Chapter 1 – Nature of Science

1. **Scientific Knowledge**
   a. **What is science?**
      i. The study of the natural world – life science, Earth science, and physical science
   b. **What does science tell us?**
      i. Scientific knowledge is always changing, but it can provide explanations for how things happen
   c. **How do scientific theories differ from scientific laws?**
      i. A law describes the way the world works, and a theory explains how things happen. Theories usually explain laws.
   d. **Where do scientists get their evidence?**
      i. Scientists can collect empirical evidence in the field or in a laboratory
   e. **How do scientific ideas change?**
      i. Because new evidence gets discovered, or by collaboration and/or debate with other scientists

2. **Scientific Investigations**
   a. **What are some types of scientific investigations?**
      i. Experiments and observation
   b. **What are some parts of scientific investigations?**
      i. Hypothesis, independent (test) variable, dependent (outcome) variable, observations, data
   c. **What are some scientific methods?**
      i. Define the problem, form hypothesis/make predictions, plan the investigation, collect and organize data, interpret the data and analyze it, make and defend your conclusion
   d. **How are scientific methods used?**
      i. Different situations require different methods – sometimes investigations are better, other times you will have to rely on observations
   e. **What are characteristics of good scientific investigations?**
      i. They should be able to be repeated and replicated, as well as reviewed by a peer.
   f. **How is repetition different from replication?**
      i. Repetition is when you repeat your own experiment again; replication is when someone else repeats your experiment
   g. **How can you evaluate the quality of scientific information?**
      i. The most reliable information is usually published in journals or books written and reviewed by scientists, or through government or academic institutions.

3. **Representing Data**
   a. **How do scientists make sense of data?**
      i. By organizing, graphing, and analyzing data
   b. **What do graphs show?**
      i. Data in a visual way
   c. **How do scientists evaluate models?**
      i. By how much it can explain, how well it can adapt, or by the one with the fewest limitations

4. **Vocabulary**
   – empirical evidence, theory, law, experiment, observation, hypothesis, independent (test) variable, dependent (outcome) variable, data, model

Chapter 2 – Earth’s Structures

1. **Minerals**
   a. **What do minerals have in common?**
      i. They have a definite chemical composition, are solid, have a crystalline structure, and are natural occurring
b. How are minerals formed?
   i. As magma and lava cool, by metamorphism, and from solutions

c. How are minerals classified?
   i. As silicate or non-silicate (native elements, halides, sulfates, carbonates, oxides, and sulfides)

d. What properties can be used to identify minerals?
   i. Color, streak, luster, cleavage, fracture, density, hardness, and other special properties

2. The Rock Cycle
   a. What is rock?
      i. A naturally occurring solid mixture of one or more minerals, and sometimes organic matter
   b. What processes change rock?
      i. Weathering, erosion, deposition, temperature, and pressure
   c. What are the classes of rock?
      i. Sedimentary, metamorphic, and igneous
   d. What is the rock cycle?
      i. The series of ways rock can change forms
   e. How do tectonic plate motions affect the rock cycle?
      i. By moving up and down, or by pulling apart Earth’s surface

3. Earth’s Layers
   a. What is inside Earth?
      i. Earth is made of several layers
   b. What are Earth’s compositional layers?
      i. From outside in - crust, mantle, and core
   c. What are Earth’s physical layers?
      i. From outside in – lithosphere, asthenosphere, mesosphere, outer core, inner core

4. Plate Tectonics
   a. What evidence suggests that continents move?
      i. Fossils of the same species have been found on different continents, the locations of mountain ranges and rocks on various continents match up, and historic climate conditions in various locations match up
   b. What is Pangaea?
      i. Scientists think that a long time ago, all of the continents were joined together and one big land mass called Pangaea
   c. What discoveries support the idea of continental drift?
      i. Age and magnetic properties of the sea floor, sea-floor spreading, and ocean trenches
   d. What is the theory of plate tectonics?
      i. Describes large-scale movements of Earth’s lithosphere, which explains how and why Earth’s continents move
   e. What is a tectonic plate?
      i. Pieces of Earth’s lithosphere that move and float on the asthenosphere
   f. What are the three types of plate boundaries?
      i. Convergent, divergent, and transform
   g. What causes tectonic plates to move?
      i. Convection in the mantle, ridge push, and slab pull

5. Mountain Building
   a. How can tectonic plate motion cause deformation?
      i. When rock is placed under stress, it deforms or changes. When the plates move they cause stress on rock/Earth.
   b. What are two kinds of folds?
      i. Synclines and anticlines
   c. What are the three kinds of faults?
      i. Strike-slip, normal, and reverse
   d. What are the three kinds of mountains?
6. **Earthquakes**
   a. What is an earthquake?
      i. Ground movements that happen when blocks of rock in Earth move suddenly and release energy
   b. What causes earthquakes?
      i. When two tectonic plates move it creates pressure, which makes faults. Energy builds up at the faults; when it gets released you have an earthquake
   c. Where do earthquakes happen?
      i. Along plate boundaries – divergent, convergent and transform
   d. What are some effects of earthquakes?
      i. Dangers to people and structures; they can also cause tsunamis

7. **Volcanoes**
   a. What is a volcano?
      i. Any place where gas, ash, or melted rock (magma) come out of the ground
   b. What are the kinds of volcanic landforms?
      i. Volcanic mountains (shield, cinder cone, or composite), fissures, lava plateaus, craters, and calderas
   c. Where do volcanoes form?
      i. Along tectonic plate boundaries and hot spots

8. **Vocabulary** – mineral, element, atom, compound, matter, crystal, streak, luster, cleavage, weathering, erosion, deposition, sedimentary rock, igneous rock, metamorphic, rock cycle, uplift, subsidence, rift zone, crust, mantle, convection, core, lithosphere, asthenosphere, mesosphere, Pangaea, sea-floor spreading, plate tectonics, tectonic plates, convergent boundary, divergent boundary, transform boundary, convection, deformation, folding, fault, shear stress, tension, compression, earthquake, focus, epicenter, tectonic plate boundary, elastic rebound, volcano, magma, lava, vent, hot spot

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**Chapter 3 – Earth’s History**

1. **Geologic Change Over Time**
   a. What is the principle of uniformitarianism?
      i. Geologic processes that happened in the past can be explained by the geologic processes happening today
   b. How do organisms become preserved as fossils?
      i. They can get trapped in amber or asphalt, buried in rock, or become frozen or petrified
   c. What are trace fossils?
      i. A fossil that formed in sedimentary rock by animal activity on or in that area (foot prints, etc.)
   d. What can fossils tell us?
      i. About environmental changes over time, and how life forms have changed over time
   e. How does sedimentary rock show Earth’s history?
      i. These rocks provide clues about the environment they formed in because of their composition, texture, and features
   f. What do Earth’s surface features tell us?
      i. Continents move, and landforms change over time
   g. What other materials tell us about Earth’s climate history?
      i. Trees, sea-floor spreading, and ice

2. **Relative Dating**
   a. What is relative dating?
      i. Estimating if an object is older or younger than another object (without deciding on the actual age)
   b. How are undisturbed rock layers dated?
      i. Using superposition (younger rock layers lie above older rock layers)
   c. How are sedimentary rock layers disturbed?
i. Tilting, folding, faults, intrusions, and unconformities

d. How are rock layers ordered?
i. Usually the youngest layers are on top of the oldest layers
e. How are fossils used to determine relative ages of rocks?
i. Scientists can classify the remains of organisms in the fossil, which show change over time.
f. How are geologic columns used to compare relative ages of rocks?
i. Geologic columns are created by scientists – they are arrangements of rock layers based on age (old rocks are at the bottom, younger rocks towards the top)

3. Absolute Dating
a. How can the absolute age of rock be determined?
i. By using radioactive isotopes and radiometric dating
b. What is the best rock for radiometric dating?
i. igneous
c. What are some radiometric dating methods?
i. Radiocarbon dating, potassium-argon dating, and uranium-lead dating
d. How is radiometric dating used to determine the age of Earth?
i. By using other bodies in space and comparing the ages
e. How can fossils help to determine the age of sedimentary rock?
i. Using index fossils
f. How are index fossil used?
i. They are used as markers for the time that the organisms lived on Earth, which help scientists date other objects

e. Vocabulary – uniformitarianism, fossil, trace fossil, climate, ice core, relative dating, superposition, unconformity, fossil geologic column, absolute dating, radioactive dating, half-life, radiometric dating,

Chapter 4 – Human Impact of Earth

1. Natural Resources
a. What are natural resources?
i. Any natural material used by humans (air, soil, minerals, water, petroleum, plants, and animals)
b. How can we categorize natural resources?
i. Renewable and non renewable
c. How do we use natural resources?
i. As material resources (food, drinks, building materials, clothing materials, etc.) and as energy resources (water, solar power, fossil fuels, etc.)

2. Human Impact on Land
a. Why is land important?
i. It supplies a solid surface for building, soil for growing plants, fossil fuels for energy, etc.
b. What are the different types of land use?
i. Recreational, transport, agricultural, residential, commercial, and industrial
c. Why is soil important?
i. It’s a habitat for organisms, and it stores water and nutrients
d. How can human activities affect land and soil?
i. Urban sprawl replaces trees with buildings, erosion is sped up when too many trees are cut down (deforestation), nutrients get depleted, desertification makes land unable to support life

3. Human Impact on Water
a. Why is water important?
i. It shapes Earth and is vital for life
b. There is lots of water, so what’s the problem?
i. 97% of the available water is salty
c. Where do we get fresh water?
i. Aquifers, ground water, rivers, lakes, and streams
d. What are water quality and supply?
   i. Water quality measures how clean water is, supply is the availability of water

e. What threatens fresh water quality?
   i. Thermal, chemical, and biological pollution, and also eutrophication (when there are too many artificial nutrients in water, which changes the balance of life in the water in a bad way)

f. How is water quality measured?
   i. Quality is based on the amount of dissolved solids, pH, dissolved oxygen, turbidity, and microbial load in the water sample

g. How is water treated for human use?
   i. Water is treated to remove bad chemicals and debris

h. Who monitors and protects our water quality?
   i. The Environmental Protection Agency (EPA)

i. How does water get to the faucet?
   i. Though water supply systems

j. What threatens our water supply?
   i. Increased use and demand for fresh water

k. How do efforts to supply water to humans affect the environment?
   i. Buildings dams and canals change the natural flow of water, and construction of these items can harm the environment and take away habitats for plants and animals

4. Human Impact of the Atmosphere
   a. Why us the atmosphere important?
      i. It provides gases organisms need to survive, absorbs harmful radiation from the sun, and keeps Earth warm
   b. What is air pollution?
      i. When the atmosphere is contaminated by pollution from human and natural sources (gases and particulates)
   c. What pollutants can form from vehicle exhaust?
      i. Ground level ozone and smog
   d. How does pollution from human activities produce acid precipitation?
      i. Burning fossil fuels releases pollution into the air, which mixes with precipitation
   e. What are some effects of acid precipitation?
      i. Soil and water become more acidic, killing plants and washing away nutrients; lakes and streams also become more acidic which can kill aquatic life
   f. What are measures of air quality?
      i. The air quality index
   g. How can air quality affect health?
      i. Pollution can cause coughing, headaches, difficulty breathing, burning/itchy eyes, asthma, emphysema, allergies, lung cancer, and chronic bronchitis
   h. How might humans be changing Earth’s climate?
      i. By burning fossil fuels
   i. What are some predicted effects of climate change?
      i. Warmer temperatures; drought in some places, increased precipitation in others, and availability of food will be affected
   j. How is the ozone layer affected by air pollution?
      i. Pollution causes the ozone layer to break down, which lets harmful UV rays from the sun pass through to Earth’s surface

5. Protecting Earth’s Water, Land, and Air
   a. What are conservation and stewardship?
      i. Conservation is using resources wisely, stewardship the careful planning and management of resources
   b. How can we preserve water resources?
      i. By conserving water and promoting water stewardship
   c. How can we preserve land resources?
      i. Through land preservation (protecting land from damage), reforestation (replanting trees), reclamation (restoring damaged land), reducing urban sprawl (building up
instead of out), recycling (reusing materials instead of throwing them away), and soil conservation methods (changing up farming methods to protect land, etc).

d. How can we reduce air pollution?
   i. Through energy conservation, technology, and laws like the Clean Air Act.

6. **Vocabulary** – natural resource, renewable resource, nonrenewable resource, fossil fuel, material resource, energy resource, urbanization, land degradation, deforestation, desertification, water pollution, point-source pollution, nonpoint-source pollution, thermal pollution, eutrophication, potable, reservoir, greenhouse effect, air pollution, particulate, smog, acid precipitation, air quality, conservation, stewardship

**Chapter 5 – Waves and Light**

1. **Waves**
   a. What are waves?
      i. A disturbance that transfers energy from one place to another
   b. How does a wave transfer energy?
      i. Waves transfer energy in the direction it travels; either longitudinal (particles move back and forth) or transverse (particles move perpendicular/ up and down)
   c. What are some types of waves?
      i. Mechanical (require a medium to travel) and electromagnetic (disturbance in electric and magnetic fields)

2. **Properties of Waves**
   a. How can we describe a wave?
      i. By its amplitude (how “high” a wave is), wavelength (how far apart waves are, or repeat), and frequency (how long a wave takes to repeat)
   b. What affects the energy of a wave?
      i. Amplitude, frequency, and the energy loss due to spreading
   c. What determines the speed of a wave?
      i. The medium the wave is traveling through, and its frequency and wavelength

3. **The Electromagnetic Spectrum**
   a. What is the nature of light?
      i. Light is a type of energy that travels as a wave, but does not need a medium; light is a disturbance in electric and magnetic fields
   b. What determines the color of light?
      i. Light has wavelengths, and each wavelength makes a different color
   c. What are the parts of the EM spectrum?
      i. Radio waves, microwaves, infrared light, visible light, ultraviolet light, x-rays, and gamma rays
   d. How much of the sun’s energy reaches us?
      i. Radio waves and visible light can reach Earth’s surface, but the atmosphere blocks most other EM waves; we can also shield ourselves with protective clothing, sunscreen, etc.
   e. How much energy does EM radiation have?
      i. Higher frequency = more energy, more energy = more dangerous

4. **Interactions of Light**
   a. How can matter interact with light?
      i. Matter can transmit, absorb, and reflect light
   b. What determines the color of objects we see?
      i. The light that is being reflected, absorbed, or transmitted (whichever color is reflected off an object is what we will see.)
   c. What happens when light waves interact with matter?
      i. Light slows when it passes through matter, it can also change direction (refraction), and scatter.
5. **Vocabulary** – wave, medium, longitudinal wave, transverse wave, mechanical wave, electromagnetic wave, amplitude, wavelength, wave period, frequency, hertz, wavefront, wave speed, radiation, electromagnetic spectrum, infrared, ultraviolet, transparent, translucent, opaque, absorption, reflection, refraction, scattering

### Chapter 6 – Energy and Heat

1. **Energy Conversion and Conservation**
   a. What are forms of energy?
      i. Mechanical, sound, electromagnetic (EM), chemical, thermal, heat, and nuclear energy
   b. What is an energy transformation?
      i. When energy changes from one form to another form
   c. Is energy conserved?
      i. Energy cannot be created or destroyed, it can only change forms
   d. How is efficiency measured?
      i. The amount on useful output energy created by something is compared to the amount of energy put into it

2. **Temperature**
   a. What is the kinetic theory of matter?
      i. All of the particles that make up matter are constantly in motion, and because they're in motion they have kinetic energy
   b. How do particles in solids, liquids, and gases move?
      i. Solid – particles vibrate in a stable position and are held tightly together; liquid – particles can move more than in a solid, but they move together; gas – particles move freely and in every direction
   c. How does temperature related to kinetic energy?
      i. Temperature is a measure of the average kinetic energy of the particles in an object
   d. How is temperature measured?
      i. In units called degrees with a tool called a thermometer; degree can be measured in Celsius, Fahrenheit, and Kelvins

3. **Thermal Energy and Heat**
   a. What is thermal energy?
      i. The total kinetic energy of all the particles in a substance
   b. What is the difference between thermal energy and temperature?
      i. Temperature is the average kinetic energy of particles, thermal energy is the total kinetic energy of particles
   c. What is heat?
      i. Energy transferred from one object at a higher temperature to an object with a lower temperature
   d. How is heat measured?
      i. With calories or Joules; 1 cal = 4.18 J
   e. How is heat related to thermal energy?
      i. Adding or removing heat will affect the temperature and thermal energy
   f. How can heat affect the state of an object?
      i. Temperature will affect the state of matter of an object
   g. What is conduction?
      i. Transfer of energy as heat through direct contact with conductors (transfers heat well) or insulators (does not transfer heat well)
   h. What is convection?
      i. Transfer of energy as heat through movement of a liquid or gas
   i. What is radiation?
      i. Transferring energy by electromagnetic waves

4. **Vocabulary** – energy transformation, law of conservation of energy, efficiency, kinetic theory of matter, temperature, degree, thermometer, thermal energy, heat, calorie, conduction, conductor, insulator, convection, radiation
Chapter 7 – Life Over Time

1. Theory of Evolution by Natural Selection
   a. What did Darwin observe?
      i. Darwin observed birds from area of islands and noticed differences among the species; he noticed the different species also had different ways of going about things
   b. What other ideas influenced Darwin?
      i. Organisms pass traits on to their offspring, organisms can acquire traits over time, the earth changes over time, and that a struggle for survival exists
   c. What are the four parts of natural selection?
      i. Overproduction, genetic variation, selection, and adaptation
   d. How do species change over time?
      i. Species change in response to their environment
   e. Why is adaptation important for survival?
      i. Species that don’t adapt to the environment might go extinct

2. Evidence of Evolution
   a. How do fossils form?
      i. Usually in sedimentary rock; dead organisms can get trapped and covered with a layer of sediment or mud, which settles and forms a fossil
   b. How do fossils change over time?
      i. Fossils change depending on how old the organism is and when and where it lived
   c. What other evidence supports evolution?
      i. Organisms with common structures, similar DNA, and developmental similarities
   d. How do we know organisms are related?
      i. Because of fossil and molecular evidence

3. Vocabulary – evolution, artificial selection, natural selection, variation, adaptation, extinction, fossil, fossil record

Chapter 8 – Reproduction and Heredity

1. Mitosis
   a. Why do cells divide?
      i. To reproduce (make more cells) and for growth and repair of the organism
   b. What happens to genetic material during cell division?
      i. The genetic material (DNA) is copied and compacted into chromosomes
   c. What are the stages of the cell cycle?
      i. Interphases, mitosis, and cytokinesis
   d. What are the phases of mitosis?
      i. Prophase, metaphase, anaphase, and telophase

2. Meiosis
   a. How do sex cells differ from body cells?
      i. Sex cells have half the genetic information of a normal, complete cell
   b. Why do organisms need sex cells?
      i. Sex cells are needed to prevent an organism from having too many chromosomes
   c. How are sex cells made?
      i. Meiosis makes sex cells (sperm and eggs)
   d. What are the stages of meiosis?
      i. Meiosis 1 (prophase 1, metaphase 1, anaphase 1, telophase 1) and meiosis 2 (prophase 2, metaphase 2, anaphase 2, telophase 2)
   e. How does meiosis compare to mitosis?
      i. Only cells that will become sex cells go through meiosis, all other cells go through mitosis; during meiosis chromosomes are copied once and the nucleus divides twice, during mitosis the chromosomes are copied once and the nucleus divides once; meiosis produces cells with only half the genetic information, mitosis produces cells with a full set of genetic information
3. **Sexual and Asexual Reproduction**
   a. **What is asexual reproduction?**
      i. One organism produces another organism that is exactly identical to itself
   b. **How do organisms reproduce asexually?**
      i. Binary fission (in prokaryotes, the organism splits in two, making two new cells); budding (when an organism develops buds on its body that eventually branch off to make a new organism), spores (special cells that can survive harsh conditions and are light enough to be carried by the wind; they turn into new organisms), and vegetative reproduction (some plants can grow from stems, roots, and leaves of existing plants)
   c. **What is sexual reproduction?**
      i. Two parent organisms contribute a sex cell to create a new organism through fertilization
   d. **What are the advantages of each type of reproduction?**
      i. Advantages of asexual reproduction – it’s quick, offspring inherit all favorable traits from the parent, doesn’t require a partner, all offspring able to reproduce
      ii. Advantage of sexual reproduction – increases genetic variation, increased chances of offspring survival
      iii. Advantages of both – some organisms can use either; many plants can use asexual reproduction to reproduce quickly, increasing the chances of that species’ survival

4. **Heredity**
   a. **What is heredity?**
      i. When parents pass genetic information to their offspring
   b. **What did Gregor Mendel discover about heredity?**
      i. He discovered that the traits offspring have are based on inherited factors
      ii. There are dominant traits and recessive traits
   c. **How are traits inherited?**
      i. Genes are passed from parents to offspring
      ii. These genes determine what traits the offspring will have
      iii. Many genes can influence a single trait
      iv. Other times a single gene can influence many traits
      v. The environment can also influence traits
   d. **What are the exceptions to complete dominance?**
      i. Incomplete dominance (when both a dominant and recessive trait are expressed at the same time, blended together)
      ii. Codominance (when both traits are expressed equally)

5. **Punnett Squares**
   a. **How are Punnett squares used to predict patterns of heredity?**
      i. It can be used to predict possible combinations of genes for offspring
   b. **How can a Punnett square be used to make predictions about offspring?**
      i. It relies on probability to predict the possible combinations of genes for offspring
   c. **How can a pedigree trace a trait through generations?**
      i. Pedigrees work like family trees – they map and track various traits through a family

6. **Vocabulary** – DNA, chromosomes, cell cycle, interphase, mitosis, cytokinesis, homologous chromosomes, meiosis, asexual reproduction, sexual reproduction, fertilization, heredity, gene, allele, genotype, phenotype, dominant, recessive, incomplete dominance, codominance, Punnett square, probability, ratio, pedigree

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**Chapter 9 – DNA and Modern Genetics**

1. **DNA Structure and Function**
   a. **What is DNA?**
      i. Deoxyribonucleic acid (DNA) is the genetic material in cells
   b. **How was DNA discovered?**
      i. It took many scientists many years to put together enough information to figure out DNA
   c. **What does DNA look like?**
      i. A double helix, made of sugars, phosphates, and bases
   d. **How are copies of DNA made?**
1. **Introduction to Ecology**
   a. How are all living things connected?
      i. Ecology is the study of how organisms interact with each other and their environment
      ii. Through both the living and nonliving environments
   b. What are all the levels of organization in the environment?
      i. Ecosystems, communities, populations, and individuals
   c. What determines where a population can live?
      i. The organisms' habitat and niche (job or role)

2. **Roles in Energy Transfer**
   a. How do organisms get energy?
      i. Producers convert energy into food
      ii. Decomposers break down matter
      iii. Consumers eat other organisms
         1. Carnivores (eat meat), herbivores (eat vegetables), and omnivores (eat anything)
   b. How is energy transferred among organisms?
      i. Energy flows through a food chain
   c. How do food webs show energy connections?
      i. Food webs show feeding relationships among organisms in an ecosystem
   d. How are organisms connected by food webs?
      i. All living organisms are connected by global food webs

3. **Interactions in Communities**
   a. How do predator and prey interact?
      i. Predators eat prey, so their populations are connected
   b. What are some types of symbiotic relationships?
      i. Mutualism (when both organisms benefit from the relationship)
      ii. Commensalism (when one organism benefits and the other is unaffected)
      iii. Parasitism (when one organism benefits and the other is harmed)
c. Why does competition occur in communities?
   i. When organisms are fighting for the same limited resources

4. **Florida's Ecosystems**
   a. What limits the size of populations?
      i. Limiting factors (food, water, shelter, mates, etc)
   b. What are introduced species?
      i. Species that have been brought into an area because of human interaction
   c. What are Florida's land ecosystems?
      i. Prairies, forests, beaches, dunes
   d. What are Florida's freshwater ecosystems?
      i. Lakes, ponds, rivers, streams, and wetlands
   e. What are Florida's marine ecosystems?
      i. Coral reefs, estuaries, salt marshes, and mangrove swamps

5. **Vocabulary** – ecology, biotic factor, abiotic factor, population, species, community, ecosystem, habitat, niche, producer, decomposer, consumer, herbivore, carnivore, omnivore, food chain, food web, predator, prey, symbiosis, mutualism, commensalism, parasitism, competition, limiting factor, native species, introduced species, wetland, coral reef, estuary