INSPIRED STANDARDS MATCH FOR MAINE

Maine Learning Results for Science and Technology

Meeting curriculum standards is a major focus in education today. This document highlights the correlation of Inspiration® with the Maine Learning Results for Science and Technology.

The Inspired Standards Match is designed to demonstrate the many ways Inspiration supports the standards and to give educators ideas for using this tool to meet learning goals across the curriculum.

How to read the Inspired Standards Match:

- Pink highlight indicates a standard or objective that is supported by the use of Inspiration
- Green note annotation includes names of an Inspiration template that corresponds to the highlighted standard. These templates are part of the software program and act as starters or frameworks for student work.

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Science and Technology

The explosive growth of scientific knowledge and continuing developments in technology are transforming society. These rapid changes require that students learn to access, understand, and evaluate current information by utilizing the skills and knowledge of science and technology. Science includes processes and a body of knowledge. Processes are the ways scientists investigate and communicate about the natural world. The body of knowledge includes concepts, principles, facts, laws, and theories. Technology utilizes tools, techniques, and an applied understanding of science to design products and solve problems.

Science and technology are connected. Technological problems create a demand for scientific knowledge and modern technologies make it possible to discover new scientific knowledge. In a world shaped by science and technology, it is important for students to learn how science and technology connect with all content areas.

Helping students develop curiosity and excitement for science and technology while they gain essential knowledge and skills is best achieved by actively engaging learners in multiple experiences that increase their ability to be critical thinkers and problem solvers. Standards A through I describe content standards that encompass the subject matter conventionally referred to as life, physical, earth, and space science. Standards J through M describe essential skills that should always be embedded throughout the curriculum, rather than taught separately.

A. CLASSIFYING LIFE FORMS
Students will understand that there are similarities within the diversity of all living things. *Modern classification systems are based on comparisons of the structure, function, life-cycles, and behavior of organisms.*

B. ECOLOGY
Students will understand how living things depend on one another and on non-living aspects of the environment. *Balance in ecosystems is based on an intricate web of relationships among populations of living organisms and on non-living factors such as water and temperature. Changes in specific populations or conditions affect other parts of the ecosystem. Individual systems continually change in response to human and other factors.*

C. CELLS
Students will understand that cells are the basic units of life. *The functions performed by organelles (specialized structures found in cells) within individual cells are also carried out by the organ system in multi-cellular organisms. This standard requires that students be conversant with magnifying devices, cell structure and function, body systems, and disease causes and the body's defense against them.*

D. CONTINUITY AND CHANGE
Students will understand the basis for all life and that all living things change over time. *Fossils show past life, extinct species, and environmental changes over time. Organisms change and new species may arise due to genetically coded adaptations.*

E. STRUCTURE OF MATTER
Students will understand the structure of matter and the changes it can undergo. *Matter is made of atoms, each with characteristic properties, which can combine to form all substances in the universe. The state and properties of matter may differ when it experiences chemical, physical, and nuclear changes.*

F. THE EARTH
Students will gain knowledge about the earth and the processes that change it. *The earth's surface undergoes steady or sudden changes due to forces of wind, water, ice, volcanism, and shifting of tectonic plates.*

G. THE UNIVERSE
Students will gain knowledge about the universe and how humans have learned about it, and about the principles upon which it operates. *This includes understanding the result of the relative positions and movement of the earth, moon, sun, stars, planets, and galaxies. It also entails an understanding of how scientists gather data and formulate explanations for phenomena in space.*

H. ENERGY
Students will understand concepts of energy. *Energy takes many forms which can exert forces and do work. The conversion of energy from one form to another offers useful applications and sometimes presents problems.*

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I. MOTION

Students will understand the motion of objects and how forces can change that motion. *All objects are in motion, at least at an atomic/subatomic level. By understanding how forces (e.g., gravity, friction, and magnetism) act on objects, they can predict their effects on the motion of the object.*

J. INQUIRY AND PROBLEM SOLVING

Students will apply inquiry and problem-solving approaches in science and technology. *Scientific inquiry, problem solving, and the technological method provide insight into and comprehension of the world around us. A variety of tools, including emerging technologies assist, the inquiry processes. Models are used to understand the world.*

K. SCIENTIFIC REASONING

Students will learn to formulate and justify ideas and to make informed decisions. *This involves framing and supporting arguments, recognizing patterns and relationships, identifying bias and stereotypes, brainstorming alternative explanations and solutions, judging accuracy, analyzing situations, and revising studies to improve their validity.*

L. COMMUNICATION

Students will communicate effectively in the applications of science and technology. *Clear and accurate communication employs appropriate symbols and terminology, models, and a variety of media and presentation styles. Communication includes constructing knowledge through reflection, evaluation, refocusing, and critically analyzing information from a variety of sources. Individuals and collaborative groups must communicate effectively.*

M. IMPLICATIONS OF SCIENCE AND TECHNOLOGY

Students will understand the historical, social, economic, environmental, and ethical implications of science and technology. *Scientific and technological breakthroughs are influenced by prevailing beliefs and conditions which in turn are impacted by new ideas and inventions. By assessing the impacts of technological activity on the environment, students will develop their own sense of global stewardship.*

Science and Technology

A. CLASSIFYING LIFE FORMS

Students will understand that there are similarities within the diversity of all living things. Students will be able to:

ELEMENTARY GRADES Pre-K-2

1. Identify the differences between living and non-living things.
2. Describe characteristics of different living things.
3. Explain, draw, or otherwise demonstrate the life cycle of an organism.
4. Design and describe a classification system for objects.

EXAMPLE

- Given a collection of shells, sort them into groups and describe the "rule" for each group.

ELEMENTARY GRADES 3-4

1. Group the same organisms in different ways using different characteristics.
2. Design and describe a classification system for organisms.
3. Describe the different living things within a given habitat.
4. Compare and contrast the life cycles, behavior, and structure of different organisms.

EXAMPLE

- Identify and describe living organisms in a selected plot of land by the school.

MIDDLE GRADES 5-8

1. Compare systems of classifying organisms including systems used by scientists.
2. Decipher the system for assigning a scientific name to every living thing.
3. Describe some structural and behavioral adaptations that allow organisms to survive in a changing environment.

EXAMPLE

- Use Internet resources to research and report on bird migration.

SECONDARY GRADES

1. Explain the role of DNA in resolving questions of relationship and evolutionary change.
2. Describe similarities and differences among organisms within each level of the taxonomic system for classifying organisms (kingdom through species).
3. Analyze the basic characteristics of living things, including their need for food, water, and gases and the ability to reproduce.

Science and Technology

B. ECOLOGY

Students will understand how living things depend on one another and on non-living aspects of the environment. Students will be able to:

ELEMENTARY GRADES Pre-K-2

1. Identify ways that organisms depend upon their environment.
2. Describe how almost all animals' food can be traced back to plants.
3. Give examples of how one change in a system affects other parts of the system.
4. Describe different ecological systems on earth.
5. Describe a familiar local environment.

EXAMPLES

- Draw a food chain. (Example: plant→mouse→snake→eagle)
- Predict what would be affected if a disease caused the death of all the rabbits in the area.

ELEMENTARY GRADES 3-4

1. Describe a food web and the relationships within a given ecosystem.
2. Explain the difference between producers (e.g., green plants), consumers (e.g., those that eat green plants), and decomposers (e.g., bacteria that break down the "consumers" when they die), and identify examples of each.
3. Compare and contrast physical and living components of different biomes - i.e., regions characterized by their climate and plant life - (e.g., tundra, rain forest, ocean, desert).
4. Investigate the connection between major living and non-living components of a local ecosystem.

MIDDLE GRADES 5-8

1. Describe in general terms the chemical processes of photosynthesis and respiration.
2. Analyze how the finite resources in an ecosystem limit the types and populations of organisms within it.
3. Describe succession and other ways that ecosystems can change over time.
4. Generate examples of the variety of ways that organisms interact (e.g., competition, predator/prey, parasitism/mutualism).
5. Describe various mechanisms found in the natural world for transporting living and non-living matter and the results of such movements.

SECONDARY GRADES

1. Illustrate the cycles of matter in the environment and explain their interrelationships.
2. Compare the process of photosynthesis and respiration, and describe the factors that effect them.
3. Analyze the factors that affect population size (e.g., reproductive and survival rates).
4. Analyze the impact of human and other activities on the type and pace of change in ecosystems.

EXAMPLE

- Create a poster illustrating the cycles of water, oxygen, and carbon dioxide as they relate to photosynthesis and respiration.

Science and Technology

C. CELLS

Students will understand that cells are the basic units of life. Students will be able to:

ELEMENTARY GRADES Pre-K-2

1. Demonstrate that living things are made up of different parts.
2. Demonstrate an understanding that plants and animals need food, water, and gases to survive.
3. Explore magnifying devices and how they allow one to see in more detail.
4. Provide examples of causes of diseases.

EXAMPLES

- Grow plants with and without the necessary requirements for life.
- Use hand lenses to see details on a flower.

ELEMENTARY GRADES 3-4

1. Demonstrate an understanding that a cell is the basic unit of living organisms.
2. Describe how single-celled organisms exist.
3. Explore how the use of a microscope allows one to see cells in a variety of organisms.
4. Describe the functions of the major human organ systems.

EXAMPLE

- Describe how the circulatory system supplies nutrients and takes wastes away from cells in the body.

MIDDLE GRADES 5-8

1. Compare and contrast human organ systems with those of other species.
2. Prepare and examine microscope slides of single-celled and multi-celled organisms.
3. Describe the structure and function of major organs in human systems.
4. Identify the causes and effects of diseases, explain their transmission, and identify prevention strategies.
5. Describe how body systems work together.

EXAMPLES

- Identify the functions of different cells in multi-celled organisms.
- Use models to compare and contrast the structure and function of the circulatory system with the structure and function of the skeletal system.

SECONDARY GRADES

1. Relate the parts of a cell to its function.
2. Illustrate how cells replicate and transmit information, including the roles of DNA and RNA.
3. Discuss the function of the important "molecules of life" - proteins (including enzymes and hormones), carbohydrates, lipids, and nucleic acids.
4. Explain how the human body protects itself against disease and how the body might lose that ability.
5. Analyze and debate basic principles of genetic engineering: how it is done, its uses, and some ethical implications.

EXAMPLES

- Describe how the structure of a cell membrane is related to its function.
- Create a model contrasting the processes of meiosis and mitosis.

Science and Technology

D. CONTINUITY AND CHANGE

Students will understand the basis for all life and that all living things change over time. Students will be able to:

ELEMENTARY GRADES Pre-K-2

1. Explain how fossils show the existence of past life.
2. Identify characteristics that help organisms live in their environment.
3. Draw or describe ways in which an organism can change over its lifetime, sometimes in predictable ways (e.g., butterfly, frog).
4. Describe ways in which individuals of the same species are alike and different.

EXAMPLES

- Explain why a fossil animal might not be alive now.
- Compare the similarities and differences of birds and mammals.
- Illustrate the changes in the life cycle of a Monarch butterfly.

ELEMENTARY GRADES 3-4

1. Identify present day organisms that have not always existed, and past life forms that have become extinct.
2. Describe how fossils form.
3. Explain how adaptations, in response to change over time, may increase a species' chances of survival.
4. Describe ways in which organisms may be similar to and different from their parents and explore the possible reasons for this.

EXAMPLE

- Make a drawing or poster to illustrate how the horse has changed over millennia.

MIDDLE GRADES 5-8

1. Describe how fossils can be used by scientists to trace the history of a species.
2. Explain how scientists use fossils to prove that life forms, climate, environment, and geologic features in a certain location are not the same now as they were in the past.
3. Provide examples of the concept of natural and artificial selection and its role in species changes over time.
4. Compare how sexually and asexually reproducing species transfer genetic information to offspring.

EXAMPLES

- Explain how sexual reproduction can lead to offspring that have traits different from the traits of their parents.
- Describe how new varieties of plants and animals have been produced by humans through selective breeding for certain traits.
- Choose an animal and describe how environmental pressures may lead to changes in that species over time.

SECONDARY GRADES

1. Explain how mutations can be caused by gene mutation or chromosomal alteration and describe the possible results of such mutations on individuals or populations.
2. Describe why the offspring of sexually reproducing species have different survival rates than those of asexually reproducing species under a variety of conditions. Describe the advantages and disadvantages of each.
3. Explain and document the importance of relatively short-term changes (e.g., one generation) on a species' survival.
4. Describe how genetic manipulation can cause unusually rapid changes in species.
5. Compare and contrast fertilization, zygote formation, and embryo development in humans and other species.
6. Analyze a theory scientists use to explain the origin of life.
7. Explain both the evidence used to develop the geologic time scale and why an awareness of geologic time is important to an understanding of the process of change in the universe as well as on earth.

EXAMPLE

- Describe how scientists use radioisotopes and other technologies to verify fossil changes over time.

Science and Technology

E. STRUCTURE OF MATTER

Students will understand the structure of matter and the changes it can undergo. Students will be able to:

ELEMENTARY GRADES Pre-K-2

1. Show that large things are made up of smaller pieces.
2. Describe some physical properties of objects.
3. Group objects based on observable characteristics (e.g., color, size, texture).

EXAMPLE

- Take apart and reassemble a toy truck.

ELEMENTARY GRADES 3-4

1. Describe how the physical properties of objects sometimes change when one object chemically combines with another.
2. Explain how matter changes in both chemical and physical ways.

EXAMPLE

- Investigate the rusting of steel wool and the burning of a candle.

MIDDLE GRADES 5-8

1. Predict and test whether objects will float or sink based on a qualitative and quantitative understanding of the concepts of density and buoyancy.
2. Describe the evidence that all matter consists of particles called atoms that are made up of certain smaller particles.
3. Use the Periodic Table to group elements based on their characteristics.
4. Describe how a substance can combine with different substances in different ways, depending on the conditions and the properties of each substance.
5. Describe how the motion of the particles of matter determines the state of that matter (e.g., solid, liquid, gas, plasma) and vice versa.
6. Explain how the relatively small number of naturally occurring elements can result in the large variety of substances found in the world.
7. Investigate the similarities and differences between elements, compounds, and mixtures.
8. Demonstrate the law of conservation of matter.

SECONDARY GRADES

1. Trace the development of models of the atom to the present and describe how each model reflects the scientific understanding of their time.
2. Analyze how matter is affected by changes in temperature, pressure, and volume.
3. Describe the characteristics and behavior of acids and bases.
4. Describe an application of the Law of Conservation of Matter.
5. Describe how atoms are joined by chemical bonding.
6. Compare the physical and chemical characteristics of elements.
7. Describe nuclear reactions, including fusion, fission, and decay, their occurrences in nature, and how they can be used by humans.

EXAMPLES

- Explain how advances in science and technology have increased our knowledge of the structure of atoms.
- Describe how physical properties of the ocean, such as salinity and temperature, effect its global circulation and localized motion.

Science and Technology

F. THE EARTH

Students will gain knowledge about the earth and the processes that change it. Students will be able to:

ELEMENTARY GRADES Pre-K-2

1. Describe the way weather changes.
2. Analyze the relationships between observable weather patterns and the cycling of the seasons.
3. Observe changes that are caused by water, snow, wind, and ice.

EXAMPLES

- Chart weather conditions and compare and contrast changes over time.
- Find local examples of erosion (e.g., ditches, puddles).

ELEMENTARY GRADES 3-4

1. Describe the change in position of the continents over time.
2. Demonstrate an understanding that many things about the earth (e.g., climate) occur in cycles that vary in length and frequency.
3. Describe differences among minerals, rocks, and soils.
4. Illustrate how water and other substances go through a cyclic process of change in the environment.

EXAMPLE

- Distinguish between short-term changes (e.g., weather patterns and tides) and long-term changes (e.g., glaciers).

MIDDLE GRADES 5-8

1. Demonstrate how the earth's tilt on its axis results in the seasons.
2. Describe how soils are formed and why soils differ from one place to another.
3. Explain the evidence scientists use when they give the age of the earth.
4. Describe factors that can cause short-term and long-term changes to the earth.
5. Classify and identify rocks and minerals based on their physical and chemical properties, their composition, and the processes which formed them.
6. Describe the many products used by humans that are derived from materials in the earth's crust.
7. Demonstrate factors effecting the flow of groundwater.

EXAMPLES

- Collect and analyze soil samples from various locations in the community.
- Study weather fronts as well as short-term catastrophic events (e.g., hurricanes and tornadoes).

SECONDARY GRADES

1. Describe how air pressure, temperature, and moisture interact to cause changes in the weather.
2. Analyze potential effects of changes in the earth's oceans and atmosphere.
3. Describe the impact of plate movement and erosion on the rock cycle.
4. Describe ways that scientists measure long periods of time and determine the age of very old objects.
5. Demonstrate how rocks and minerals are used to determine geologic history.
6. Analyze the changes in continental position and the evidence that supports the concept of tectonic plates.

EXAMPLES

- Measure physical changes in the atmosphere to predict the weather.
- Research the location of rock types and fossils in different parts of the world.
- Conduct simulations to determine ways that global climate can be affected by large-scale circulation of the oceans and the atmosphere.

Science and Technology

G. THE UNIVERSE

Students will gain knowledge about the universe and how humans have learned about it, and about the principles upon which it operates. Students will be able to:

ELEMENTARY GRADES Pre-K-2

1. Explain the cycles of day/night and of seasons.
2. Demonstrate that shadows of objects change based on where light is coming from.
3. Demonstrate an understanding that the sun is one of many stars in the universe and is the closest star to earth.

EXAMPLES

- Model/role play the earth going around the sun.
- Use a flashlight to demonstrate the effect on shadows of changes in the location of light sources.

ELEMENTARY GRADES 3-4

1. Illustrate the relative positions of the sun, moon, and planets.
2. Trace the sources of earth's heat and light energy to the sun.
3. Describe earth's rotation on its axis and its revolution around the sun.
4. Explore the relationship between the earth and its moon.

EXAMPLES

- Observe and chart the phases of the moon.

MIDDLE GRADES 5-8

1. Compare past and present knowledge about characteristics of stars (e.g., composition, location, life-cycles) and explain how people have learned about them.
2. Describe the concept of galaxies, including size and number of stars.
3. Compare and contrast distances and the time required to travel those distances on earth, in the solar system, in the galaxy, and between galaxies.
4. Describe scientists' exploration of space and the objects they have found (e.g., comets, asteroids, pulsars).
5. Describe the motions of moons, planets, stars, solar systems, and galaxies.

EXAMPLE

- Use available satellite pictures to identify objects found in space.

SECONDARY GRADES

1. Describe how scientists gather data about the universe.
2. Research current explanations for phenomena such as black holes and quasars.
3. Explain how astronomers measure interstellar distances.

EXAMPLE

- Use a computer to analyze images of planetary bodies.

Science and Technology

H. ENERGY

Students will understand concepts of energy. Students will be able to:

ELEMENTARY GRADES Pre-K-2

1. Demonstrate an understanding that the sun gives off light and heat energy.
2. Explain why living things need energy.

EXAMPLE

- Compare the growth of plants in different conditions of light.

ELEMENTARY GRADES 3-4

1. Identify different forms of energy (e.g., light, sound, heat).
2. Explain ways different forms of energy can be produced.

EXAMPLE

- Prove that sounds are caused by vibrational energy.

MIDDLE GRADES 5-8

1. Analyze the benefits and drawbacks of energy conversions (e.g., in electricity generation).
2. Demonstrate that energy cannot be created or destroyed but only changed from one form to another.
3. Compare and contrast the ways energy travels (e.g., waves, conduction, convection, radiation).
4. Describe the characteristics of static and current electricity.
5. Categorize energy sources as renewable or non-renewable and compare how these sources are used by humans.
6. Describe how energy put into or taken out of a system can cause changes in the motion of particles in matter.

SECONDARY GRADES

1. Analyze the evidence that leads scientists to conclude that light behaves somewhat like a wave and somewhat like a particle.
2. Examine and describe how light is reflected and refracted (deflected) by mirrors and lenses.
3. Explain or demonstrate how sound waves travel.
4. Analyze the relationship between the kinetic and potential energy of a falling object.
5. Use mathematics to describe the work and power in a system.
6. Describe the relationship between matter and energy and how matter releases energy through the processes of nuclear fission and fusion.
7. Use mathematics to describe and predict electrical and magnetic activity (e.g., current, resistance, voltage).
8. Compare and contrast how conductors, semiconductors, and superconductors work and describe their present and potential uses.
9. Demonstrate an understanding that energy can be found in chemical bonds and can be used when it is released from those bonds.

Science and Technology

I. MOTION

Students will understand the motion of objects and how forces can change that motion. Students will be able to:

ELEMENTARY GRADES Pre-K-2

1. Develop a variety of ways to describe the motion of an object.
2. Demonstrate that the motion of an object can be changed.

EXAMPLE

- Describe the motion of an object using terms such as forward, backward, straight, zigzag, up, down, fast, slow, etc.

ELEMENTARY GRADES 3-4

1. Describe the effects of different types of forces (e.g., mechanical, electrical, magnetic) on motion.
2. Draw conclusions about how the amount of force affects the motion of more massive and less massive objects.
3. Generate examples illustrating that when something is pushed or pulled, it exerts a reaction force.

MIDDLE GRADES 5-8

1. Describe the motion of objects using knowledge of Newton's Laws.
2. Use mathematics to describe the motion of objects (e.g., speed, distance, time, acceleration).
3. Describe and quantify the ways machines can provide mechanical advantages in producing motion.

SECONDARY GRADES

1. Use mathematics to describe the law of conservation of momentum.
2. Explain some current theories of gravitational force.
3. Use Newton's Laws to qualitatively and quantitatively describe the motion of objects.
4. Describe how forces affect fluids (e.g., air and water).
5. Explain the relationship between temperature, heat, and molecular motion.
6. Describe how forces within and between atoms affect their behavior and the properties of matter.

EXAMPLE

- Investigate and describe the motion of an amusement park ride.

Science and Technology

J. INQUIRY AND PROBLEM SOLVING

Students will apply inquiry and problem-solving approaches in science and technology. Students will be able to:

ELEMENTARY GRADES Pre-K-2

1. Make accurate observations using appropriate tools and units of measure.
2. Ask questions and propose strategies and materials to use in seeking answers to questions.
3. Use results in a purposeful way, which includes making predictions based on patterns they have observed.
4. Identify products which were invented to solve a problem.

ELEMENTARY GRADES 3-4

1. Make accurate observations using appropriate tools and units of measure.
2. Conduct scientific investigations: make observations, collect and analyze data, and do experiments.
3. Use results in a purposeful way: design fair tests, make predictions based on observed patterns, and interpret data to make further predictions.
4. Design and build an invention.
5. Explain how differences in time, place, or experimenter can lead to different data.
6. Explain how different conclusions can be derived from the same data.

MIDDLE GRADES 5-8

1. Make accurate observations using appropriate tools and units of measure.
2. Design and conduct scientific investigations which include controlled experiments and systematic observations. Collect and analyze data, and draw conclusions fairly.
3. Verify and evaluate scientific investigations and use the results in a purposeful way.
4. Compare and contrast the processes of scientific inquiry and the technological method.
5. Explain how personal bias can affect observations.
6. Design, construct, and test a device (invention) that solves a special problem.

EXAMPLE

- Given temperature data from hot liquids contained in a variety of cups, predict the relative insulating capacity of each. Then, test the prediction and formulate additional questions based on a comparison of the results.

SECONDARY GRADES

1. Make accurate observations using appropriate tools and units of measure.
2. Verify, evaluate, and use results in a purposeful way. This includes analyzing and interpreting data, making predictions based on observed patterns, testing solutions against the original problem conditions, and formulating additional questions.
3. Demonstrate the ability to use scientific inquiry and technological method with short term and long term investigations, recognizing that there is more than one way to solve a problem. Demonstrate knowledge of when to try different strategies.
4. Design and construct a device to perform a specific function, then redesign for improvement (e.g., performance, cost).

Science and Technology

K. SCIENTIFIC REASONING

Students will learn to formulate and justify ideas and to make informed decisions. Students will be able to:

ELEMENTARY GRADES Pre-K-2

1. Examine strengths and weaknesses of simple arguments.
2. Distinguish between important and unimportant information in simple arguments.
3. Make observations.
4. Participate in brainstorming activities.
5. Use various forms of simple logic.
6. Discover relationships and patterns.

ELEMENTARY GRADES 3-4

1. Give alternative explanations for observed phenomena.
2. Describe how feelings can distort reasoning.
3. Draw conclusions about observations.
4. Use various types of evidence (e.g., logical, quantitative) to support a claim.
5. Demonstrate an understanding that ideas are more believable when supported by good reasons.
6. Practice and apply simple logic, intuitive thinking, and brainstorming.

MIDDLE GRADES 5-8

1. Examine the ways people form generalizations.
2. Identify exceptions to proposed generalizations.
3. Identify basic informal fallacies in arguments.
4. Analyze means of slanting information.
5. Identify stereotypes.
6. Support reasoning by using a variety of evidence.
7. Show that proving a hypothesis false is easier than proving it true, and explain why.
8. Construct logical arguments.
9. Apply analogous reasoning.

EXAMPLES

- Use logical connectors such as “if.....then” to accurately reflect cause and effect.
- Recognize the intermingling of fact and opinion in scientific explanations.

SECONDARY GRADES

1. Judge the accuracy of alternative explanations by identifying the evidence necessary to support them.
2. Explain why agreement among people does not make an argument valid.
3. Develop generalizations based on observations.
4. Determine when there is a need to revise studies in order to improve their validity through better sampling, controls or data analysis techniques.
5. Produce inductive and deductive arguments to support conjecture.
6. Analyze situations where more than one logical conclusion can be drawn.

Science and Technology

L. COMMUNICATION

Students will communicate effectively in the application of science and technology. Students will be able to:

ELEMENTARY GRADES Pre-K-2

1. Describe and compare things in terms of number, shape, texture, size, weight, color, and behavior.
2. Read and write instructions to be followed or instructions which explain procedures.
3. Ask clarifying questions.
4. Explain problem-solving processes using verbal, pictorial, and written methods.
5. Make and read simple graphs.
6. Use objects and pictures to represent scientific and technological ideas.

EXAMPLE

- First grade students create a graph to record their daily weather observations. This might include bars for sunny, cloudy, rainy, snowy, and "mixed", as well as cold, warm, and hot. On a regular basis the students reflect on their graph. They describe and compare the weather on different days, weeks, or months, and draw conclusions about the weather based on the data.

ELEMENTARY GRADES 3-4

1. Record results of experiments or activities (e.g., interviews, discussions, field work) and summarize and communicate what they have learned.
2. Ask clarifying and extending questions.
3. Reflect on work in science and technology using such activities as discussions, journals, and self-assessment.
4. Make and/or use sketches, tables, graphs, physical representations, and manipulatives to explain procedures and ideas.
5. Gather and effectively present information, using a variety of media including computers (e.g., spreadsheets, word processing, programming, graphics, modeling).
6. Cite examples of bias in information sources and question the validity of information from varied sources.
7. Function effectively in groups within various assigned roles (e.g., reader, recorder).

EXAMPLE

- Create functioning models which demonstrate the ways in which simple machines make work easier (e.g., levers, inclined planes, gears, pulleys, wheels, and axles).

MIDDLE GRADES 5-8

1. Discuss scientific and technological ideas and make conjectures and convincing arguments.
2. Defend problem-solving strategies and solutions.
3. Evaluate individual and group communication for clarity, and work to improve communication.
4. Make and use scale drawings, maps, and three-dimensional models to represent real objects, find locations, and describe relationships.
5. Access information at remote sites using telecommunications.
6. Identify and perform roles necessary to accomplish group tasks.

EXAMPLE

- Given actual census data on populations and species in a wetland, present arguments in support of and against a proposition to develop the area.

SECONDARY GRADES

1. Analyze research or other literature for accuracy in the design and findings of experiments.
2. Use journals and self-assessment to describe and analyze scientific and technological experiences and to reflect on problem-solving processes.
3. Make and use appropriate symbols, pictures, diagrams, scale drawings, and models to represent and simplify real-life situations and to solve problems.
4. Employ graphs, tables, and maps in making arguments and drawing conclusions.
5. Critique models, stating how they do and do not effectively represent the real phenomenon.
6. Evaluate the communication capabilities of new kinds of media (e.g., cameras with computer disks instead of film).
7. Use computers to organize data, generate models, and do research for problem solving.
8. Engage in a debate, on a scientific issue, where both points of view are based on the same set of information.

Science and Technology

M. IMPLICATIONS OF SCIENCE AND TECHNOLOGY

Students will understand the historical, social, economic, environmental, and ethical implications of science and technology. Students will be able to:

ELEMENTARY GRADES Pre-K-2

1. Describe how legends, stories, and scientific explanations are different ways in which people attempt to explain the world.
2. Describe at least two inventions, what they do, how they work, and how they have made life easier.
3. Identify commonly used resources, their sources, and where waste products go.
4. Demonstrate some practices for recycling and care of resources.
5. Explain how their lives would be different without specific inventions or scientific knowledge.

EXAMPLES

- Pick a simple invention (e.g., toothbrush, fork, lawnmower) and explain how its design conforms to function.
- Trace all the ways that they rely on electricity every day.

ELEMENTARY GRADES 3-4

1. Explore how cultures have found different technological solutions to deal with similar needs or problems (e.g., construction, clothing, agricultural tools and methods).
2. Investigate and describe the role of scientists and inventors.
3. Explore how technology (e.g., transportation, irrigation) has altered human settlement.
4. Explain practices for conservation in daily life, based on a recognition that renewable and non-renewable resources have limits.

EXAMPLES

- Look at a map of the town and explain why homes are concentrated in certain areas.
- Describe where faucet water comes from, where it goes, and how to conserve it.

MIDDLE GRADES 5-8

1. Research and evaluate the social and environmental impacts of scientific and technological developments.
2. Describe the historical and cultural conditions at the time of an invention or discovery, and analyze the societal impacts of that invention.
3. Discuss the ethical issues surrounding a specific scientific or technological development.
4. Describe an individual's biological and other impacts on an environmental system.
5. Identify factors that have caused some countries to become leaders in science and technology.
6. Give examples of actions which may have expected or unexpected consequences that may be positive, negative, or both.
7. Explain the connections between industry, natural resources, population, and economic development.
8. Recognize scientific and technological contributions of diverse people including women, different ethnic groups, races, and physically disabled.

EXAMPLES

- Investigate the events and technology that led to the discovery of microorganisms and to the subsequent changes in medicine.
- Identify an historical human problem, describe the possible solutions available at the time the problem was discovered, explain how the problem was solved, and evaluate the positive and negative effects of the solution.

SECONDARY GRADES

1. Examine the impact of political decisions on science and technology.
2. Demonstrate the importance of resource management, controlling environmental impacts, and maintaining natural ecosystems.
3. Evaluate the ethical use or introduction of new scientific or technological developments.
4. Analyze the impacts of various scientific and technological developments.
5. Examine the historical relationships between prevailing cultural beliefs and breakthroughs in science and technology.
6. Research issues that illustrate the effects of technological imbalances and suggest some solutions.

EXAMPLES

- Design a sustainable community.
- Compare the costs, risks, and benefits to society of a scientific or technological development (e.g., nuclear fission, genetic engineering).

Science Examples

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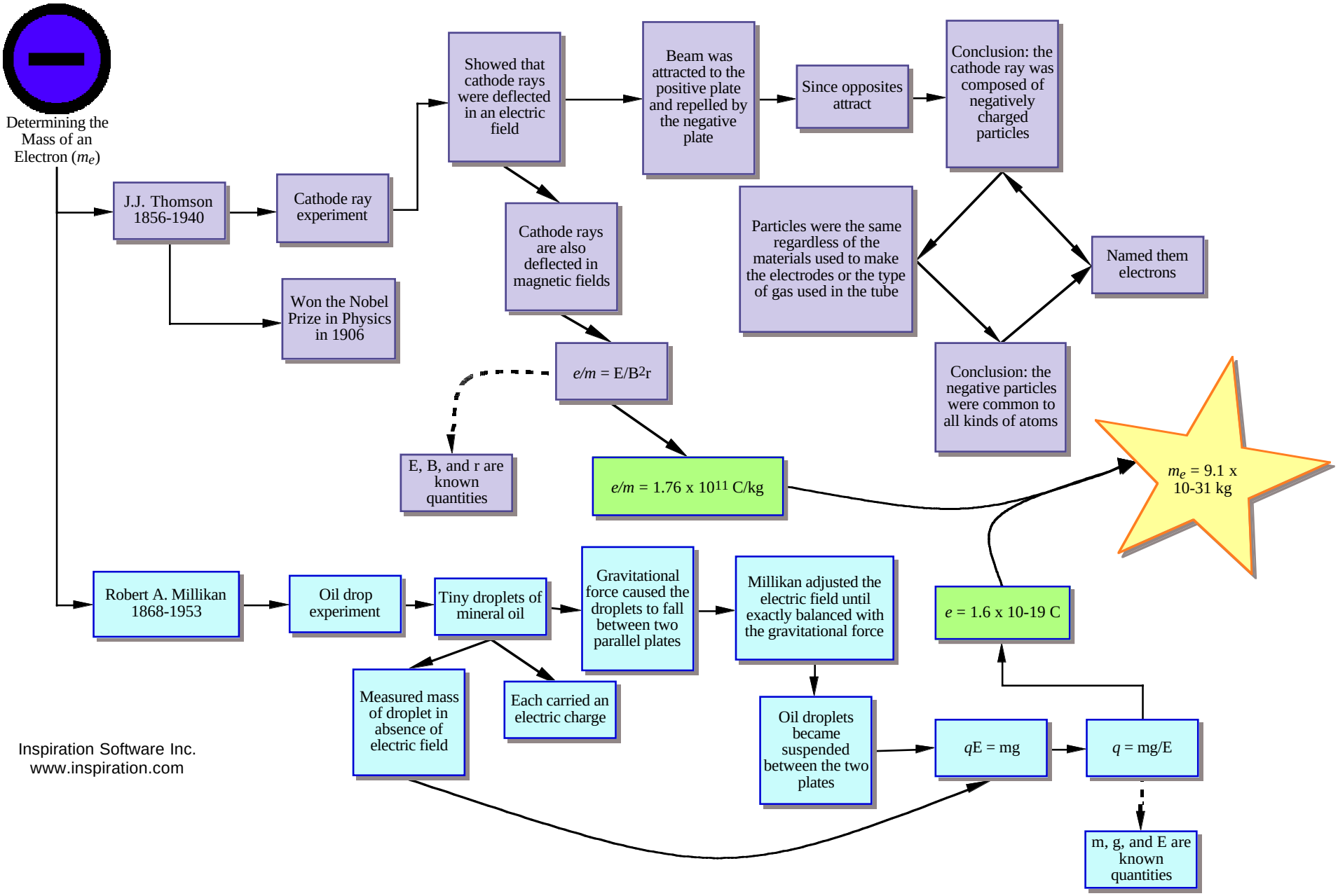
Determining the Mass of an Electron (m_e)
J.J. Thomson 1856-1940
Cathode ray experiment
Showed that cathode rays were deflected in an electric field
Beam was attracted to the positive plate and repelled by the negative plate
Since opposites attract
Conclusion: the cathode ray was composed of negatively charged particles
Won the Nobel Prize in Physics in 1906
Cathode rays are also deflected in magnetic fields
Particles were the same regardless of the materials used to make the electrodes or the type of gas used in the tube
Named them electrons
Conclusion: the negative particles were common to all kinds of atoms
$e/m = E/B^2r$
E, B, and r are known quantities
e/m = 1.76 x 10^{11} C/kg
m_e = 9.1 x 10-31 kg
Robert A. Millikan 1868-1953
Oil drop experiment
Tiny droplets of mineral oil
Gravitational force caused the droplets to fall between two parallel plates
Millikan adjusted the electric field until exactly balanced with the gravitational force
e = 1.6 x 10-19 C
Measured mass of droplet in absence of electric field
Each carried an electric charge
Oil droplets became suspended between the two plates
$qE = mg$
$q = mg/E$
m, g, and E are known quantities
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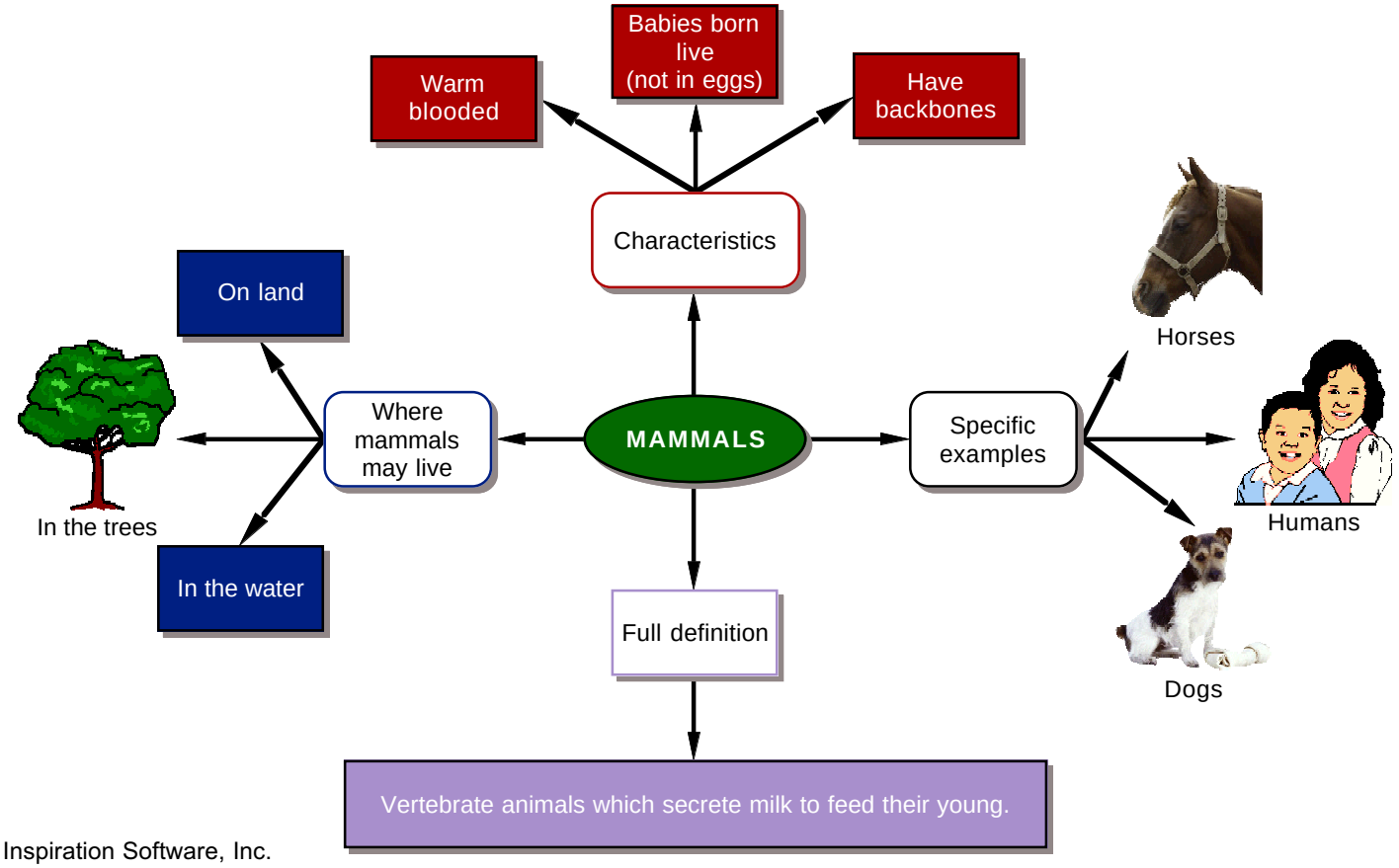

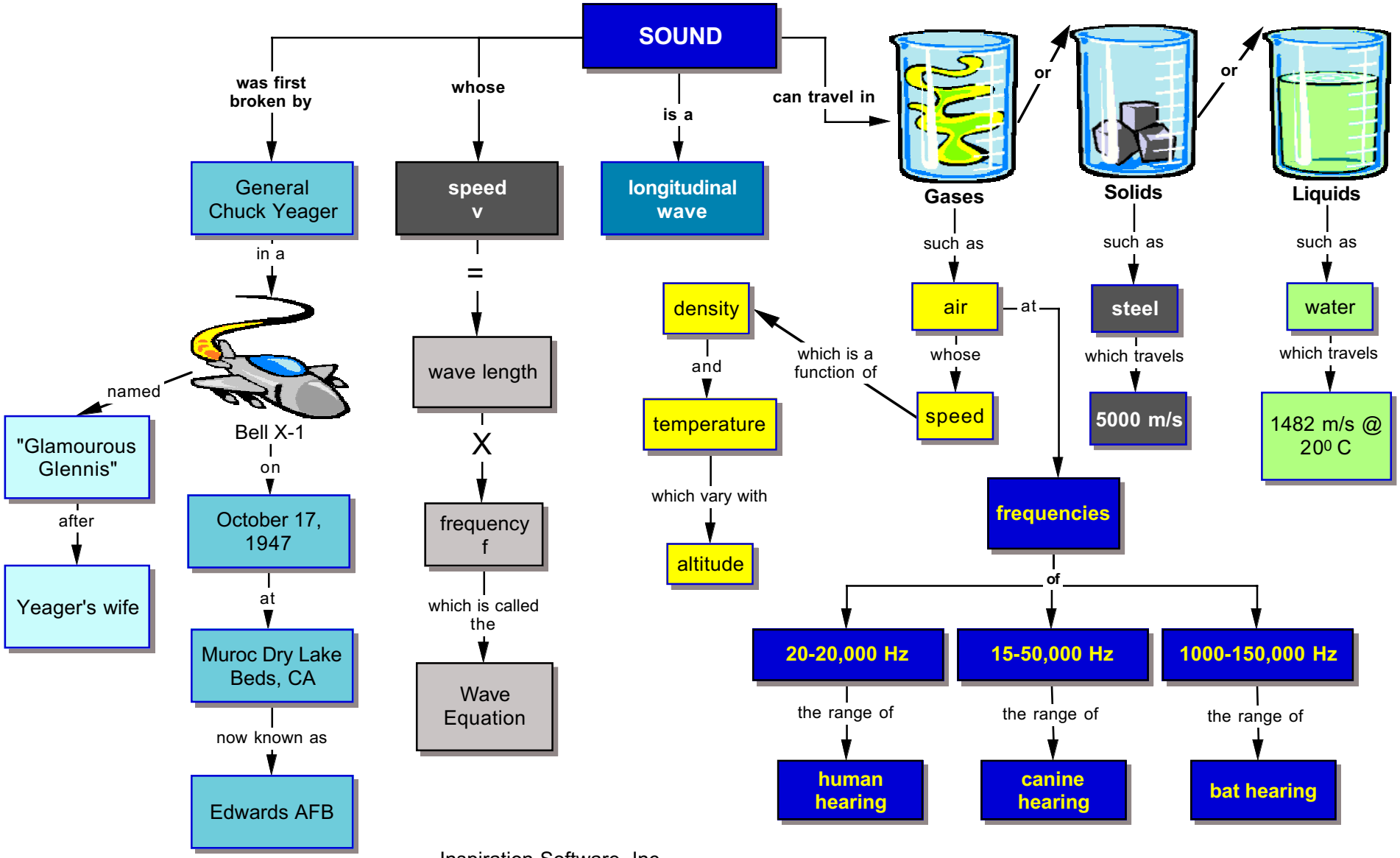

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