Washington West Supervisory Union

Science Curriculum

Pre K - 12

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The standards addressed here are from the National Science Education Standards and the Vermont Framework of Standards and Learning Opportunities. We also looked at many curricula available to us from throughout the state. We give special credit and thanks to the Franklin Northwest Supervisory Union and to South Burlington for their documents which helped us greatly in planning and forming our own. Thanks also to Frank Watson of VISMT and Karin Hess formerly of Thatcher Brook for reviewing our document and for helpful input along the way. We have given consideration to themes, which were already in place in our district and to the comments from teachers and administrators, which we received continuously throughout the process of putting this document together.

The content of the sections labeled “Assessments” is at the discretion of the classroom teacher for implementation of the assessment. It is expected that most students will maintain science portfolios, which will include one assessment piece for each standard taught. Assessment pieces may include (but are not limited to) teacher observation notes, journal entries, photographs, audio tapes, research reports, video tapes, 3-D projects, paper pencil activities, charts, graphs, diagrams, drawings, process skills checklist, written lab reports, self assessment, etc. Currently the State of Vermont assesses student knowledge of science at grades 5, 9, and 11.

This curriculum is organized by grade levels. Each section represents the science knowledge that a student should have at that particular grade level: Space, Time and Matter; the Living World; the Human Body; and the Universe and the Environment. The Evidence of Learning sections represent the knowledge, which all students should have for each particular standard. The focusing questions are suggestions to lead the teacher through those principles, which are fundamental to the understanding of specific science concepts. Multi age classrooms are encouraged to schedule the topics so that all the material for those grade levels will be covered by the time the students leave the classroom.

Science Process Skills are included in the study of science and are associated with the process of inquiry. They appear below as a simple list, but they are embedded throughout the entire curriculum.

**Science Process Skills**
- Observing
- Identifying and Controlling Variables
- Classifying
- Gathering, Organizing and Processing Data
- Communicating
- Measuring
- Analyzing
- Predicting
- Formulating Hypotheses
- Inferring
- Designing Investigations and Experiments

*Inquiry Science* “involves asking a simple question, completing an investigation, answering the question and presenting the result to others.” (National Science Education Standards) We have included topics that give students increased understanding of the objects and materials they encounter daily. The classroom is a limited environment. Science should extend to the outside world taking advantage of whatever resources are available. The VT Standards 7.1, 7.2, 7.3, and 7.4 addressing Inquiry Science are embedded throughout this curriculum and are not necessarily referenced on each page of this document.
The following is adapted from the Vermont Elementary Science Project:

When doing inquiry-based science:
Students view themselves as scientists in the process of learning. This is evident when they:
• Look forward to doing science
• Demonstrate a desire to do more
• Seek to collaborate and work cooperatively with peers
• Are confident in doing science; they demonstrate a willingness to modify ideas, take risks, and display healthy skepticism
• Respect individuals and differing points of view
Students accept an invitation to learn and readily pursue science exploration. This is evident when they:
• Exhibit curiosity and ponder questions
• Take the opportunity to test their own ideas
Students plan and carry out an investigation. This is evident when they:
• Design a fair test to try out an idea without being told how to proceed
• Plan ways to verify, extend, or discard ideas
• Carry out investigations while safely handling materials, observing, measuring, and recording data
Students communicate using a variety of methods. This is evident when they:
• Express ideas in a variety of ways – journals, reporting out, drawing, graphing, charting, etc.
• Listen, speak, and write about science with parents, teachers, and peers
• Use the language of process science
• Communicate their understanding of concepts being worked on
Students offer explanations and solutions while building science concepts. This is evident when they:
• Offer explanations based on previous experience and knowledge resulting from current investigations
• Use investigations to satisfy their own questions
• Sort information and make judgments as to what is important
• Are willing to revise explanations and consider new ideas as they build understanding
Students ask questions about the world around them. This is evident when they:
• Question verbally as well as through actions
• Ask questions that lead to investigations leading to further questions
• Value and enjoy asking questions as an important part of science
Students use observations. This is evident when they:
• Observe carefully rather than just look
• See details; seek patterns; detect sequences and events; notice changes, similarities, and differences
• Make connections to previously held ideas
Students critique their own science practices. This is evident when they:
• Create and use quality indicators to assess their own work
• Report and recognize their strengths and identify what they would like to improve on
• Reflect upon their learning with adults and peers

Each elementary and middle school has a resource reference book to aid in the implementation of this curriculum. Some of the books available are: Resources for Teaching Elementary School Science, National Science Resource Center; Project 2061: Benchmarks for Science Literacy; National Science Education Standards by the National Research Council; and NSTA Pathways through the Science Standards - elementary, middle, and high school editions: Guidelines for Moving the Vision into Practice.
Science Curriculum Overview

Science Standards 7.1 through 7.4 which address the Scientific Method – Investigation, Theory, and History as well as 7.11 Systems are embedded throughout each specific topic in this curriculum. While these standards are not listed in this overview, it is the expectation that they will be included in every unit of study. Standards 7.17 Design Technology – Systems and 7.19 Design Technology – Solutions are addressed in other WWSU curriculum documents.

Please note this list is meant as a very brief overview and one must refer to the corresponding section of this document for the complete topic and information.

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<td>P &amp; K</td>
<td>properties, living &amp; nonliving</td>
<td>human similarities and differences</td>
<td>earth / rocks</td>
<td>extracting natural resources</td>
<td>tool safety</td>
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<td>1</td>
<td>electricity &amp; magnetism</td>
<td>animals</td>
<td>senses</td>
<td>reuse &amp; recycle</td>
<td>simple machines</td>
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<td>2</td>
<td>states of matter</td>
<td>plants</td>
<td>body parts, digestion, skeleton, circulation</td>
<td>weather, water cycle</td>
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<td>3</td>
<td>forces / motion, solids, liquids, and gases</td>
<td>populations, food web</td>
<td>personal health, human development</td>
<td>weather, water cycle, pollution</td>
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<td>heat, light, &amp; sound</td>
<td>evolution &amp; extinction</td>
<td>sun &amp; sky</td>
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<td>electricity &amp; magnetism</td>
<td>ecosystems, photosynthesis, classification</td>
<td>forces of nature &amp; change over time</td>
<td>tools &amp; machines</td>
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<td>solar system, universe</td>
<td>renewable &amp; nonrenewable resources</td>
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<td>endocrine &amp; immune systems Genetics</td>
<td>Ecology and natural resource management</td>
<td>uses of technology</td>
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<td>sci. of chem., matter &amp; energy, atomic structure, electronic configuration, periodic table, ionic compounds, covalent bonds, molecular forces, electrochemistry, carbon / organic compounds, Molecular chemical equations, stoichiometry, change, gases &amp; liquids, solutions, acids &amp; bases, reaction rates, electrochemistry</td>
<td>cells, tissue</td>
<td>human physiology, musc./skel., nervous, digestion, respiration, circulation, excretory, endocrine, immune, &amp; reproduction systems</td>
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<td>reproduction of cells, molecular basis of inheritance, genetics</td>
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### Performance Criteria - Pre-K through 12

**Scientific Method**

This profile is a teaching tool that represents a continuum of skill levels for using the Scientific Method.

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<tr>
<td><strong>a. Questions</strong></td>
<td>Ask questions about objects, organisms &amp; events in the world around them.</td>
<td>Frame question in a way that distinguishes causes &amp; effects.</td>
<td>Frame questions in a way that distinguishes causes &amp; effects.</td>
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<td><strong>c. Hypothesis</strong></td>
<td>Make a prediction directly related to a question.</td>
<td>Write a prediction directly related to the question &amp; showing cause &amp; effect.</td>
<td>Write a prediction directly related to the question &amp; showing cause &amp; effect.</td>
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<tr>
<td><strong>c. Experimental Design</strong></td>
<td>Relate plan directly to hypothesis, identify variable(s), select appropriate sample size, use appropriate measurement.</td>
<td>Relate plan directly to hypothesis, identify variable(s), select appropriate measurement independently and correctly.</td>
<td>Relate plan directly to hypothesis, identify variable(s), select appropriate measurement independently and correctly.</td>
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<tr>
<td><strong>c. Data Collection</strong></td>
<td>Collect and record data in an organized way. Record important observations.</td>
<td>Independently choose method for collecting &amp; recording data. Record in writing accurate observation.</td>
<td>Independently choose methods for collecting &amp; recording data. Record in writing accurate observation.</td>
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<td><strong>c,d. Data Analysis Conclusions</strong></td>
<td>Draw conclusions that accurately reflect the hypothesis. Express conclusion that addresses the hypothesis &amp; accurately reflects data &amp; observations, e.g. orally or use manipulatives, tally, pictures, written graphs, tables, model, chart, diagrams, videos.</td>
<td>Express written conclusions that address the hypothesis &amp; accurately reflect data and observations. Support written findings, e.g. graphs, charts, diagrams, models, tables, videos.</td>
<td>Express written conclusions that address the hypothesis &amp; accurately reflect data and observations. Support written findings, e.g. graphs, charts, diagrams, models, tables, videos.</td>
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<td><strong>b,d.e. Applications and Extensions</strong></td>
<td>Brainstorm questions &amp; connections or graph data or design alternative presentation of data. Formulate &amp; record further questions.</td>
<td>Brainstorm questions &amp; connections or graph data or design alternate presentation of data. Formulate &amp; write further questions or connect learning to new situations.</td>
<td>Brainstorm questions &amp; connections or graph data or design alternate presentation of data. Formulate &amp; write further questions or connect learning to new situations.</td>
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Science Curriculum - Grades PreK-4

The science program in the elementary schools of the Washington West Supervisory Union provides young students with experiences in all aspects of the Vermont Framework of Standards and Learning Opportunities. At this level of learning, mathematics and language standards are closely intermingled with those of science. The standards shown below are embedded throughout the science curriculum. For that reason, they are not listed as separate sections in each of the topics on the following pages.

Inquiry, Experimentation, and Theory

Scientific Method

7.1 Students use scientific methods to describe, investigate, explain phenomena, and raise questions. This is evident when students:
   a. Ask questions about objects, organisms, and events in the world around them;
   b. Use reliable information obtained from scientific knowledge, observation, and exploration;
   c. Create hypotheses for problems, design a fair test of their hypothesis, collect data through observation and instrumentation, and analyze data to draw conclusions; use conclusions to clarify understanding and generate new questions to be explored;
   d. Use evidence to construct an explanation, including scientific principles they already know and observations they make;
   e. Explain a variety of observations and phenomena using concepts that have been learned;
   f. Use either deductive or inductive reasoning to explain observations and phenomena, or to predict answers to questions;
   g. Recognize other points of view, and check their own and others' explanations against experiences, observations, and knowledge;
   h. Identify problems, propose and implement solutions, and evaluate products and designs; and
   i. Work individually and in teams to collect and share information and ideas.

Investigation

7.2 Students design and conduct a variety of their own investigations and projects. This is evident when students:
   a. Design and conduct an experiment;
   b. Design and conduct a systematic observation;
   c. Complete a design of a physical structure or technological system;
   d. Complete a data study;
   e. Plan and manage a schedule;
   f. Complete and pure mathematics investigation; or
   g. Complete research.

Theory

7.3 Students understand the nature of mathematical, scientific, and technological theory. This is evident when students:
   a. Show understanding that concepts form the foundation for theories;
   b. Look for evidence that explains why things happen;
   c. Modify knowledge when new observations are made or new knowledge is gained.
History of Science, Mathematics, and Technology

7.4 Students understand the history of science, mathematics, and technology. This is evident when students:
   a. Investigate contributions made to science, mathematics, and technology by many different kinds of people and explain their importance.

Roles and Responsibilities

7.5 Students analyze the roles and responsibilities of scientists, mathematicians, and technologists in social, economic, cultural, and political systems. This is evident when students:
   a. Explain how discoveries or inventions can help or hurt people.
Space, Time and Matter
Matter, Motion, Forces, and Energy
Pre K & K

VT Standard 7.12

Students understand forces and motion, the properties and composition of matter, and energy sources and transformations. This is evident when students:
a. Sort objects and materials according to observations of similarities and differences of properties.

Focusing Questions

How are objects the same?
How are they different?
How can we measure the differences?

Evidence of Learning

The student will:
• Sort objects according to observable properties (size, shape, weight, color, smell, sound or texture) using the senses.
• Identify and sort solid objects according to the material they are made from (wood, plastic, metal, fabric).
• Describe objects by characteristics rather than name.

Vital Results

1.17 a, c, 2.1
VT Standard 7.13
Students understand the characteristics of organisms, see patterns of similarity and differences among living organisms, understand the role of evolution, and recognize the interdependence of all systems that support life. This is evident when students:
  a. Identify characteristics of organisms;
  b. Categorize living organisms.

Focusing Questions

How can we tell living things from non-living things?
How can we tell insects are living things?
What are the stages of insect development?

Evidence of Learning

The student will:
  • Classify or group living and non-living things into categories.
  • Describe simply how living things use food and energy, and produce waste.
  • Give examples of living things that reproduce.
  • Relate an example of something that was born and died.
  • Draw a picture showing how insects interact with surroundings.
  • Draw or tell how animals use senses to help them survive.

Vital Results

1.17a, 2.1c, 7.5a, 7.11a,b
The Living World
Human Body
Human Similarities and Differences – Health and Safety
Pre K & K

VT Standard 7.14
Students demonstrate understanding of the human body - heredity, body systems, and individual development - and understand the impact of the environment on the human body. This is evident when students:
a. Recognize that there are many similarities between parents and their children, some inherited and some learned;
b. Identify and describe environmental factors that can influence human health.

Focusing Questions

How can we keep our bodies safe and healthy?
How are humans alike and different?

Evidence of Learning

The student will:
• Explain basic hygiene habits needed to maintain health.
• Draw pictures identifying common health problems.
• Identify orally or by drawing safe and unsafe behaviors to self and others.
• Identify orally or by drawing community members/agencies that provide health care.
• Describe different external features of people.
• Describe ways that humans are more alike than different.
• Identify external parts of the human body, their function and care.

Vital Results

1.17 c, 2.1, 3.4, 3.5 a, b, c, f

K - 3
The Universe, Earth and the Environment
Theories, Systems, and Forces
The Earth - Rocks
Pre K & K

VT Standard 7.15
Students demonstrate understanding of the earth and its environment, the solar system, and the universe in terms of the systems that characterize them, the forces that affect and shape them over time, and the theories that currently explain their evolution. This is evident when students:

a. Identify and record patterns and forces that shape the earth.

Focusing Questions

What is the Earth made of?
How are rocks alike and different?
How is the land different from place to place?
How are rocks moved from place to place?
What forces cause rocks to get smaller?

Evidence of Learning

The student will:

• Describe soil as being made up of different materials of different sizes.
• After observation, sort rocks to indicate different materials with specific properties.
• After observation of fossils, offer an explanation of how they might have been formed.
• Categorize rocks by color, shape or texture.
• Describe how wind, water, and ice can move rocks and soil from place to place.

Vital Results

1.17 a, c, 2.1

K - 4
VT Standard 7.16
Students understand how natural resources are extracted, distributed, processed and disposed of. This is evident when students:
   a. Recognize that steps need to be followed in extracting natural resources;
   b. Show that some materials can be reused and recycled while others will be disposed of in landfills.

Focusing Questions
What are Vermont natural resources?
What are the steps involved in extracting natural resources?

Evidence of Learning
The student will:
   • Name one or two Vermont natural resources.
   • Describe by drawing the steps involved in extracting a natural resource.

Vital Results
1.13a, 1.20
Design and Technology
Outputs and Impacts
Tools
Pre K & K

VT Standard 7.18
Students understand that people control the outputs and impacts of our expanding technology in communication, construction, manufacturing, power and transportation, energy sources, health technology, and biotechnology. This is evident when students:

a. Use tools to extend their capabilities;
b. Use tools and machines in a safe manner.

Focusing Questions

What are tools?
What are safe ways to use tools?

Evidence of Learning

The student will:
• Sort pictures of tools (or real tools) as used by children and/or adults.
• Describe or demonstrate safe ways to use age appropriate tools.

Vital Results

2.1a, 1.13a
Students understand forces and motion, the properties and composition of matter, and energy sources and transformations. This is evident when students:

a. Observe and record the effects of electric charge (e.g., charges repel, batteries); investigate magnetic and non-magnetic materials, and materials that are conductors and non-conductors of electricity.

**Focusing Questions**

- What are magnets?
- What things are attracted to a magnet?
- What things are repelled by magnets?
- What is electricity?
- What is an electrical circuit?
- What are conductors and non-conductors of electricity?

**Evidence of Learning**

The student will:
- Sort objects according to magnetic attraction.
- Describe objects attracted or repelled by a magnet.
- Draw an electric circuit.
- Sort objects according to their ability to conduct electricity.

**Vital Results**

1.17 a, c, 2.1
The Living World
Organisms, Evolution, and Interdependence
Animals
Grade 1

VT Standard 7.13
Students understand the characteristics of organisms, see patterns of similarity and differences among living organisms, understand the role of evolution, and recognize the interdependence of all systems that support life. This is evident when students:

a. Identify characteristics of organisms;
b. Categorize living organisms.

Focusing Questions

What are animals?
How can we tell animals are living things?
Where do animals live?
How long have animals lived on earth?
What are the stages of development?

Evidence of Learning

The student will:

- Sort, classify, categorize into groups of animals/non-animals and types of animals (birds, insects, fish, etc.).
- Compare and contrast animal environments by writing or drawing.
- List animal survival needs.
- Classify animals as carnivorous, herbivorous, or omnivorous.
- Write or tell ways animals use energy.
- On a map or globe give examples of animals around the world.

Vital Results

1.17 a, 2.1 c, d
The Living World
Human Body
Senses
Grade 1

VT Standard 7.14
Students demonstrate understanding of the human body - heredity, body systems, and individual development - and understand the impact of the environment on the human body. This is evident when students:
a. Identify the parts of the human body, and demonstrate understanding of how the parts work together to perform functions that satisfy common needs;
b.Identify and describe environmental factors that can influence human health.

Focusing Questions

What are our five senses?
How do our senses help us to survive?
How does the environment affect our health?

Evidence of Learning

The student will:
• Name each of the five senses and its sense organ.
• Give an example of how each sense helps us to survive.
• Identify environmental factors that affect our health.

Vital Results

1.17c, 2.1, 3.4, 3.5a, b, c, f
Design and Technology
Natural Resources
Reuse and Recycle
Grade 1

VT Standard 7.16
Students understand how natural resources are extracted, distributed, processed and disposed of. This is evident when students:

a. Recognize that steps need to be followed in extracting natural resources;
b. Show that some materials can be reused and recycled while others will be disposed of in landfills.

Focusing Questions

What materials must be disposed of in landfills?
What are natural resources?
What materials can be reused or recycled?

Evidence of Learning

The student will:

• Identify materials that must be disposed of in landfills.
• Identify materials that must not be disposed of in landfills (paint cans, tires, oil, etc.).
• Identify local natural resources (i.e. forests, streams, lakes).
• Describe how material objects can be repaired and reused.
• Identify ways to recycle materials at home and school.

Vital Results

3.7b
Students understand that people control the outputs and impacts of our expanding technology in communication, construction, manufacturing, power and transportation, energy sources, health technology, and biotechnology. This is evident when students:

a. Understand that technology is a human endeavor;
b. Use tools to extend their capabilities;
c. Use tools and machines in a safe manner.

**Focusing Questions**

- What tools/machines do we use at home and school?
- Why were tools and machines invented?
- What are machines?
- Why do we need/use tools and machines?

**Evidence of Learning**

The student will:

- List age appropriate tools/technology to do work at home and school.
- Explain how and why tools and machines were invented and how they have been improved over time.
- Identify simple machines by labeling pictures (screw, lever and fulcrum, ramp, pulley, and wheel).
- Describe how simple machines work.
- Explain that tools and machines were invented by people to make certain jobs easier.

**Vital Results**

2.1, 2.10
Space, Time, and Matter
Matter, Motion, Forces, and Energy
Properties and States of Matter
Grade 2

VT Standard 7.12
Students understand forces and motion, the properties and composition of matter, and energy sources and transformations. This is evident when students:

a. Sort objects and materials according to observations of similarities and differences of properties;
b. Observe and describe changes of states of matter;
e. Identify and describe several common forms of energy (e.g., light, heat, sound) and provide examples of sources, as well as some characteristics of the transmission.

Focusing Questions

What are the three states of matter?
What are their properties?
What do all forms of matter have in common?
How can matter change its state?
Does the amount of matter change when its shape or size or state changes?
What is light?
What is sound?
How do sound and light travel?

Evidence of Learning

The student will:

• Identify three states of matter.
• After investigation, record the properties of each form of matter (solids - compare color, shape, size, stackability; liquids - compare color, fluidity, viscosity; gases - compare odors.
• Describe what happens when liquids are poured into various size and shape containers.
• Demonstrate that the basic material and amount of an object stays the same even though its appearance may change (water/ice; cup of corn flakes whole/crushed).
• Describe the differences between how solids, liquids, and gases behave.
• Describe how sound travels.
• Describe how light travels.

Vital Results

1.17 b, d, 2.1
The Living World
Organisms, Evolution, and Interdependence
Plants
Grade 2

VT Standard 7.13
Students understand the characteristics of organisms, see patterns of similarity and differences among living organisms, understand the role of evolution, and recognize the interdependence of all systems that support life. This is evident when students:
a. Identify characteristics of organisms;
b. Categorize living organisms.

Focusing Questions
How can we tell plants are living things?
Where do plants live?
How long have plants been on earth?
What are seeds?

Evidence of Learning
The student will:
• After investigating various types of seeds and their characteristics, record findings in a journal or portfolio.
• Describe orally or in writing how plants reproduce (seed, bulb, spore, cutting).
• After observation, record the life cycle of a plant.
• Draw or write a description of pollination.
• State that plants need air, light, water, and soil nutrients to survive.
• State that plant waste is oxygen.
• After investigation, record the similarities and differences between parent plant and offspring.
• Describe orally or in writing the co-dependence between plants and animals.

Vital Results
1.17 a, 2.1 c, d, e, 3.9 a, 2.13
The Living World

Human Body

Body Parts and Skeletal, Digestive, and Circulatory Systems

Grade 2

VT Standard 7.14
Students demonstrate understanding of the human body - heredity, body systems, and individual development - and understand the impact of the environment on the human body. This is evident when students:

a. Recognize that there are many similarities between parents and their children, some inherited and some learned;
b. Identify the parts of the human body, and demonstrate understanding of how the parts work together to perform functions that satisfy common needs;
c. Identify and describe environmental factors that can influence human health.

Focusing Questions

What makes a healthy person?
How are we alike and unlike our parents?
How can we take care of our physical and emotional needs?
What do humans need to grow and develop?
What are the life processes of humans?
What are the skeletal, digestive, and circulatory systems?

Evidence of Learning

The student will:

- Understand how rest, germs, food choices, sleep and exercise affect the body.
- Recognize ways to maintain health and safety.
- Identify and classify food groups and model the food pyramid.
- Understand and identify individual inherited and learned characteristics and behaviors.
- List human needs for survival (air, water and food).
- Explain through writing or drawing the developmental stages of a human.
- Describe the human structures that serve different functions (walking, holding, talking, etc.).
- Describe how humans ingest, digest and assimilate food.
- Describe ways that humans react to their environment.
- Identify emotional and physical needs for growth and development (touch, love, caring, communication).
- Demonstrate through role-play refusal skills, which enhance healthy choices.

Vital Results

1.17c, 2.1, 3.4, 3.5e