave theory, quantum theory and the laws of thermo-dynamics to explain energy transformations. **12.C.4b** Analyze and explain the atomic and nuclear structure of matter. **12.C.5a** Analyze reactions (e.g., nuclear reactions, burning of fuel, decomposition of waste) in natural and man-made energy systems. **12.C.5b** Analyze the properties of materials (e.g., mass, boiling point, melting point, hardness) in relation to their physical and/or chemical structures. **D. Know and apply concepts that describe force and motion and the principles that explain them.** **12.D.4a** Explain and predict motions in inertial and accelerated frames of reference. **12.D.4b** Describe the effects of electromagnetic and nuclear forces including atomic and molecular bonding, capacitance and nuclear reactions. **12.D.5a** Analyze factors that influence the relative motion of an object (e.g., friction, wind shear, cross currents, potential differences). **12.D.5b** Analyze the effects of gravitational, electromagnetic and nuclear forces on a physical system. **E. Know and apply concepts that describe the features and processes of the Earth and its resources.** **12.E.4a** Explain how external and internal energy sources drive Earth processes (e.g., solar energy drives weather patterns; internal heat drives plate	

	tectonics). **12.E.4b** Describe how rock sequences and fossil remains are used to interpret the age and changes in the Earth. **12.E.5** Analyze the processes involved in naturally occurring short-term and long-term Earth events (e.g., floods, ice ages, temperature, sea-level fluctuations). **STATE GOAL 13: Understand the relationships among science, technology and society in historical and contemporary contexts.** **A. Know and apply the accepted practices of science.** **13.A.4a** Estimate and suggest ways to reduce the degree of risk involved in science activities. **13.A.4b** Assess the validity of scientific data by analyzing the results, sample set, sample size, similar previous experimentation, possible misrepresentation of data presented and potential sources of error. **13.A.4c** Describe how scientific knowledge, explanations and technological designs may change with new information over time (e.g., the understanding of DNA, the design of computers). **13.A.4d** Explain how peer review helps to assure the accurate use of data and improves the scientific process. **13.A.5a** Design procedures and policies to eliminate or reduce risk in potentially hazardous science activities. **13.A.5b** Explain criteria that scientists use to evaluate the validity of scientific claims and theories. **13.A.5c** Explain the strengths, weaknesses and uses of research methodologies including observational studies, controlled laboratory experiments, computer modeling and statistical studies. **13.A.5d** Explain, using a practical example (e.g., cold fusion), why experimental replication and peer review are essential to scientific claims. **B. Know and apply concepts that describe the interaction between science, technology and society.** **13.B.4b** Analyze a particular occupation to identify decisions that may be influenced by a knowledge of science. **13.B.4c** Analyze ways that resource management and technology can be used to accommodate population trends. **13.B.4d** Analyze local examples of resource use, technology use or conservation programs; document findings; and make recommendations for improvements. **13.B.4e** Evaluate claims derived from purported scientific studies used in advertising and marketing strategies. **13.B.5a** Analyze challenges created by international competition for increases in scientific knowledge and technological capabilities (e.g., patent issues, industrial espionage, technology obsolescence). **13.B.5b** Analyze and describe the processes and effects of scientific and technological breakthroughs. **13.B.5c** Design and conduct an environmental impact study, analyze findings and justify recommendations. **13.B.5d** Analyze the costs, benefits and effects of scientific and technological policies at the local, state, national and global levels (e.g., genetic research, Internet access).

	13.B.5e Assess how scientific and techno-logical progress has affected other fields of study, careers and job markets and aspects of everyday life.
Objectives o **Conceptual** o **Factual** o **Procedural**	VII. Atmosphere, Oceans, and Climate A. The Atmosphere 1. Describe the composition of Earth's atmosphere. 2. Identify the layers of the atmosphere. B. Energy in the Atmosphere 1. Explain how radiant energy reaches and interacts with the Earth. 2. Summarize the processes of radiation, conduction, and convection. C. Moisture in the Atmosphere 1. Outline the hydrologic cycle. 2. Explain how heat energy affects the changing phases of water. 3. Compare and contrast absolute humidity and relative humidity. 4. Describe the process of adiabatic cooling and its role in cloud formation. 5. Explain the role of the orographic effect in producing clouds and precipitation. 6. Identify the types of clouds. 7. Identify the four forms of precipitation and compare the processes that cause precipitation. D. Atmospheric Circulation 1. Explain the behaviors of high and low pressure regions in the atmosphere. 2. Describe the global patterns of air circulation 3. Explain the Coriolis Effect and how it effects global wind circulation. 4. Explain and illustrate global air circulation. 5. Identify two factors that form local wind patterns. 6. Explain non-weather related wind phenomena such as the Santa Ana and Chinook winds. 7. Describe what a jet stream is, how it forms, and why it behaves the way it does. E. Air Masses and Fronts 1. Explain how an air mass forms and list the four types of air masses. 2. Analyze the affect of jet streams on the interaction of air masses. 3. Describe how the interaction of air masses affects the weather of North America. 4. Explain how cold and warm fronts form and interact with one another. 5. Compare the characteristic weather patterns of cold fronts with those of warm fronts. F. Pressure Systems 1. Relate the behavior of fronts to high and low pressure systems.

2. Describe the circulation patterns in low and high pressure systems.
3. List the weather associated with high and low pressure systems.
4. List some of the common weather patterns in North America.

G. Circulation of the Oceans
1. Establish the link between the oceans and weather.
2. Explain the characteristics and behavior of the surface currents in the oceans.
3. List the major surface currents in the ocean.
4. Describe how the deep ocean circulates.
5. Explain how the surface and deep ocean currents interact.
6. Analyze the impact of the ENSO and NAO on weather.

H. The Oceans and Climate
1. Explain the El Nino / La Nina phenomena in the Southern Pacific.
2. Describe the Pacific Decadal Oscillation.
3. Outline how short term climate change affects drought and famine around the world.

I. Climate Change
1. Discuss how the climate cycles.
2. Compare how the Earth's climate has changed over the span of millions and thousands of years.
3. Discuss how the climate has changed over the last thousand years.
4. Compare how the climate has changed over the last two centuries.
5. Describe what global warming is and discuss what is causing it.
6. Explain how the atmosphere is cooled.
7. Compare how natural climate cycles affect human induced climate change.
8. Discuss the future of climate change.

VIII. Severe Weather *(Chapters 11 - 16)*

A. Overview of Severe Weather *(Chapters 14 & 15 / Abbott Chapter 11)*
a. Define and list the types of severe weather.
b. Compare the deaths due to the various forms of severe weather in the U.S.
c. Compare the economic loses due to the various forms of severe weather in the U.S.

B. Mid-latitude Cyclones
1. Explain the characteristics and examples of a mid-latitude cyclone.
2. Explain the characteristics, behaviors, and past examples of nor'easters, blizzards, ice storms, and heat waves.

C. Thunderstorms
1. Explain the formation, characteristics, behaviors, and past

examples of thunderstorms.
2. Discuss the characteristics and hazards of heavy rains, flash floods, hail, lightning, and downbursts, and list some examples for each.

D. Derechos
1. Explain what a derecho is and how they are formed.
2. Outline the damages caused by derechos, and list some examples of particularly destructive derecho events.

E. Tornadoes
1. Explain the formation, characteristics, behaviors, classification, and past examples of thunderstorms.
2. Compare historical tornado events for frequency, intensity, damage, economic impact, and casualties.

F. Mitigation of Severe Weather Hazards
1. Discuss disaster aid, insurance, protection, and adaptation in mitigating severe weather disasters.
2. Explain the difficulties behind some of the mitigating efforts.

G. Hurricanes *(Chapters 13 & 14)*
1. Hurricane Hazards
    a. Define tropical cyclones and give some examples of their power and destruction.
    b. Discuss the risks, vulnerabilities, and impacts surrounding tropical cyclone hazards.
2. Hurricane Characteristics
    a. Describe the characteristics and structure of a hurricane.
    b. Explain how, where, and why hurricanes and tropical cyclones form.
3. Classifying and Forecasting Hurricanes
    a. Describe how hurricanes are named, classified, and categorized.
    b. Identify and discuss the hurricane season, the frequency of hurricanes both in the past and in the future, and the forecasting of a hurricane season.
    c. Discuss the paths of hurricanes.
4. Hurricane Damages
    a. Detail the characteristics and damages caused by storm surges, heavy rains and inland flooding, wind, and waves.
    b. Illustrate with past cases, hurricanes along the Atlantic coastline, the Gulf coastline, and the Pacific coastline, cyclones in Bangladesh, and typhoons in the Western Pacific coastline.
5. Coastline and Wave Characteristics
    a. Discuss the characteristics of waves, the coastlines, and the interaction between the two.

b. Discuss the affects of human interaction with the coastline.

6. Mitigating Hurricane Hazards
    a. Outline ways to reduce the damages caused by tropical cyclones.
    b. Discuss evacuation, disaster aid, insurance, protection, and adaptation in mitigating tropical cyclone disasters.
    c. Explain the difficulties behind some of the mitigating efforts.

H. Floods *(Chapters 11 & 12)*

1. Flood Hazards
    a. Define flood.
    b. Compare flood hazards to other natural hazards.
    c. Analyze the trends of floods over the past several decades.
    d. Outline the deaths due to floods in the recent past.
    e. Identify flood prone environments.
    f. Discuss why people decide to live in flood prone areas.
2. Stream Characteristics
    a. Examine the basic principles underlying stream flow, drainage basin, gradient, and discharge.
    b. Outline the features and characteristics of stream erosion and deposition including floodplains, meanders, channel width, depth, and capacity, deltas, and alluvial fans.
3. Types of Streams
    a. Outline the types of streams.
    b. Compare and contrast gaining and losing streams.
4. Steam Equilibrium
    a. Explain what is meant by stream equilibrium.
    b. Discuss the nature of sediment transport in a stream.
    c. Explain the relationship between stream load and stream discharge.
    d. Differentiate between positive and negative feedback mechanisms in stream loads.
5. Conditions for Flooding
    a. Explain precipitation intensity and runoff in relation to flooding.
    b. Discuss stream order and flooding.
    c. Discuss flooding on frozen or saturated ground.
    d. Explain what a streams power has to do with flood intensity.
6. Flood Frequency
    a. Compare flood frequency, discharge, and recurrence intervals.
    b. Discuss the problems with recurrence intervals.

7. Types of Floods
    a. Explain the characteristics, formation, and hazard potential of the different types of floods.
    b. Provide examples for each of the types of floods.
8. Flood Control
    a. Compare the structural and non-structural attempts to control floods.
    b. List the types, characteristics, examples, and problems with dams, levees, and channelization.
    c. List the changes imposed on streams and the various problems that result from them that work to exacerbate the flooding problem.
9. Learning from Past Floods
    a. Analyze floods through paleoflood analysis.
    b. Discuss examples of great floods.
    c. Discuss the benefits of floods.
10. Mitigating Floods
    a. Review the factors that influence and exacerbate floods.
    b. Discuss evacuation, disaster aid, insurance, protection, and adaptation in mitigating flood disasters.
    c. Explain the difficulties behind some of the mitigating efforts.

I. Droughts *(Abbott Chapter 11)*
1. Define drought.
2. Explain why droughts are known as creeping hazards.
3. Discuss the complexities of drought impact.
4. Explain why droughts are so harmful to semi-arid regions using the Sahel region in Africa as an example.
5. Outline the role of drought in the Dustbowl of the 1930's.
6. Explain the problems with drought management.
7. Compare and contrast the different types of droughts.
8. Explain the causes of drought.
9. Compare the relationship between drought and famine.
10. Discuss disaster aid, protection, and adaptation in mitigating droughts and famine.
11. Explain some of the difficulties with the mitigating efforts.

J. Wildfires *(Chapter 16)*
1. Wildfire Characteristics
    a. Discuss the history, nature, and usefulness of fire.
    b. List the causes of wildfires.
    c. Explain the process and behavior of fire.
    d. Illustrate and explain the fire triangle.
    e. Discuss the various natural fuels for wildfires.
    f. Outline the stages and spread of fires.
    g. List the affects on a slope resulting from a fire.

<table>
<tr><td></td><td colspan="2">h. Explain what is meant by fire weather and fire danger class.
i. Give some examples of great fires of the past.
j. Describe what a firestorm is and what causes them, illustrated by the fire square.
2. Humans and Wildfires
a. Discuss home design and fire vulnerability.
b. Describe methods of fire suppression and prevention.
c. Illustrate the negative effects of fire suppression with the examples of Yellowstone and Baja/California.
d. Discuss the failed efforts for a prescribed burn in the Los Alamos fire.
e. Discuss disaster aid, protection, and adaptation in mitigating fires.
f. Explain some of the difficulties with the mitigating efforts.</td></tr>
<tr><td>Assessments</td><td>Performance Tasks
▪ Homework completion
▪ Design and carry out a controlled experiment
▪ Lab work and reports
▪ Quizzes
▪ Exams</td><td>Other Evidence</td></tr>
</table>

Unit Frameworks

Unit of Study: major topics	**Mass Extinctions**	Resources that will support instruction

Illinois Learning Standards, Benchmarks,

National Standards Assessment Frameworks, or other standards that will be taught in this unit

STATE GOAL 11: Understand the processes of scientific inquiry and technological design to investigate questions, conduct experiments and solve problems.

A. Know and apply the concepts, principles and processes of scientific inquiry.
11.A.4a Formulate hypotheses referencing prior research and knowledge.
11.A.4e Formulate alternative hypotheses to explain unexpected results.
11.A.5a Formulate hypotheses referencing prior research and knowledge.

STATE GOAL 12: Understand the fundamental concepts, principles and interconnections of the life, physical and earth/space sciences.

A. Know and apply concepts that explain how living things function, adapt and change.
12.A.4c Describe processes by which organisms change over time using evidence from comparative anatomy and physiology, embryology, the fossil record, genetics and biochemistry.
12.A.5a Explain changes within cells and organisms in response to stimuli and changing environmental conditions (e.g., homeostasis, dormancy).

B. Know and apply concepts that describe how living things interact with each other and with their environment.
12.B.4a Compare physical, ecological and behavioral factors that influence interactions and interdependence of organisms.
12.B.4b Simulate and analyze factors that influence the size and stability of populations within ecosystems (e.g., birth rate, death rate, predation, migration patterns).
12.B.5a Analyze and explain biodiversity issues and the causes and effects of extinction.
12.B.5b Compare and predict how life forms can adapt to changes in the environment by applying concepts of change and constancy (e.g., variations within a population increase the likelihood of survival under new conditions).

C. Know and apply concepts that describe properties of matter and energy and the interactions between them.
12.C.4a Use kinetic theory, wave theory, quantum theory and the laws of thermo-dynamics to explain energy transformations.
12.C.5b Analyze the properties of materials (e.g., mass, boiling point, melting point, hardness) in relation to their physical and/or chemical structures.

D. Know and apply concepts that describe force and motion and the principles

	that explain them. **12.D.4a** Explain and predict motions in inertial and accelerated frames of reference. **12.D.5a** Analyze factors that influence the relative motion of an object (e.g., friction, wind shear, cross currents, potential differences). **12.D.5b** Analyze the effects of gravitational, electromagnetic and nuclear forces on a physical system. **E. Know and apply concepts that describe the features and processes of the Earth and its resources.** **12.E.4a** Explain how external and internal energy sources drive Earth processes (e.g., solar energy drives weather patterns; internal heat drives plate tectonics). **12.E.4b** Describe how rock sequences and fossil remains are used to interpret the age and changes in the Earth. **12.E.5** Analyze the processes involved in naturally occurring short-term and long-term Earth events (e.g., floods, ice ages, temperature, sea-level fluctuations). **STATE GOAL 13: Understand the relationships among science, technology and society in historical and contemporary contexts.** **A. Know and apply the accepted practices of science.** **13.A.4a** Estimate and suggest ways to reduce the degree of risk involved in science activities. **13.A.4b** Assess the validity of scientific data by analyzing the results, sample set, sample size, similar previous experimentation, possible misrepresentation of data presented and potential sources of error. **13.A.4c** Describe how scientific knowledge, explanations and technological designs may change with new information over time (e.g., the understanding of DNA, the design of computers). **13.A.4d** Explain how peer review helps to assure the accurate use of data and improves the scientific process. **13.A.5a** Design procedures and policies to eliminate or reduce risk in potentially hazardous science activities. **13.A.5b** Explain criteria that scientists use to evaluate the validity of scientific claims and theories. **13.A.5c** Explain the strengths, weaknesses and uses of research methodologies including observational studies, controlled laboratory experiments, computer modeling and statistical studies. **13.A.5d** Explain, using a practical example (e.g., cold fusion), why experimental replication and peer review are essential to scientific claims. **B. Know and apply concepts that describe the interaction between science, technology and society.** **13.B.4a** Compare and contrast scientific inquiry and technological design as pure and applied sciences. **13.B.4b** Analyze a particular occupation to identify decisions that may be influenced by a knowledge of science. **13.B.4c** Analyze ways that resource management and technology can be used to accommodate population trends. **13.B.4d** Analyze local examples of resource use, technology use or conservation programs; document findings; and make recommendations for

	improvements. **13.B.4e** Evaluate claims derived from purported scientific studies used in advertising and marketing strategies. **13.B.5a** Analyze challenges created by international competition for increases in scientific knowledge and technological capabilities (e.g., patent issues, industrial espionage, technology obsolescence). **13.B.5b** Analyze and describe the processes and effects of scientific and technological breakthroughs. **13.B.5c** Design and conduct an environmental impact study, analyze findings and justify recommendations. **13.B.5d** Analyze the costs, benefits and effects of scientific and technological policies at the local, state, national and global levels (e.g., genetic research, Internet access). **13.B.5e** Assess how scientific and techno-logical progress has affected other fields of study, careers and job markets and aspects of everyday life.
Objectives o **Conceptual** o **Factual** o **Procedural**	Mass Extinctions in Earth's History *(Abbott Chapter 15)* A. Fossils and Geologic Time 1. Define mass extinction. 2. Define and describe the types of fossils and methods of fossil preservation. 3. Explain the Laws of Faunal Assemblages and Faunal Succession. 4. Outline the history of life from its beginnings as indicated by the fossil record. 5. Illustrate the major events and their temporal occurrences using the Geologic Time Scale. 6. Explain the relationships and theories surrounding fossils, evolution, and organism classification. B. Mass Extinctions 1. Outline the times and species that died out at each of the major extinctions events during the Phanerazoic Eon. 2. Discuss the possible causes of mass extinction. 3. Detail the possible and probable causes of the Permian extinction and the Cretaceous-Tertiary extinction. 4. Discuss species alive today that have survived some of the major extinction events throughout geologic time. 5. Discuss the most recent extinction events in the later Quaternary period and the role of humans in those extinction events. XIII. Impacts *(Abbott Chapter 16)* A. Space Debris 1. Describe the hazard associated with impacts with space objects. 2. Compare and contrast meteoroids, meteors, meteorites, asteroids, and comets. 3. Discuss the origins of large space objects. 4. Distinguish between the different types of meteorites. 5. Evaluate the influx of meteoroids.

<table>
<tr><td></td><td colspan="2">B. Past Impacts and Craters
1. Outline the crater forming process and give some examples of past impacts and their resultant craters on the Earth.
2. Discuss the various forms of evidence left by large impact events.
3. Describe the biggest known impact events in Earth's history.
4. Discuss the biggest near miss events in recent history.
C. Impact Hazard
1. Evaluate the chances of death from a large impact event.
2. Calculate the frequency of a large impact event on Earth.
3. Evaluate the likelyhood of a large impact from a comet or asteroid.
4. Predict the likely consequences of a large impact event on Earth.
5. Discuss the defenses against a large impact.</td></tr>
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