### 8th Grade Science Study Guide

<table>
<thead>
<tr>
<th>3.01</th>
<th>Analyze the unique properties of water including:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- Universal solvent</td>
</tr>
<tr>
<td></td>
<td>- Cohesion and adhesion</td>
</tr>
<tr>
<td></td>
<td>- Polarity</td>
</tr>
<tr>
<td></td>
<td>- Density and buoyancy</td>
</tr>
<tr>
<td></td>
<td>- Specific heat</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3.02</th>
<th>Explain the structure of the hydrosphere including:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- Water distribution on earth</td>
</tr>
<tr>
<td></td>
<td>- Local river basin</td>
</tr>
<tr>
<td></td>
<td>- Local water availability</td>
</tr>
</tbody>
</table>

Water has unique properties.

**Cohesion** is when molecules of one type are drawn to each other; surface tension is the tightness across the surface that is caused by water molecules pulling on each other; when molecules of different kinds are drawn to each other, it is called adhesion.

**Polarity** - one end has a positive charge and the other has a negative charge

The structure of water gives it various interesting properties that are critical on life on Earth;

Water bonds to itself and other substances; water cools as it evaporates; water expands when it freezes

Sea water has unique properties; it is saline, its freezing point is slightly lower than fresh water, its density is slightly higher than fresh water, and pH is slightly basic.

Water has the highest surface tension of all liquids
Density = ratio of mass to volume
Unit of Density = g/cm³
Density of water = 0.997 g/cm³

**Specific heat** - ability to hold heat

The ocean occupies over 70% of the earth’s surface and represents a rich and diverse biome

In a river base, all of the water eventually flows to the same place.

Watersheds are the areas of land that water drains in to when the ground is saturated or impermeable.

Ground water is one of the earth’s most valuable resource.

The rate of ground water movement varies based on the rock material through which the water is moving.

Wells provide the best source of information about an aquifer.

The ocean is connected to major lakes, watersheds, and waterways because all major watersheds on Earth drain to the ocean. Rivers and streams transport nutrients, salts, sediments, and pollutants from watersheds to estuaries and to the ocean.

The ocean is the dominant physical feature of our planet.

There is one ocean with many ocean basins, such as the North Pacific, South Pacific, North Atlantic, South Atlantic, Indian and Arctic.
3.03 Evaluate evidence that Earth’s oceans are a reservoir of nutrients, minerals, dissolved gases, and life forms:
- Estuaries
- Marine ecosystems
- Upwelling
- Behavior of gases in the marine environment
- Value and sustainability of marine resources
- Deep ocean technology and understandings gained

Do NOT have students memorize facts related to ecosystems. The purpose is to get a view of the diversity of life forms and uniqueness of marine ecosystems. Although the ocean is large, it is finite and resources are limited.

Estuaries are partially enclosed bodies where seawater is diluted by fresh water that drains from the land. Estuaries act as a filtering system to remove some chemical elements and compounds from land run off. Estuaries provide important and productive nursery areas for many marine and aquatic species.

The salt in seawater comes from eroding land, volcanic emissions, reactions at the sea floor, and atmospheric deposition.

There are many deep ocean ecosystems that are independent of energy from sunlight and photosynthetic organisms. Hydrothermal vents, submarine hot springs, and methane cold seeps rely only on chemical energy and chemosynthetic organisms to support life.

Use of ocean resources has increased significantly; therefore the future sustainability of ocean resources depends on our understanding of those resources and their potential and limitations.

The ocean affects every human life. Most rain comes from the ocean and over half of Earth’s oxygen. From the ocean we get foods, medicines, and mineral and energy resources.

Tides, waves and predation cause vertical zonation patterns along the shore, influencing the distribution, diversity, and availability of organisms. Many organisms spend parts of their life cycle in aquatic and terrestrial surroundings.

Most life in the ocean exists as microbes. Microbes are the most important primary producers in the ocean. Not only are they the most abundant life form in the ocean, they have extremely fast growth rates and life cycles.

3.04 Describe how terrestrial and aquatic food webs are interconnected.

Food webs share similar properties.
- Food webs are highly connected and easily disturbed.
- Food webs interact with one another.
- The level of toxins in an organism can be increased on the basis of the organism’s position in a food chain which, as the food web develops, biomagnifications take place.

The ocean is the last and largest unexplored place on Earth. Less than 5% of it has been explored.

Exploration, inquiry, and study are required to better understand the ocean systems and processes.

New technologies, sensors, and tools are expanding our ability to explore the ocean.

Ocean scientists rely on satellites, drifters, buoys, subsea observatories and unmanned submersibles.

Ocean exploration requires collaboration among biologists, chemists, climatologists, computer programmers, engineers, geologists, meteorologists, and physicists, and new ways of thinking.

Use of mathematical models is now an essential part of ocean sciences. Models help us understand the complexity of the ocean and of its interaction with Earth’s climate. They process observations and help describe the interactions among systems.
### 3.07 Describe how humans affect the quality of water:
- Point and non-point sources of water pollution in North Carolina
- Possible effects of excess nutrients in North Carolina waters
- Economic trade-offs
- Local water issues

### 3.08 Recognize that the good health of environments and organisms requires:
- Monitoring of the hydrosphere
- Water quality standards
- Methods of water treatment
- Maintaining safe water quality
- Stewardship

### 4.01 Understand that both naturally occurring and synthetic substances are chemicals.

### 4.02 Evaluate evidence that elements combine in a multitude of ways to produce compounds that account for all living and nonliving substances.

<table>
<thead>
<tr>
<th>The health of water systems is dependent on the balance of its many natural systems.</th>
<th>Ocean habitats are defined by environmental factors—interactions of abiotic factors such as salinity, temperature, oxygen, pH, light, nutrients, pressure, substrate, and circulation.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human activities can disrupt the balance of natural systems. This threatens to alter environmental conditions upon which we depend for survival.</td>
<td>Population provides insights into the health of a water system. Tolerance to water quality conditions varies among organisms. Clear water may contain odorless, tasteless, and colorless harmful contaminants. Water must be tested for specific contaminants such as bacteria, nitrates, arsenic, and so on.</td>
</tr>
<tr>
<td>Knowledge about natural systems and informed decision making regarding its use are essential for the maintenance of a life-sustaining planet. The variety of NC coasts and rivers shape the behavior and life cycles of its inhabitants.</td>
<td>If chemicals, hazardous wastes, oil, etc. collect on the ground surface, runoff percolating into the soil can transfer these undesired substances into the ground water.</td>
</tr>
<tr>
<td>The ocean has significant importance to the Earth’s economic and ecological systems. Everyone is responsible for caring for water. Water sustains life on Earth and humans must live in ways that sustain our supply of water. Individual and collective actions are needed to effectively manage water resources for all. Much of the world’s population lives in coastal areas. Laws, regulations, and resource management affect what is taken out and put into the ocean.</td>
<td>Everything in the environment is made up of chemicals. A chemical is any substance that has a defined molecular composition.</td>
</tr>
<tr>
<td>All forms of matter are made of one or more &gt;100 elements combined in many different molecular combinations. Thus, all forms of matter are made of chemicals. Elements combine to form compounds. The properties of compounds depend on their atoms and chemical bonds.</td>
<td></td>
</tr>
</tbody>
</table>
4.03 Explain how the periodic table is a model for:
- Classifying elements
- Identifying the properties of elements

4.04 Describe the suitability of materials for use in technological design:
- Electrical conductivity
  - Density
  - Magnetism
  - Solubility
  - Malleability

The periodic table contains a wealth of information about elements. Horizontal rows are called periods. These elements have common electron configuration. Vertical columns are called groups. These elements have similar properties.

It is convenient to divide the table into 2 groups - metals and nonmetals.

Metals are good conductors of electricity. Most of the known elements are metals.
The transition metals are generally not as reactive as Groups 1 and 2 and have varied properties. Nonmetals are poor conductors of electricity and have a wide range of properties.

Along the staircase line separating the metals and nonmetals are the metalloids. They are not as conductive as metals but are more conductive than nonmetals.

The chemical and physical properties of elements must be taken into account when designing a product or solution to a problem. Properties of materials determine whether they will function in a design.

Electrical conductivity refers to how well electricity is conducted by the material. This is determined by examining the properties of the element or compound.

All matter has mass and volume.

**Density** = ratio of mass to volume

Because the density of a given substance is the same for all samples of the substance, density is used for identification purposes.

**Solution** - a liquid mixture that can be separated into its original parts

Parts of a solution:
- **Solvent** - the substance that does the dissolving
- **Solute** - the substance that gets dissolved
- **Precipitate** - the solute that will no longer dissolve in the solute
- **Solubility** - the amount of a substance that will dissolve in the solute
- **Saturated solution** - a solution that will hold no more solute

Corrosion is the chemical weathering of materials such as metals. This must be taken into account when using metals. A substance’s atomic structure determines its physical and chemical properties.
<table>
<thead>
<tr>
<th>4.05 Identify substances based on characteristic physical (and chemical) properties:</th>
<th>4.07 Identify evidence supporting the law of conservation of matter.</th>
<th>4.08 Identify evidence that some chemicals may contribute to human health conditions including:</th>
</tr>
</thead>
</table>
|  - Density  
  - Boiling/Melting points  
  - Solubility  
  - Chemical reactivity  
  - Specific heat |  - During an ordinary chemical reaction matter cannot be created or destroyed  
  - In a chemical reaction, the total mass of the reactants equals the total mass of the products. |  - Cancer  
  - Autoimmune disease  
  - Birth defects  
  - Heart disease  
  - Diabetes  
  - Learning and behavioral disorders  
  - Kidney disease  
  - Asthma |
| 4.06 Describe and measure quantities related to chemical/physical changes within a system. |  - Temperature  
  - Volume  
  - Mass  
  - Precipitate  
  - Gas production |  |
|  - Temperature  
  - Volume  
  - Mass  
  - Precipitate  
  - Gas production |  - Chemical reactions form new substances by breaking and making chemical bonds.  
  - Chemical reactions alter arrangements of atoms.  
  - The rate of chemical reactions can vary. All physical and chemical changes involve a change in energy.  
  - Chemical reactions describe how matter behaves.  
  - Mass remains constant throughout a chemical reaction. |  - Organisms have different responses to chemical exposure because each organism is unique.  
  - A chemical is considered toxic if it produces adverse effects in a living organism at levels of exposure that are likely to occur. These adverse effects can range from slight symptoms such as headache, nausea, or rashes, to acute responses such as coma, convulsions, and death.  
  - The human body has defenses against many toxic agents. Cells, especially in the liver and kidneys, can break down toxins (at a dose below the threshold). The resulting non-toxic substances are eliminated from the body in urine and feces.  
  - Threshold responses for chemicals that cause cancers and other chronic conditions are harder to determine than those that result in acute responses. |
| Physical properties involve things that can be measured without changing the chemical properties. | Chemical reactions form new substances by breaking and making chemical bonds. |  |
| Matter can undergo physical changes which affect only physical properties. | Chemical reactions alter arrangements of atoms. |  |
| Physical changes can involve changes in energy. | The rate of chemical reactions can vary. All physical and chemical changes involve a change in energy. |  |
| **Exothermic reaction** - a reaction in which energy is released.  
  **Endothermic reaction** - a reaction in which energy is absorbed. | Chemical reactions describe how matter behaves. |  |
| Evidence that a chemical change has occurred generally fits into these categories; gas production (bubbling or an odor), formation of a precipitate, or heat. | Mass remains constant throughout a chemical reaction. |  |
| Properties of matter may be either physical or chemical. |  |  |
### 4.09
Describe factors that determine the effects a chemical has on a living organism including:
- Exposure
- Potency

Describe risks and benefits of chemicals including:
- Medicines
- Food preservatives
- Crop yield
- Sanitation

Scientists use the dose-response curve to understand toxicity of a chemical. Some of both naturally occurring and synthetic chemicals can have a detrimental effect on human health, but many do not.

Chemicals can enter the body through inhalation, ingestion, and absorption. The effect a chemical has on the body depends on dose (total amount of chemical that gets into the organism) and the resulting concentration (dose: body size), the length of exposure, and the route of exposure.

For most toxic responses, there is a dose called threshold, below which there are no adverse effects from exposure to the chemical. There are historic examples of situations involving hazardous chemical exposure.

In the absence of human data, research with animals is the most reliable means of detecting important toxic properties of chemical substances and for estimating risks to human and environmental health.

Percent concentration refers to the amount of a chemical compared with the total volume of liquid.

\[
\text{ml of chemical} = \frac{\% \text{ concentration}}{\text{ml of liquid}}
\]

Decisions about chemical exposure happen at different levels—from the individual to larger social, economic, and political forces. There are many organizations and agencies involved in research and monitoring to protect human health and to safeguard the environment.

Human will often have to consume an enormous quantity of a harmful chemical to be affected. Chemical compounds of the same substance will always have the same proportion by mass, without regard to, where and how the compound originated.

### 4.10
Describe risks and benefits of chemicals including:
- Medicines
- Food preservatives
- Crop yield
- Sanitation

Chemistry has enabled tremendous changes to be made in the way we live.

Chemistry is an important part of daily life.
### 5.01
Interpret ways in which rocks, fossils, and ice cores record Earth’s geologic history and the evolution of life including:
- Geologic Time Scale
- Index Fossils
- Law of Superposition
- Unconformity
- Evidence for climate change
- Extinction of species
- Catastrophic events

### 5.02
Correlate evolutionary theories and processes:

#### Biological
- Geological
- Technological

Rocks, fossils, and ice cores show:
- That life forms have changed over time
- That Earth’s climate and surface changed over time

It is not the intent to convince students that global temperatures are rising at an unprecedented rate, but rather to present the result of research and encourage students to apply critical thinking skills to complex issues such as global climate change.

Fossils that can be used to help determine the relative age of rock layers are called index fossils.

The Law of Superposition states that each undisturbed rock layer is older than the layer above it. This law is used to read rock layers.

By studying rocks and fossils, scientists have developed a geologic time scale which outlines the major divisions of Earth’s history.

The divisions of geologic time are based on changes that occurred on Earth at these times such as extinction.

Many factors, both natural and anthropogenic (human-made) determine Earth climate. The natural factors can include, but are not limited to the following:
- Atmosphere: Sun (energy, orbit, tilt, cycles, reflection, (albedo), clouds, precipitation, wind, gases (H2O, vapor, CO2, CH4,) feedbacks and cycles.
- Geosphere: geography (mountains, water sources, volcanoes, surface roughness, earth’s core heat, feedbacks.
- Hydrosphere: currents, surface roughness, ice sheets, cycles, feedbacks.
- Biosphere: living organisms, carbon storage and cycling, evapo-transpiration, surface roughness, and feedbacks.
- The human factors are often thought to have influence on local climate; however they may also have regional and global effects. The human factors include, but are not limited to the following:
  - Land Uses: slash and field burning, deforestation, agriculture, wetlands, cities (“urban heat island” effect)
  - Resource Uses: burning of fossil fuels (oil, wood, and coal)

Throughout history, species that could not adapt to Earth events died out. Some catastrophic events include asteroids hitting earth, the ice ages and volcanic eruptions with technological advances and utilization of tools, scientist are able to study the interconnections of biological and geological changes over time.

The earliest evidence of life is found in the oceans such as deep ocean organisms that rely on chemical energy.
5.03
Examine evidence that the geologic evolution has had significant global impact including:

- Distribution of living things
- Major geological events
- Mechanical and chemical weathering

Sea level changes over time have expanded and contracted continental shelves, created and destroyed inland seas and shapes the surface of land.

Sea level changes as plate tectonics cause the volume of the oceans and the height of land to change, as ice caps on land melt or enlarge and/or as sea water expands when ocean water warms and cools.

The processes responsible for changes we observe today are similar to the processes that have occurred throughout Earth’s history.

The evolution of Earth’s living things is strongly linked to the movements of the lithospheric plates. Living things evolve in response to changes in their environment. The movements of the plates cause changes in climate, in geographic features such as mountains, and in the types of living things in particular places.

When the history of the Earth and its living things is studied, some basic patterns occur over and over again. One pattern is when landmasses join together, diversity decrease. Another pattern is that when landmasses split apart, the diversity of land animals increases. One a big landmass, animals can easily move to suitable places and avoid the more challenging environments. On a small landmass, animals are stuck where they are and thus must adapt to local conditions. At the same time, the animals are cut off from competitors and natural enemies on other landmasses. This combination of conditions results in the development of an enormous number of new species.

Lithospheric plates constantly move at rates of centimeters per year in response to movement in the mantle. Major geological events, such as earthquakes, volcanic eruptions, and mountain building, result from these plate motions.

The movement of the Earth’s lithospheric plates is a source of continuous and historic impact on Earth’s surface features and the distribution of life forms.

Alfred Wegner used Mesosaurus fossils found in both Africa and South America as evidence for theory of continental drift. Other evidence includes mountain ranges in eastern US and Canada match ranges in Greenland and northwest Europe, ages and kinds of rock along one continents, diamonds in Brazil and West Africa mines are the same, fossils of same plant spores found in Africa, Asia, Australia, and Antarctica.

Mechanical weathering involves only physical changes, such as size or shape. The chemical make-up of the rocks does not change. Mechanical weathering occurs as a result of ice wedging, root action, and temperature changes.
5.04 Analyze satellite imagery as a method to monitor Earth from space:

- Spectral analysis.

Scientists need information that requires observation of very large regions or of the whole planet.

Remote sensing enables scientists to obtain information about the environment that would otherwise be difficult to collect. Remote sensing is a process by which scientists study satellite images taken in orbit and then transmitted to Earth. A satellite image is composed of square units called pixels.

The pixel size limits the fineness of detail for a satellite image, which is called the resolution. The smaller the pixel size, the finer the detail that can be seen and the higher the resolution.

Remote sensing depends upon the electromagnetic spectrum.

Light is electromagnetic waves, and the different wavelengths of light correspond to the different colors that our eyes and brain allow us to see. The sun also gives off considerable energy as ultraviolet light and infrared light. Earth’s atmosphere absorbs most of the ultraviolet light, but the infrared energy reaches the surface and reflects back towards space, along with much of visible light. The amount of energy reflected at different wavelengths provides a wealth of information about Earth’s surface. Spectral analysis examines reflectance curves. Reflected radiation gives a “signature” for features.

Satellite images are combined and enhanced. Ground truthing, observing directly, what you are analyzing using satellite images, is an important part of remote sensing.

Reflectance curves show the percentages of electromagnetic wavelengths, both visual and infrared, that are reflected from a surface, such as water or dry soil. Remote sensing scientists have determined the typical spectral reflectance for vegetation, soil, and water, as well as other surface materials. Reflectance curves show the percentages of electromagnetic wavelengths, both visual and infrared, that are reflected from a surface, such as water or dry soil. Remote sensing scientists have determined the typical spectral reflectance for vegetation, soil, and water, as well as other surface materials.

Electronic scanners record radiation as it is reflected and emitted from earth. Each ground surface has its own reflection pattern, which is called a signature. The signatures are the radiated wavelengths of light, each appears somewhat different from the others, and they help distinguish different objects and environmental conditions on the earth from one another. Radar is used when cloud cover interferes with the way that some sensors receive and record radiation from earth.

Analysis of images made at different times show changes on Earth’s surface.
### 5.05
Use maps, ground truthing and remote sensing to make predictions regarding:
- Changes over time
- Land use
- Urban sprawl
- Resource management

### 6.01
Describe cell theory:
- All living things are composed of cells.
- Cells provide structure and carry on major functions to sustain life.
- Some organisms are single cell; other organisms, including humans, are multi-cellular.
- Cell function is similar in all living things.

### 6.03
Compare life functions of Protists:
- **Euglena**
- **Amoeba**
- **Paramecium**
- **Volvox**

Analysis of images made at different times show changes on Earth’s surface.

According to the cell theory, proposed over 150 years ago:
- All living things are composed of cells.
- All cells come from pre-existing cells.
- Cells are the fundamental units of life.

Although cells were described in the 1600s, they were not studied widely until the 1800s, because microscopes were not improved until that time.

The **cell theory** was proposed in 1838 by the German zoologist Theodor Schwann and the German botanist Matthias Schleiden. The idea was considered radical at the time.

**Corollaries of modern cell research/theory:**
- The chemical composition of all cells is fundamentally alike.
- All cells arise from preexisting cells through cell division.
- Properties of life are in essence defined by the properties of cells.
- An organism’s capacity to live is based on individual and collective activities within a cell, and
- Cellular activities provide for the continuity of life.

Cells organize into tissues; tissues form organs; organs form systems; systems form organisms.

Cell theory is one of the major theories in life science.

Even the simplest organisms have parts which enable them to move, take in food, to reproduce and to detect the environment they are in.

**Euglena**- genus of flagellates, known for unique feature of an eye spot, some contain chlorophyll, common in fresh water.

**Amoeba**- movement by cytoplasmic streaming, surrounds food and engulfs it using pseudopods, one type one parasitic and causes Amoebic Dysentery in humans.

**Paramecium**- most complex and specialized protests; ciliate.

Volvox colony of ciliates visible to naked eye; contain chlorophyll.
<table>
<thead>
<tr>
<th>6.04</th>
<th>7.01</th>
<th>7.02</th>
</tr>
</thead>
</table>
| Conclude that animal cells carry on complex chemical processes to balance the needs of the organism.  
- Cells grow and divide to produce more cells.  
- Cells take in nutrients to make the energy for the work cells do.  
- Cells take in materials that a cell or an organism needs. | Compare and contrast microbes:  
- Size, shape, structure.  
- Whether they are living cells | Describe diseases caused by microscopic biological hazards including:  
- Viruses  
- Bacteria  
- Parasites  
- Contagions  
- Mutagens |
| All cells divide to create new cells either by mitosis or meiosis.  
Cell membrane is selectively permeable, allowing only certain substances from the outside environment to enter the cell.  
Sugars to produce energy for the cell are broken down in a process that uses oxygen and produces carbon dioxide and water.  
Cells are 90% water. Other molecules include: 50% protein, 15% carbohydrate, 15% nucleic acid, 10% lipid, and 10% others.  
Cells are composed at the elemental level of: 60% Hydrogen, 25% Oxygen, 10% Carbon, and 5% Nitrogen. | Bacteria and Protists have characteristics of living things.  
Viruses are not considered to be alive but they affect living things. Viruses need a host cell. | The Center of Disease Control collects data regarding outbreaks of diseases and studies patterns of occurrence.  
AIDS, Influenza, the Common Cold, Polio, Chicken Pox, Small Pox, Yellow Fever, Viral Meningitis, West Nile Virus and Ebola are caused by viruses.  
Rabes, Leprosy, Lyme Disease, and Bacterial Meningitis are caused by bacteria. |
### 7.03
Analyze data to determine trends or patterns to determine how an infectious disease may spread including:
- Carriers
- Vectors
- Conditions conducive to disease
- Calculate reproductive potential of bacteria

Vectors are mechanisms (other than a person) that spread disease without getting sick itself. Rats, ticks, mosquitoes, and soil are examples of vectors.

An infectious disease is one that can be passed from one organism to another.

A single bacterial cell can reproduce into 2 million cells every day. If they all survived, in a few weeks the cell and its offspring would equal the mass of the Earth. Fortunately, they can’t all survive because they deplete the nutrients they need to live. They die and break down to make food for another life. Antibiotics work based on chemical and structural differences of bacteria.

### 7.04
Evaluate the human attempt to reduce the risk of and treatment for microbial infections including:
- Solutions with antimicrobial properties
- Antibiotic treatment
- Research

Treatments that are successful currently may not be in the future due to mutations of microbes.

Sequencing the DNA of microbes has many potential applications including, but not limited to better approaches to preventing, diagnosing, and treating diseases; comparative studies to human genes; industrial processes; possible solutions to environmental problems; and producing energy.

### 7.05
Investigate aspects of biotechnology including:
- Specific generic information available
- Careers
- Economic benefits to North Carolina
- Ethical issues
- Impact for agriculture

Career choices related to biotechnology are unfolding and being created in response to industry, scientific, and technological needs.

Bacteria are important in the preparation of foods and beverages.