INSPIRED STANDARDS MATCH FOR ILLNOIS

Learning Standards: Science

Meeting curriculum standards is a major focus in education today. This document highlights the correlation of Inspiration® with the Illinois Learning Standards: Science.

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

State Goals: 11-13

SCIENCE

The *Illinois Learning Standards for Science* were developed using the 1985 State Goals for Science, the National Science Education Standards, various other state and national works, and local education standards contributed by team members.

Science is a creative endeavor of the human mind. It offers a special perspective of the natural world in terms of understanding and interaction. The aim of science education is to develop in learners a rich and full understanding of the inquiry process; the key concepts and principles of life sciences, physical science, and earth and space sciences; and issues of science, technology, and society in historical and contemporary contexts. The National Science Education Standards present these understandings and their interactions with the natural world as eight science content standard categories. The Illinois Learning Standards in Science integrate these categories into a powerful resource for the design and evaluation of science curricula taught in Illinois schools.

The *Illinois Learning Standards for Science* are organized by goals that inform one another and depend upon one another for meaning. Expectations for learners related to the inquiry process are presented in standards addressing the doing of science and elements of technological design. Unifying concepts connect scientific understanding and process and are embedded in standards spanning life science, physical science, and earth and space science. The importance of this knowledge and its application is conveyed in standards describing the conventions and nature of the scientific enterprise and the interplay among science, technology and society in past, present and future contexts.

APPLICATIONS OF LEARNING

Through Applications of Learning, students demonstrate and deepen their understanding of basic knowledge and skills. These applied learning skills cross academic disciplines and reinforce the important learning of the disciplines. The ability to use these skills will greatly influence students' success in school, in the workplace and in the community.

SOLVING PROBLEMS

Recognize and investigate problems; formulate and propose solutions supported by reason and evidence.

Asking questions and seeking answers are at the heart of scientific inquiry. Following the steps of scientific inquiry, students learn how to gather evidence, review and understand their findings, and compare their solutions with those of others. They learn that there can be differing solutions to the same problem, some more useful than others. In the process, they learn and apply scientific principles. They also learn to be objective in deciding whether their solutions meet specifications and perform as desired.

COMMUNICATING

Express and interpret information and ideas.

Scientists must carefully describe their methods and results to a variety of audiences, including other scientists. This requires precise and complete descriptions and the presentation of conclusions supported by evidence. Young science students develop the powers of observation and description. Older students gain the ability to organize and study data, to determine its meaning, to translate their findings into clear understandable language and to compare their results with those of other investigators.

USING TECHNOLOGY

Use appropriate instruments, electronic equipment, computers and networks to access information, process ideas and communicate results.

Technology is invented and improved by the use of scientific principles. In turn, scientists depend on technology in performing experiments, analyzing data and communicating the results. Science students learn to use a range of technologies: instruments, computer hardware and software, on-line services and equipment, primary source data and images, and communication networks. They learn how technology, in turn, is the result of a scientific design process that includes continual refinements and improvements.

WORKING ON TEAMS

Learn and contribute productively as individuals and as members of groups.

The practical application of science requires both individual and group efforts. Individuals bring unique insight and focus to the work of inquiry and problem solving. Working in groups, scientists pose questions, share hypotheses, divide their experimental efforts, and share data and results. Science students have the opportunity to work both ways—as individuals and as members of teams organized to conduct complex investigations and solve problems.

MAKING CONNECTIONS

Recognize and apply connections of important information and ideas within and among learning areas.

Science has many disciplines, all interrelated. Understanding the functioning of living things depends on knowing chemistry; understanding chemistry depends on knowing physics. In the same way, science itself is highly dependent on mathematics—and it also relates strongly to medicine, geography, physical development and health, social trends and issues, and many other topics. Science, at its best, provides knowledge and skills that improve the understanding of virtually all subjects.

SCIENCE

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

As a result of their schooling students will be able to:

LEARNING STANDARD	EARLY ELEMENTARY	LATE ELEMENTARY
A. Know and apply the concepts, principles and processes of scientific inquiry.	**11.A.1a** Describe an observed event. **11.A.1b** Develop questions on scientific topics. **11.A.1c** Collect data for investigations using measuring instruments and technologies. **11.A.1d** Record and store data using available technologies. **11.A.1e** Arrange data into logical patterns and describe the patterns. **11.A.1f** Compare observations of individual and group results.	**11.A.2a** Formulate questions on a specific science topic and choose the steps needed to answer the questions. **11.A.2b** Collect data for investigations using scientific process skills including observing, estimating and measuring. **11.A.2c** Construct charts and visualizations to display data. **11.A.2d** Use data to produce reasonable explanations. **11.A.2e** Report and display the results of individual and group investigations.
B. Know and apply the concepts, principles and processes of technological design.	**11.B.1a** Given a simple design problem, formulate possible solutions. **11.B.1b** Design a device that will be useful in solving the problem. **11.B.1c** Build the device using the materials and tools provided. **11.B.1d** Test the device and record results using given instruments, techniques and measurement methods. **11.B.1e** Report the design of the device, the test process and the results in solving a given problem.	**11.B.2a** Identify a design problem and propose possible solutions. **11.B.2b** Develop a plan, design and procedure to address the problem identifying constraints (e.g., time, materials, technology). **11.B.2c** Build a prototype of the design using available tools and materials. **11.B.2d** Test the prototype using suitable instruments, techniques and quantitative measurements to record data. **11.B.2e** Assess test results and the effectiveness of the design using given criteria and noting possible sources of error. **11.B.2f** Report test design, test process and test results.

Note: Examples are designated by "e.g." and enclosed in parentheses. They are meant to guide the teacher as to the general intent of the standards and benchmarks, not to identify all possible items.

WHY THIS GOAL IS IMPORTANT:

The inquiry process prepares learners to engage in science and apply methods of technological design. This understanding will enable students to pose questions, use models to enhance understanding, make predictions, gather and work with data, use appropriate measurement methods, analyze results, draw conclusions based on evidence, communicate their methods and results, and think about the implications of scientific research and technological problem solving.

MIDDLE/JUNIOR HIGH SCHOOL	EARLY HIGH SCHOOL	LATE HIGH SCHOOL
11.A.3a Formulate hypotheses that can be tested by collecting data.	**11.A.4a** Formulate hypotheses referencing prior research and knowledge.	**11.A.5a** Formulate hypotheses referencing prior research and knowledge.
11.A.3b Conduct scientific experiments that control all but one variable.	**11.A.4b** Conduct controlled experiments or simulations to test hypotheses.	**11.A.5b** Design procedures to test the selected hypotheses.
11.A.3c Collect and record data accurately using consistent measuring and recording techniques and media.	**11.A.4c** Collect, organize and analyze data accurately and precisely.	**11.A.5c** Conduct systematic controlled experiments to test the selected hypotheses.
11.A.3d Explain the existence of unexpected results in a data set.	**11.A.4d** Apply statistical methods to the data to reach and support conclusions.	**11.A.5d** Apply statistical methods to make predictions and to test the accuracy of results.
11.A.3e Use data manipulation tools and quantitative (e.g., mean, mode, simple equations) and representational methods (e.g., simulations, image processing) to analyze measurements.	**11.A.4e** Formulate alternative hypotheses to explain unexpected results. **11.A.4f** Using available technology, report, display and defend to an audience conclusions drawn from investigations.	**11.A.5e** Report, display and defend the results of investigations to audiences that may include professionals and technical experts.
11.A.3f Interpret and represent results of analysis to produce findings.		
11.A.3g Report and display the process and results of a scientific investigation.		
11.B.3a Identify an actual design problem and establish criteria for determining the success of a solution.	**11.B.4a** Identify a technological design problem inherent in a commonly used product.	**11.B.5a** Identify a design problem that has practical applications and propose possible solutions, considering such constraints as available tools, materials, time and costs.
11.B.3b Sketch, propose and compare design solutions to the problem considering available materials, tools, cost effectiveness and safety.	**11.B.4b** Propose and compare different solution designs to the design problem based upon given constraints including available tools, materials and time.	**11.B.5b** Select criteria for a successful design solution to the identified problem.
11.B.3c Select the most appropriate design and build a prototype or simulation.	**11.B.4c** Develop working visualizations of the proposed solution designs (e.g., blueprints, schematics, flowcharts, cad-cam, animations).	**11.B.5c** Build and test different models or simulations of the design solution using suitable materials, tools and technology.
11.B.3d Test the prototype using available materials, instruments and technology and record the data.	**11.B.4d** Determine the criteria upon which the designs will be judged, identify advantages and disadvantages of the designs and select the most promising design.	**11.B.5d** Choose a model and refine its design based on the test results.
11.B.3e Evaluate the test results based on established criteria, note sources of error and recommend improvements.	**11.B.4e** Develop and test a prototype or simulation of the solution design using available materials, instruments and technology.	**11.B.5e** Apply established criteria to evaluate the suitability, acceptability, benefits, drawbacks and consequences for the tested design solution and recommend modifications and refinements.
11.B.3f Using available technology, report the relative success of the design based on the test results and criteria.	**11.B.4f** Evaluate the test results based established criteria, note sources of error a recommend improvements. **11.B.4g** Using available technology, report to an audience the relative success of the design based on the test results and criteria.	**11.B.5f** Using available technology, prepare and present findings of the tested design solution to an audience that may include professional and technical experts.

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

As a result of their schooling students will be able to:

LEARNING STANDARD	EARLY ELEMENTARY	LATE ELEMENTARY
A. Know and apply concepts that explain how living things function, adapt and change.	**12.A.1a** Identify and describe the component parts of living things (e.g., birds have feathers; people have bones, blood, hair, skin) and their major functions. **12.A.1b** Categorize living organisms using a variety of observable features (e.g., size, color, shape, backbone).	**12.A.2a** Describe simple life cycles of plants and animals and the similarities and differences in their offspring. **12.A.2b** Categorize features as either inherited or learned (e.g., flower color or eye color is inherited; language is learned).
B. Know and apply concepts that describe how living things interact with each other and with their environment.	**12.B.1a** Describe and compare characteristics of living things in relationship to their environments. **12.B.1b** Describe how living things depend on one another for survival.	**12.B.2a** Describe relationships among various organisms in their environments (e.g., predator/prey, parasite/host, food chains and food webs). **12.B.2b** Identify physical features of plants and animals that help them live in different environments (e.g., specialized teeth for eating certain foods, thorns for protection, insulation for cold temperature).
C. Know and apply concepts that describe properties of matter and energy and the interactions between them.	**12.C.1a** Identify and compare sources of energy (e.g., batteries, the sun). **12.C.1b** Compare large-scale physical properties of matter (e.g., size, shape, color, texture, odor).	**12.C.2a** Describe and compare types of energy including light, heat, sound, electrical and mechanical. **12.C.2b** Describe and explain the properties of solids, liquids and gases.
D. Know and apply concepts that describe force and motion and the principles that explain them.	**12.D.1a** Identify examples of motion (e.g., moving in a straight line, vibrating, rotating). **12.D.1b** Identify observable forces in nature (e.g., pushes, pulls, gravity, magnetism).	**12.D.2a** Explain constant, variable and periodic motions. **12.D.2b** Demonstrate and explain ways that forces cause actions and reactions (e.g., magnets attracting and repelling; objects falling, rolling and bouncing).

Note: Examples are designated by "e.g." and enclosed in parentheses. They are meant to guide the teacher as to the general intent of the standards and benchmarks, not to identify all possible items.

GOAL 12 CONTINUED

WHY THIS GOAL IS IMPORTANT:

This goal is comprised of key concepts and principles in the life, physical and earth/space sciences that have considerable explanatory and predictive power for scientists and non-scientists alike. These ideas have been thoroughly studied and have stood the test of time. Knowing and being able to apply these concepts, principles and processes help students understand what they observe in nature and through scientific experimentation. A working knowledge of these concepts and principles allows students to relate new subject matter to material previously learned and to create deeper and more meaningful levels of understanding.

MIDDLE/JUNIOR HIGH SCHOOL	EARLY HIGH SCHOOL	LATE HIGH SCHOOL
12.A.3a Explain how cells function as "building blocks" of organisms and describe the requirements for cells to live. **12.A.3b** Compare characteristics of organisms produced from a single parent with those of organisms produced by two parents. **12.A.3c** Compare and contrast how different forms and structures reflect different functions (e.g., similarities and differences among animals that fly, walk or swim; structures of plant cells and animal cells).	**12.A.4a** Explain how genetic combinations produce visible effects and variations among physical features and cellular functions of organisms. **12.A.4b** Describe the structures and organization of cells and tissues that underlie basic life functions including nutrition, respiration, cellular transport, biosynthesis and reproduction. **12.A.4c** Describe processes by which organisms change over time using evidence from comparative anatomy and physiology, embryology, the fossil record, genetics and biochemistry.	**12.A.5a** Explain changes within cells and organisms in response to stimuli and changing environmental conditions (e.g., homeostasis, dormancy). **12.A.5b** Analyze the transmission of genetic traits, diseases and defects.
12.B.3a Identify and classify biotic and abiotic factors in an environment that affect population density, habitat and placement of organisms in an energy pyramid. **12.B.3b** Compare and assess features of organisms for their adaptive, competitive and survival potential (e.g., appendages, reproductive rates, camouflage, defensive structures).	**12.B.4a** Compare physical, ecological and behavioral factors that influence interactions and interdependence of organisms. **12.B.4b** Simulate and analyze factors that influence the size and stability of populations within ecosystems (e.g., birth rate, death rate, predation, migration patterns).	**12.B.5a** Analyze and explain biodiversity issues and the causes and effects of extinction. **12.B.5b** Compare and predict how life forms can adapt to changes in the environment by applying concepts of change and constancy (e.g., variations within a population increase the likelihood of survival under new conditions).
12.C.3a Explain interactions of energy with matter including changes of state and conservation of mass and energy. **12.C.3b** Model and describe the chemical and physical characteristics of matter (e.g., atoms, molecules, elements, compounds, mixtures).	**12.C.4a** Use kinetic theory, wave theory, quantum theory and the laws of thermodynamics to explain energy transformations. **12.C.4b** Analyze and explain the atomic and nuclear structure of matter.	**12.C.5a** Analyze reactions (e.g., nuclear reactions, burning of fuel, decomposition of waste) in natural and man-made energy systems. **12.C.5b** Analyze the properties of materials (e.g., mass, boiling point, melting point, hardness) in relation to their physical and/or chemical structures.
12.D.3a Explain and demonstrate how forces affect motion (e.g., action/reaction, equilibrium conditions, free-falling objects). **12.D.3b** Explain the factors that affect the gravitational forces on objects (e.g., changes in mass, distance).	**12.D.4a** Explain and predict motions in inertial and accelerated frames of reference. **12.D.4b** Describe the effects of electromagnetic and nuclear forces including atomic and molecular bonding, capacitance and nuclear reactions.	**12.D.5a** Analyze factors that influence the relative motion of an object (e.g., friction, wind shear, cross currents, potential differences). **12.D.5b** Analyze the effects of gravitational, electromagnetic and nuclear forces on a physical system.

As a result of their schooling students will be able to:

LEARNING STANDARD	EARLY ELEMENTARY	LATE ELEMENTARY
E. Know and apply concepts that describe the features and processes of the Earth and its resources.	**12.E.1a** Identify components and describe diverse features of the Earth's land, water and atmospheric systems. **12.E.1b** Identify and describe patterns of weather and seasonal change. **12.E.1c** Identify renewable and nonrenewable natural resources.	**12.E.2a** Identify and explain natural cycles of the Earth's land, water and atmospheric systems (e.g., rock cycle, water cycle, weather patterns). **12.E.2b** Describe and explain short-term and long-term interactions of the Earth's components (e.g., earthquakes, types of erosion). **12.E.2c** Identify and classify recyclable materials.
F. Know and apply concepts that explain the composition and structure of the universe and Earth's place in it.	**12.F.1a** Identify and describe characteristics of the sun, Earth and moon as familiar objects in the solar system. **12.F.1b** Identify daily, seasonal and annual patterns related to the Earth's rotation and revolution.	**12.F.2a** Identify and explain natural cycles and patterns in the solar system (e.g., order of the planets; moon phases; seasons as related to Earth's tilt, one's latitude, and where Earth is in its yearly orbit around the sun). **12.F.2b** Explain the apparent motion of the sun and stars. **12.F.2c** Identify easily recognizable star patterns (e.g., the Big Dipper, constellations).

Note: Examples are designated by "e.g." and enclosed in parentheses. They are meant to guide the teacher as to the general intent of the standards and benchmarks, not to identify all possible items.

MIDDLE/JUNIOR HIGH SCHOOL	EARLY HIGH SCHOOL	LATE HIGH SCHOOL
12.E.3a Analyze and explain large-scale dynamic forces, events and processes that affect the Earth's land, water and atmospheric systems (e.g., jetstream, hurricanes, plate tectonics). **12.E.3b** Describe interactions between solid earth, oceans, atmosphere and organisms that have resulted in ongoing changes of Earth (e.g., erosion, El Nino). **12.E.3c** Evaluate the biodegradability of renewable and nonrenewable natural resources.	**12.E.4a** Explain how external and internal energy sources drive Earth processes (e.g., solar energy drives weather patterns; internal heat drives plate tectonics). **12.E.4b** Describe how rock sequences and fossil remains are used to interpret the age and changes in the Earth.	**12.E.5** Analyze the processes involved in naturally occurring short-term and long-term Earth events (e.g., floods, ice ages, temperature, sea-level fluctuations).
12.F.3a Simulate, analyze and explain the effects of gravitational force in the solar system (e.g., orbital shape and speed, tides, spherical shape of the planets and moons). **12.F.3b** Describe the organization and physical characteristics of the solar system (e.g., sun, planets, satellites, asteroids, comets). **12.F.3c** Compare and contrast the sun as a star with other objects in the Milky Way Galaxy (e.g., nebulae, dust clouds, stars, black holes).	**12.F.4a** Explain theories, past and present, for changes observed in the universe. **12.F.4b** Describe and compare the chemical and physical characteristics of galaxies and objects within galaxies (e.g., pulsars, nebulae, black holes, dark matter, stars).	**12.F.5a** Compare the processes involved in the life cycle of stars (e.g., gravitational collapse, thermonuclear fusion, nova) and evaluate the supporting evidence. **12.F.5b** Describe the size and age of the universe and evaluate the supporting evidence (e.g., red-shift, Hubble's constant).

SCIENCE

STATE GOAL 13: Understand the relationships among science, technology and society in historical and contemporary contexts.

As a result of their schooling students will be able to:

LEARNING STANDARD	EARLY ELEMENTARY	LATE ELEMENTARY
A. Know and apply the accepted practices of science.	**13.A.1a** Use basic safety practices (e.g., not tasting materials without permission, "stop/drop/roll"). **13.A.1b** Explain why similar results are expected when procedures are done the same way. **13.A.1c** Explain how knowledge can be gained by careful observation.	**13.A.2a** Demonstrate ways to avoid injury when conducting science activities (e.g., wearing goggles, fire extinguisher use). **13.A.2b** Explain why similar investigations may not produce similar results. **13.A.2c** Explain why keeping accurate and detailed records is important.
B. Know and apply concepts that describe the interaction between science, technology and society.	**13.B.1a** Explain the uses of common scientific instruments (e.g., ruler, thermometer, balance, probe, computer). **13.B.1b** Explain how using measuring tools improves the accuracy of estimates. **13.B.1c** Describe contributions men and women have made to science and technology. **13.B.1d** Identify and describe ways that science and technology affect people's everyday lives (e.g., transportation, medicine, agriculture, sanitation, communication occupations). **13.B.1e** Demonstrate ways to reduce, reuse and recycle materials.	**13.B.2a** Explain how technology is used in science for a variety of purposes (e.g., sample collection, storage and treatment; measurement; data collection, storage and retrieval; communication of information). **13.B.2b** Describe the effects on society of scientific and technological innovations (e.g., antibiotics, steam engine, digital computer). **13.B.2c** Identify and explain ways that science and technology influence the lives and careers of people. **13.B.2d** Compare the relative effectiveness of reducing, reusing and recycling in actual situations. **13.B.2e** Identify and explain ways that technology changes ecosystems (e.g., dams, highways, buildings, communication networks, power plants). **13.B.2f** Analyze how specific personal and societal choices that humans make affect local, regional and global ecosystems (e.g., lawn and garden care, mass transit).

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WHY THIS GOAL IS IMPORTANT:

Understanding the nature and practices of science such as ensuring the validity and replicability of results, building upon the work of others and recognizing risks involved in experimentation gives learners a useful sense of the scientific enterprise. In addition, the relationships among science, technology and society give humans the ability to change and improve their surroundings. Learners who understand this relationship will be able to appreciate the efforts and effects of scientific discovery and applications of technology on their own lives and on the society in which we live.

MIDDLE/JUNIOR HIGH SCHOOL	EARLY HIGH SCHOOL	LATE HIGH SCHOOL
13.A.3a Identify and reduce potential hazards in science activities (e.g., ventilation, handling chemicals). **13.A.3b** Analyze historical and contemporary cases in which the work of science has been affected by both valid and biased scientific practices. **13.A.3c** Explain what is similar and different about observational and experimental investigations.	**13.A.4a** Estimate and suggest ways to reduce the degree of risk involved in science activities. **13.A.4b** Assess the validity of scientific data by analyzing the results, sample set, sample size, similar previous experimentation, possible misrepresentation of data presented and potential sources of error. **13.A.4c** Describe how scientific knowledge, explanations and technological designs may change with new information over time (e.g., the understanding of DNA, the design of computers). **13.A.4d** Explain how peer review helps to assure the accurate use of data and improves the scientific process.	**13.A.5a** Design procedures and policies to eliminate or reduce risk in potentially hazardous science activities. **13.A.5b** Explain criteria that scientists use to evaluate the validity of scientific claims and theories. **13.A.5c** Explain the strengths, weaknesses and uses of research methodologies including observational studies, controlled laboratory experiments, computer modeling and statistical studies. **13.A.5d** Explain, using a practical example (e.g., cold fusion), why experimental replication and peer review are essential to scientific claims.
13.B.3a Identify and explain ways that scientific knowledge and economics drive technological development. **13.B.3b** Identify important contributions to science and technology that have been made by individuals and groups from various cultures. **13.B.3c** Describe how occupations use scientific and technological knowledge and skills. **13.B.3d** Analyze the interaction of resource acquisition, technological development and ecosystem impact (e.g., diamond, coal or gold mining; deforestation). **13.B.3e** Identify advantages and disadvantages of natural resource conservation and management programs. **13.B.3f** Apply classroom-developed criteria to determine the effects of policies on local science and technology issues (e.g., energy consumption, landfills, water quality).	**13.B.4a** Compare and contrast scientific inquiry and technological design as pure and applied sciences. **13.B.4b** Analyze a particular occupation to identify decisions that may be influenced by a knowledge of science. **13.B.4c** Analyze ways that resource management and technology can be used to accommodate population trends. **13.B.4d** Analyze local examples of resource use, technology use or conservation programs; document findings; and make recommendations for improvements. **13.B.4e** Evaluate claims derived from purported scientific studies used in advertising and marketing strategies.	**13.B.5a** Analyze challenges created by international competition for increases in scientific knowledge and technological capabilities (e.g., patent issues, industrial espionage, technology obsolescence). **13.B.5b** Analyze and describe the processes and effects of scientific and technological breakthroughs. **13.B.5c** Design and conduct an environmental impact study, analyze findings and justify recommendations. **13.B.5d** Analyze the costs, benefits and effects of scientific and technological policies at the local, state, national and global levels (e.g., genetic research, Internet access). **13.B.5e** Assess how scientific and technological progress has affected other fields of study, careers and job markets and aspects of everyday life.

Science Examples

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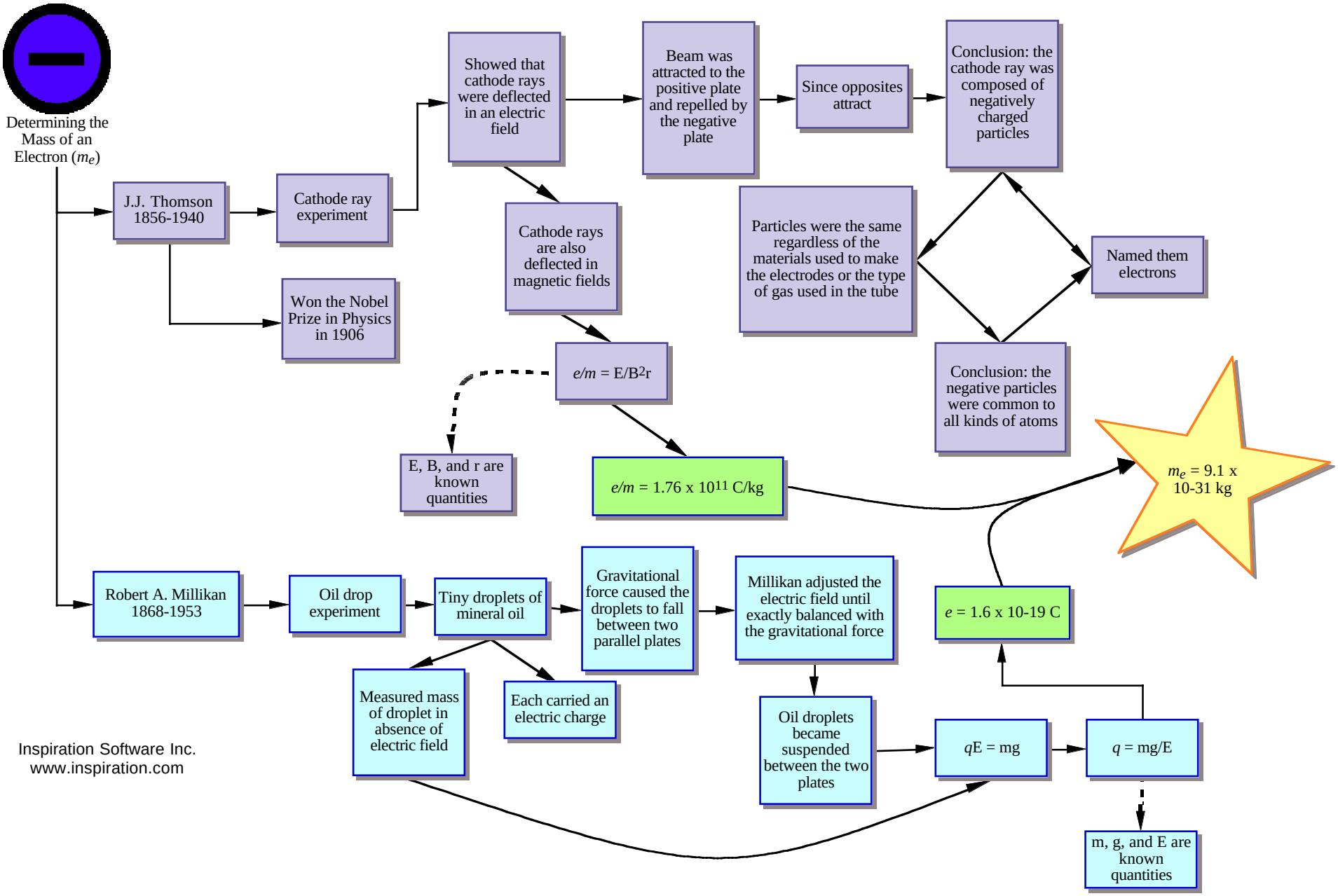
Determining the Mass of an Electron (m_e)
J.J. Thomson 1856-1940
Cathode ray experiment
Showed that cathode rays were deflected in an electric field
Beam was attracted to the positive plate and repelled by the negative plate
Since opposites attract
Conclusion: the cathode ray was composed of negatively 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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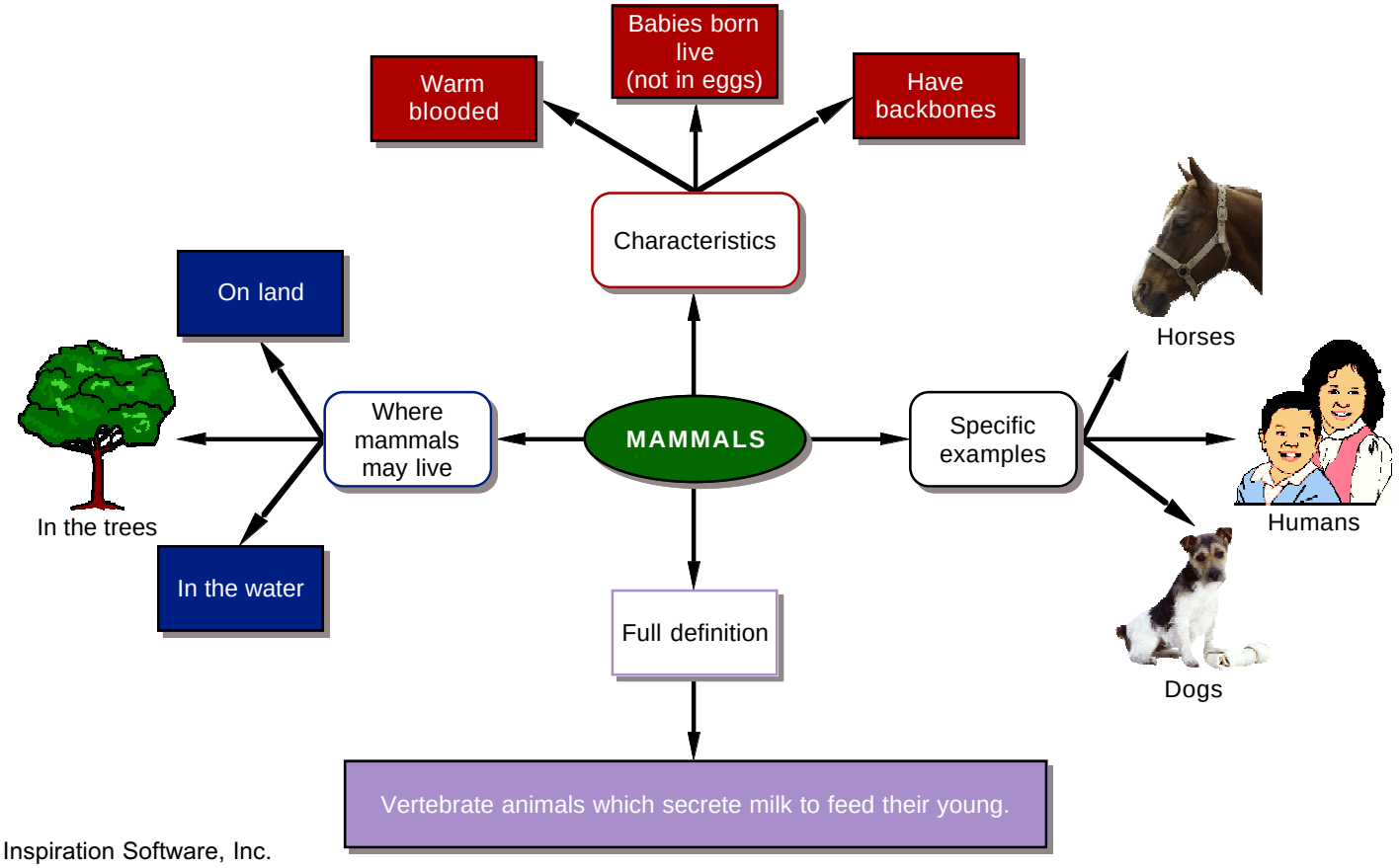

SOUND

was first broken by
- General Chuck Yeager
  - in a
    - Bell X-1
      - named
        - "Glamourous Glennis"
          - after
            - Yeager's wife
      - on
        - October 17, 1947
          - at
            - Muroc Dry Lake Beds, CA
              - now known as
                - Edwards AFB

whose
- speed v
  - =
    - wave length
      - X
        - frequency f
          - which is called the
            - Wave Equation

is a
- longitudinal wave

can travel in
- Gases
  - such as
    - air
      - whose
        - speed
          - which is a function of
            - density
              - and
                - temperature
                  - which vary with
                    - altitude
      - at
        - frequencies
          - of
            - 20-20,000 Hz
              - the range of
                - human hearing
            - 15-50,000 Hz
              - the range of
                - canine hearing
            - 1000-150,000 Hz
              - the range of
                - bat hearing
- or
- Solids
  - such as
    - steel
      - which travels
        - 5000 m/s
- or
- Liquids
  - such as
    - water
      - which travels
        - 1482 m/s @ 20^0 C

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Created by Paul Rutherford
Shawnee Mission North High School
Shawnee Mission, KS

Presentation Plan

Plan a presentation by using the prompts to generate ideas and structure your presentation. Add topics and subtopics to expand your thinking and make connections between ideas, using notes to add detail. If your presentation will include slides, use the Presentation Manager to develop your presentation.

Presentation Plan

1 TOPIC
- Carbon Footprint

2 PURPOSE
- Convince people to reduce their carbon footprint

3 AUDIENCE
- Expectations
  - To be informed and persuaded
- Knowledge Base
  - Limited in terms of knowing how to reduce footprint
- Interaction
  - Ask questions in beginning of presentation

4 CONTENT
- Opening
  - Introduce the topic
    - Explain what a carbon footprint is
  - Personal connection
  - Audience connection
    - Run through carbon footprint /carbon emissions calculator
      - Show graphs of an average person's carbon emissions
        - Show examples of the impact of carbon emissions
- Body
  - Discuss the everyday things that can reduce carbon footprint
    - Point 1
      - Transportation
        - Choose public transportation
          - Carpool
            - Consider type of car
              - Keep tires inflated
    - Point 2
      - Food and drink
        - Buy local
          - Buy organic
            - Start a garden
              - Avoid bottled water
    - Point 3
      - Energy use at home
        - Insulate
          - Buy energy-efficient appliances
            - Lower the thermostat
              - Sign up for renewable energy
- Conclusion
  - Every person can do small things to control the size of their carbon footprint. Every bit of effort adds up to make a big difference.