

Inspired Standards Match for Colorado

K-12 Academic Standards

Curriculum Standards are a major focus in education today. The following document highlights meaningful ways in which Inspiration and Kidspiration support the Colorado K-12 Academic Standards.

The Inspired Standards Match is a tool that is designed to help districts effectively integrate Inspiration and Kidspiration into their curricula.

The standards that are directly supported by Inspiration and Kidspiration are highlighted in pink. The green note annotations provide suggestions as to which Templates and Activities correspond specifically to the highlighted standard. Templates and Activities are valuable tools that are included with the software programs. They are starter documents that teachers can use as worksheets or style sheets. Each Template and Activity can easily be changed to reflect individual learning objectives, curricula, and teaching styles.

Thank you for your interest in Inspiration and Kidspiration!

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COLORADO



MODEL CONTENT
STANDARDS

READING
&
WRITING

Adopted 07/13/95

INTRODUCTION

Colorado Model Content Standards for Reading and Writing

The ability to communicate clearly -- to read, write, speak, and listen -- forms the core of human culture. Reading, writing, speaking, and listening skills are essential tools for learning, for success in the workplace, for enriching and expanding our lives, and for responsible citizenship.

Language skills are particularly critical in the area of education. Through language abilities, students understand the academic content areas. Success in learning is grounded in students acquiring solid knowledge and skills in reading, writing, speaking, and listening. The Colorado Model Content Standards set high expectations in these areas for all students.

Reading and writing also have the power to bridge time and place. We remain in contact with people who lived before us through literature and other written records of human experience. We reach toward our future by knowing how to locate, read, and make use of an ever-increasing amount of information.

More than a year of public response and discussion has resulted in these model Reading and Writing standards. These standards express what each student in Colorado should know and be able to do in order to

- become fluent readers, writers, and speakers;
- be able to communicate effectively, concisely, coherently, and imaginatively;
- recognize the power of language and use that power ethically and creatively; and
- be at ease communicating in an increasingly technological world.

For the benefit of Colorado students, educators, parents, and communities can now focus their attention and energy on creating the conditions under which all students can meet these expectations. Therefore, it is the responsibility of the education community to intervene at the earliest point in the child's formal educational experience where, through careful observation, it becomes apparent that a child is not progressing in a manner which will lead to the meeting of these standards.

Colorado Model Content Standards

READING AND WRITING

- 1. Students read and understand a variety of materials.**
- 2. Students write and speak for a variety of purposes and audiences.**
- 3. Students write and speak using conventional grammar, usage, sentence structure, punctuation, capitalization, and spelling.**
- 4. Students apply thinking skills to their reading, writing, speaking, listening, and viewing.**
- 5. Students read to locate, select, and make use of relevant information from a variety of media, reference, and technological sources.**
- 6. Students read and recognize literature as a record of human experience.**

STANDARD 1:

Students read and understand a variety of materials.

In order to meet this standard, students will

- use comprehension skills such as previewing, predicting, inferring, comparing and contrasting, re-reading and self-monitoring, summarizing, identifying the author's purpose, determining the main idea, and applying knowledge of foreshadowing, metaphor, simile, symbolism, and other figures of speech;
- make connections between their reading and what they already know, and identify what they need to know about a topic before reading about it;
- adjust reading strategies for different purposes such as reading carefully, idea by idea; skimming and scanning; fitting materials into an organizational pattern, such as reading a novel chronologically; finding information to support particular ideas; and finding the sequence of steps in a technical publication;
- use word recognition skills and resources such as phonics, context clues, picture clues, word origins, and word order clues; reference guides; roots, prefixes, and suffixes of words for comprehension; and
- use information from their reading to increase vocabulary and enhance language usage.

RATIONALE:

The goal for students at all levels is that they know and can use strategies--various ways of unlocking the meaning of words and larger blocks of text--to become successful readers. The strategies are applied in increasingly difficult reading material at each grade level. At all levels, students should be challenged to read literature and other materials that stimulate their interests and intellectual abilities. Reading from a wide variety of texts, both assigned and student selected, provides experience in gaining information and pleasure from diverse forms and perspectives.

Note: A reference list of sources of book lists can be found at the end of the Reading and Writing Standards. None of these book lists have been endorsed by the Colorado State Board of Education.

GRADES K-4

In grades K-4, what the students know and are able to do includes



- using a full range of strategies to comprehend materials such as directions, nonfiction material, rhymes and poems, and stories.

GRADES 5-8

As students in grades 5-8 extend their knowledge, what they know and are able to do includes



- using a full range of strategies to comprehend technical writing, newspapers, magazines, poetry, short stories, plays, and novels in addition to the types of reading material mentioned above. Students extend their thinking and understanding as they read stories about people from similar and different backgrounds.

GRADES 9-12

As students in grades 9-12 extend their knowledge, what they know and are able to do includes



- using a full range of strategies to comprehend essays, speeches, autobiographies, and first-person historical documents in addition to the types of literature mentioned above.

For students extending their English/Language Arts education beyond the standards, what they know and are able to do **may** include



- using a full range of strategies to comprehend literary criticism and literary analysis, professional and technical journals, and professional-level reading materials that match their career or academic interests.

STANDARD 2:

Students write and speak for a variety of purposes and audiences.

In order to meet this standard, students will

- write and speak for a variety of purposes such as telling stories, presenting analytical responses to literature, conveying technical information, explaining concepts and procedures, and persuading;
- write and speak for audiences such as peers, teachers, and the community;
- plan, draft, revise, proofread, and edit written communications;
- use a variety of devices such as figurative language, symbolism, dialect, and precise vocabulary to convey meaning;
- organize written and oral presentations using strategies such as lists, outlining, cause/effect relationships, comparison/contrast, problem/solution, and narration; and
- use handwriting and at the most appropriate time, word processing to produce a product that is legible.

RATIONALE:

Writing and speaking are essential tools for learning, for success in the workplace, and for responsible citizenship. Developing a range of writing and speaking abilities requires extensive study, practice, and thinking. Students need frequent opportunities to write and speak for different audiences and purposes, and they need to be able to communicate expressively, informatively, and analytically. Growth in writing and speaking abilities occurs by applying skills to increasingly challenging communication tasks.

GRADES K-4

In grades K-4, what students know and are able to do includes



- generating topics and developing ideas for a variety of writing and speaking purposes (for example, telling a story, publishing a class newsletter, writing a letter to an adult, writing or orally presenting a book report, creating and producing a play, introducing a speaker or an event, narrating a presentation);



- organizing their speaking and writing;
- choosing vocabulary that communicates their messages clearly and precisely;
- revising and editing speech and writing; and
- creating readable documents with legible handwriting or word processing at the appropriate time.

GRADES 5-8

As students in grades 5-8 extend their knowledge, what they know and are able to do includes



- writing stories, letters, and reports with greater detail and supporting material;
- choosing vocabulary and figures of speech that communicate clearly;
- drafting, revising, editing, and proofreading for a legible final copy;



- applying skills in analysis, synthesis, evaluation, and explanation to their writing and speaking;



- incorporating source materials into their speaking and writing (*for example, interviews, news articles, encyclopedia information*);



- writing and speaking in the content areas (*for example, science, geography, history, literature*), using the technical vocabulary of the subject accurately; and
- recognizing stylistic elements such as voice, tone, and style.

GRADES 9-12

As students in grades 9-12 extend their knowledge, what they know and are able to do includes



- using fictional, dramatic, and poetic techniques in writing;



- conveying technical information in a written form appropriate to the audience;



- supporting an opinion using various forms of persuasion (factual or emotional) in speaking and writing;

- incorporating material from a wider range of sources (*for example, newspapers, magazines, interviews, technical publications, books*) in their writing and speaking;



- selecting a focused topic and drafting, revising, editing, and proofreading a legible final copy;



- writing in various specialized fields such as career and academic interest areas (*for example, scientific, technical, business communications*); and

- experimenting with stylistic elements such as voice, tone, and style.

For students extending their English/Language Arts education beyond these standards, what they know and are able to do **may** include

- writing longer, formal papers using sources such as technical journals and government publications to support an original thesis;
- making oral presentations for audiences within or outside the school in a variety of media;
- using style books or technical manuals to become self-evaluators of their writing; and
- analyzing, synthesizing, and evaluating a variety of written and spoken material.

STANDARD 3:

Students write and speak using conventional grammar, usage, sentence structure, punctuation, capitalization, and spelling.

In order to meet this standard, students will

- know and use correct grammar in speaking and writing;
- apply correct usage in speaking and writing;
- use correct sentence structure in writing; and
- demonstrate correct punctuation, capitalization, and spelling.

RATIONALE:

Students need to know and be able to use standard English. Proficiency in this standard plays an important role in how the writer or speaker is understood and perceived. All skills in this standard are reinforced and practiced at all grade levels and should be monitored by both the teacher and student to develop lifelong learning skills.

GRADES K-4

In grades K-4, what the students know and are able to do includes

- knowing and using subject/verb agreement;
- knowing and using correct modifiers;

- knowing and using correct capitalization, punctuation, and abbreviations; and
- spelling frequently used words correctly using phonics rules and exceptions.

GRADES 5-8

As students in grades 5-8 extend their knowledge, what they know and are able to do includes

- identifying the parts of speech such as nouns, pronouns, verbs, adverbs, adjectives, conjunctions, prepositions, and interjections;
- using correct pronoun case, regular and irregular noun and verb forms, and subject-verb agreement involving comparisons in writing and speaking;
- using modifiers, homonyms, and homophones in writing and speaking;
- using simple, compound, complex, and compound/complex sentences in writing and speaking;
- punctuating and capitalizing titles and direct quotations, using possessives, and correct paragraphing in writing;
- using prefixes, root words, and suffixes correctly in writing and speaking;
- expanding spelling skills to include more complex words;
- demonstrating use of conventional spelling in their published works; and
- using resources such as spell checkers, dictionaries, and charts to monitor their spelling accuracy.

GRADES 9-12

As students in grades 9-12 extend their knowledge, what they know and are able to do includes

- using pronoun reference correctly in writing and speaking;
- using phrases and clauses for purposes of modification and parallel structure in writing and speaking;
- using internal capitalization and punctuation of secondary quotations in writing;
- using manuscript forms specified in various style manuals for writing (*for example, indenting for extended quotations, precise placement and form of page numbers, appropriate line spacing*); and
- refining spelling and grammatical skills and becoming a self-evaluator of their writing and speaking.

STANDARD 4:

Students apply thinking skills to their reading, writing, speaking, listening, and viewing.

In order to meet this standard, students will






- make predictions, analyze, draw conclusions, and discriminate between fact and opinion in writing, reading, speaking, listening, and viewing;
- use reading, writing, speaking, listening, and viewing to define and solve problems;
- recognize, express, and defend points of view orally and in writing;
- identify the purpose, perspective, and historical and cultural influences of a speaker, author, or director; and
- evaluate the reliability, accuracy, and relevancy of information.

RATIONALE:

Students use reading, writing, speaking, listening, and viewing to think and learn. By moving beyond a literal interpretation of text to an analysis of an author's, speaker's, or director's purpose and perspectives, students practice and improve their higher-level thinking skills. Students need to recognize and evaluate different points of view and to follow a line of reasoning to its logical conclusion. Students need to think about their writing and reading skills and work toward improvement.






GRADES K-4

In grades K-4, what students know and are able to do includes

- recognizing an author's point of view;
-  predicting and drawing conclusions about stories;
-  differentiating between fact and opinion in written and spoken forms;
-  using reading, writing, speaking, and listening to define and solve problems;
- responding to written and oral presentations as a reader, listener, and articulate speaker;
-  formulating questions about what they read, write, hear, and view; and
-  using listening skills to understand directions.





GRADES 5-8

As students in grades 5-8 extend their knowledge, what they know and are able to do includes


-  • recognizing an author's or speaker's point of view and purpose, separating fact from opinion;
-  • using reading, writing, speaking, listening, and viewing skills to solve problems and answer questions;
-  • making predictions, drawing conclusions, and analyzing what they read, hear, and view;
-  • recognizing, expressing, and defending a point of view orally in an articulate manner and in writing; and
-  • determining literary quality based on elements such as the author's use of vocabulary, character development, plot development, description of setting, and realism of dialogue.

GRADES 9-12

As students in grades 9-12 extend their knowledge, what they know and are able to do includes

-  • recognizing an author's point of view, purpose, and historical and cultural context;
-  • using reading, writing, listening, articulate speaking, and viewing to solve problems;
-  • knowing what constitutes literary quality based on elements such as the author's point of view, the author's selection of significant details, theme development, and the author's reflection of events and ideas of his or her lifetime; and
-  • critiquing the content of written work and oral presentations.

For students extending their English/Language Arts education beyond the standard, what they know and are able to do **may** include

-  • applying principles of formal logic to written and oral texts.

STANDARD 5:

Students read to locate, select, and make use of relevant information from a variety of media, reference, and technological sources.

In order to meet this standard, students will

- select relevant material for reading, writing, and speaking purposes;
- understand the structure, organization, and use of various media, reference, and technological sources as they select information for their reading and writing;
- paraphrase, summarize, organize, and synthesize information;
- give credit for others' ideas, images, or information; and
- use information to produce a quality product.

RATIONALE:

In this age of information and technology, people need reading and information-retrieval skills that will enable them to access facts, images, and text from many sources. The sheer volume of data makes it necessary for information seekers to be able to wade through a maze of facts, figures, and images, and to identify what is useful and relevant.

Knowing how to locate, evaluate, and make use of an ever-increasing amount of information demands a broader repertoire of reading strategies. This implies an expanded definition of literacy that includes reading for information in a technological age. Students need to become discerning consumers of information.

GRADES K-4

In grades K-4, what students know and are able to do includes



- using organizational features of printed text (for example, page numbering, alphabetizing, glossaries, chapter heading, tables of contents, indexes, captions);
- recognizing organizational features of electronic information (for example, pull-down menus, icons, key word searches);
- using organizational features to locate media or electronic information (for example, passwords, entry menu features, pull-down menus, icons, key word searches);

- taking notes, outlining, and identifying main ideas in resource materials;
- sorting information as it relates to a specific topic or purpose; and
- giving credit for borrowed information by telling or listing sources.

GRADES 5-8

As students in grades 5-8 extend their knowledge, what they know and are able to do includes

- using organizational features of printed text such as prefaces, afterwords, and appendices;
- using organizational features of electronic information (*for example, microfiche headings and numbering, headings for accessing nested information in hypertext media, electronic media CD-ROM, laser disc*), and library and interlibrary catalog databases;
- locating and selecting relevant information;
- using available technology to research and produce an end-product that is accurately documented; and
- giving credit for borrowed information in a bibliography.

GRADES 9-12

As students in grades 9-12 extend their knowledge, what they know and are able to do includes

- using organizational features of printed text such as citations, end notes, and bibliographic references to locate relevant information;
- evaluating information in light of what they know and their specific needs;
- using organizational features of electronic text such as bulletin boards, database keyword searches, and e-mail addresses to locate information when technology is available;
- using strategies to gain information from journals, research studies, and technical documents; and
- using available technology to access information, conduct research, and produce a carefully documented product.

For students extending their English/Language Arts education beyond the standards, what they know and are able to do **may** include

- understanding and applying knowledge of the structure, organization, and use of various media, reference, and technological information sources in their reading and writing as they meet academic, personal, and professional challenges;
- locating information appropriate for their reading and writing purposes such as career and academic interest, leisure time, and self-improvement;

- using information from various resources, both primary and secondary, as a vehicle for expressing their own thoughts, impressions, and ideas;
- giving precise, formal credit for others' ideas, images, or information; and
- planning and presenting multimedia presentations.

STANDARD 6:

Students read and recognize literature as a record of human experience.

In order to meet this standard, students will

- know and use literary terminology;
- read literature to investigate common issues and interests;
- read literature to understand places, people, events, and vocabulary, both familiar and unfamiliar;
- read literature that reflects the uniqueness and integrity of the American experience;
- read classic and contemporary literature, representing various cultural and ethnic traditions from throughout the world; and
- read classic and contemporary literature of the United States about the experiences and traditions of diverse ethnic groups.





RATIONALE:

Literature records human expression in such forms as speeches, poems, novels, stories, nonfiction, essays, plays, films, biographies, and autobiographies by male and female speakers and writers. The study of literary traditions offers a perspective on enduring questions, a glimpse into human motives and conflicts, and a sense of the beauty and power of spoken and written language. In addition, literature transmits and transforms culture; it also enables students to think, communicate, and participate in society. The study of literature and writers of the United States honors the heritage and cultures of all people who live or have lived in America, and it thus helps students develop an understanding of our national experience. A comprehensive literature program fosters habits of reading that carry over into adult life.

Note: A reference list of sources of book lists can be found at the end of the Reading and Writing Standards. None of these book lists have been endorsed by the Colorado State Board of Education.





GRADES K-4

In grades K-4, what students know and are able to do includes

-  • reading, responding to, and discussing a variety of literature such as folk tales, legends, myths, fiction, rhymes and poems, non-fiction, and content-area reading;
-  • reading, responding to, and discussing literature as a way to explore the similarities and differences among stories and the ways in which those stories reflect the ethnic background of the author and the culture in which they were written;
- recognizing the concept of classic or enduring literature, and reading and listening to classic works;
-  • using literary terminology such as setting, plot, character, problem, and solution; and
-  • using new vocabulary from literature in other context.




GRADES 5-8

As students in grades 5-8 extend their knowledge, what they know and are able to do includes

-  • reading, responding to, and discussing a variety of novels, poetry, short stories, non-fiction, content-area and technical material, and plays;
-  • reading, responding to, and discussing literature that represents points of view from places, people, and events that are familiar and unfamiliar;
- distinguishing the elements that characterize and define a literary "classic";
-  • comparing the diverse voices of our national experience as they read a variety of United States literature;
-  • using literary terminology accurately, including setting, character, conflict, plot, resolution, theme, foreshadowing, and figurative language; and
- using new vocabulary from literature in other context.

GRADES 9-12

As students in grades 9-12 extend their knowledge, what they know and are able to do includes

-  • reading, responding to, and discussing novels, poetry, short stories, non-fiction, content-area and technical material, plays, essays, and speeches;
-  • using literary terminology accurately, such as theme, mood, diction, idiom, perspective, style, and point of view;
- identifying recurrent themes in United States literature; and
-  • developing and supporting a thesis about the craft and significance of particular works of literature, both classic and contemporary, from a variety of ethnic writers.

For students extending their English/Language Arts education beyond the standards, what they know and are able to do **may** include



- comparing and contrasting stories, novels, poems, and other forms of literature from different countries, time periods, or cultures;
- using novels, poetry, short stories, non-fiction, autobiographies, plays, essays, speeches, literary criticisms and analyses, and any other literature to explore academic, personal, or career issues; and
- understanding the common themes in the literature of the United States and in world literature.

REFERENCE LIST OF SOURCES OF BOOK LISTS

Note: None of these book lists have been endorsed by the Colorado State Board of Education.

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Available from American Library Association, 50 E. Huron, Chicago, Illinois 60611:
Notable Books for Children (pamphlet); Best Books for Young Adults (pamphlet);
Recommended Books for the Young Adult Reader (pamphlet)

Available from Children's Book Council, 568 Broadway, Suite 404, New York, NY 10012
(Annual book list).

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COLORADO



MODEL CONTENT **STANDARDS**

HISTORY

Adopted 09/14/95

INTRODUCTION

Colorado Model Content Standards for History

Why Study History?

The study of history is essential in developing citizens who understand contemporary issues with a depth and wisdom drawn from the experience of the past. Without history, a society shares no common memory of where it has been, of what its core values are, or of what decisions of the past account for present circumstances. Lacking a collective memory of important things, people lapse into political amnesia, unable to understand what newspapers are saying, to hear what is in--or left out of-- a speech, or to talk to each other about public questions. To quote the Bradley Commission on History in Schools, the study of history. . .

"helps students to develop a sense of 'shared humanity'; to understand themselves and ... how they resemble and how they differ from other people, over time and space; to question stereotypes of others, and of themselves; to discern the difference between fact and conjecture; to grasp the complexity of historical cause; to distrust the simple answer and the dismissive explanation; to respect particularity and avoid false analogy; to recognize the abuse of historical 'lessons' and to weigh the possible consequences of such abuse; to consider that ignorance of the past may make us prisoners of it; to realize that not all problems have solutions; to be prepared for the irrational, the accidental, in human affairs, and to grasp the power of ideas and character in history."(Gagnon, 1988).

Such a broad and deep understanding of history enriches individual experiences as students go on to take their place as stewards of the principles of a democratic society, as inheritors of many cultures, and as members of an economically interdependent and culturally diverse world.

Why History Standards?

A national debate is under way over the structure of, and standards for, the social studies curriculum in schools. Some contend that standards should be written for the social studies, not for individual disciplines within that field. Others contend that each of the disciplines, such as history, geography, and civics, makes its own unique contribution to the social studies and therefore requires separate standards. House Bill 93-1313 specifically calls for model content standards in history, geography, and civics. Therefore, the Standards and Assessments Development and Implementation Council, in articulating a position that is consistent with that legal obligation, has developed Model Content Standards for History.

The Council adopted the position that history and geography provide the frameworks of time and place on which the concepts of the other social studies disciplines can be organized. The identification of separate standards for history, geography, and civics is in no way intended to specify that the content be *taught* in that manner. Rather, history and geography should be seen as broadly integrative subjects that serve as the essential links among the social studies. This perspective empowers educators to make professional choices about when to address the discrete pieces of individual disciplines and when integration is most appropriate.

The Colorado Model Content Standards for History address both world and United States history, including the history of the Americas, and may very well necessitate reorganization of the social studies. The inclusion of content from world history and the history of the Americas suggests that all students should participate in instruction in these areas. The inclusion of areas of the world that have often been neglected in the study of history is in no way intended to exclude the continued study of Western Civilization and its significant place in the history of the United States. Because of the increasing interactions among all nations of the world and the effects of these interactions on our daily lives, it is imperative that students have knowledge of the history of both our nation and that of other nations. In addition, the grade-level benchmarks may also encourage districts to reconsider the sequence of their current instruction.

We wish to express our gratitude to the authors of Lessons from History: Essential Understanding and Historical Perspectives Students Should Acquire. The organizational themes used in the Colorado Model Content Standards for History were built upon the foundations laid by this work. This organizational framework is in no way intended to fragment the study of history into these isolated, separate categories; rather, it suggests the themes that can be woven throughout the story that constitutes history. Therefore, all of the standards must be considered in their chronological, historical context.

As the reader examines these six standards, it may be useful to consider that they fall into two categories. The first two standards address the processes involved in the study of history, chronological organization, and historical inquiry. The remaining four standards outline the areas of content to be studied, that is, what students need to know. While there is certainly overlap, this distinction may help the reader better understand the structure of the standards.

Colorado Model Content Standards

HISTORY

- 1. Students understand the chronological organization of history and know how to organize events and people into major eras to identify and explain historical relationships.**
- 2. Students know how to use the processes and resources of historical inquiry*.**
- 3. Students understand that societies* are diverse* and have changed over time.**
- 4. Students understand how science, technology, and economic activity have developed, changed, and affected societies throughout history.**
- 5. Students understand political institutions and theories that have developed and changed over time.**
- 6. Students know that religious and philosophical ideas have been powerful forces throughout history.**

Note: The broad term “History”, as used in the standards, refers to any and/or all areas of history under study at a given time. This includes the history of the United States, the World (including Western Civilization and the Americas), and the State of Colorado, where appropriate, over the K-12 years.

* A glossary of terms can be found on page 25 of this document.

STANDARD 1:

Students understand the chronological organization of history and know how to organize events and people into major eras to identify and explain historical relationships.

RATIONALE:

Chronological thinking is at the very heart of historical reasoning. It provides the framework for organizing historical thought; for determining the order in time of historical developments; for determining how long they lasted; and for examining the various relationships among historical events. It also provides students with a sense of their past, which is necessary for them to understand the present and see possibilities for the future.

1.1 Students know the general chronological order of events and people in history.



GRADES K-4

In grades K-4, what students know and are able to do includes

- chronologically organizing significant events, groups*, and people in the history of Colorado.



GRADES 5-8

As students in grades 5-8 extend their knowledge, what they know and are able to do includes

- chronologically organizing major events and people of United States history; and
- describing significant events and people which form the foundation of United States history in the chronological context of the history of the Americas and the world.



GRADES 9-12

As students in grades 9-12 extend their knowledge, what they know and are able to do includes

- identifying events and people that characterize each of the major eras in United States and world history (listed below).

NOTE: These eras are drawn from Lessons from History: Essential Understanding and Historical Perspectives Students Should Acquire.

Eras in United States History

The Americas to 1600
 The Colonial Era, 1500 - 1754
 The Revolutionary Era, 1754 - 1783
 Nation Building, 1783 - 1815

The Expanding Nation, 1815 - 1850
 Civil War and Reconstruction, 1850 - 1877
 Development of the Industrial United States, 1865 -1914
 The Progressive Era, 1890 - 1914
 Emergence of the United States as a World Power, 1890 - 1920
 The 20's: Prosperity & Problems

Depression and New Deal, 1929 - 1941
 World War II and Post War United States, 1939-1961
 Contemporary United States, 1961 - Present

Eras in World History

Emergence of Civilizations, to 1000 BC
 The Classical Civilizations of the Mediterranean Basin, India, and China, 1000 BC - 600 AD

The Expansion and Interaction of Civilizations, 600 AD - 1450 AD

The Early Modern World, 1450-1800

The World in the 19th Century

The World in the Contemporary Era

1.2 Students use chronology to organize historical events and people.



GRADES K-4

In grades K-4, what students know and are able to do includes

- creating timelines that show people and events in sequence using days, weeks, months, years, decades, and centuries; and
- creating a brief historical narrative* that chronologically organizes people and events in the history of their family heritage, school, neighborhood, local community, or Colorado.



GRADES 5-8

As students in grades 5-8 extend their knowledge, what they know and are able to do includes

- identifying examples of how various cultures* have used calendars to organize and measure time;
- constructing tiered timelines to show how different series of events happened simultaneously; and
- illustrating the time structure of events in historical narratives.



GRADES 9-12

As students in grades 9-12 extend their knowledge, what they know and are able to do includes

- reconstructing the time structure and identifying connections found in historical narratives;
- using timelines to organize large quantities of historical information, compare different time periods and places, and answer historical questions; and
- describing how history can be organized, using various criteria (*for example, thematically, chronologically, geographically*) to group people and events.

1.3 Students use chronology to examine and explain historical relationships.



GRADES K-4

In grades K-4, what students know and are able to do includes

- identifying cause-and-effect relationships in a sequence of events.



GRADES 5-8

As students in grades 5-8 extend their knowledge, what they know and are able to do includes

- interpreting historical data to determine cause-effect and time-order relationships; and
- explaining patterns and identifying themes in related events over time.



GRADES 9-12

As students in grades 9-12 extend their knowledge, what they know and are able to do includes

- distinguishing between cause-and-effect relationships and events that happen or occur concurrently or sequentially;
- analyzing and explaining cause-and-effect relationships using historical information that is organized chronologically; and
- using both chronological order and the duration of events to detect and analyze patterns of historical continuity and change.

STANDARD 2:

Students know how to use the processes and resources of historical inquiry.

RATIONALE:

The study of history requires obtaining and deriving meaning from historical information. It is essential that students of history be able to use the processes of historical inquiry to formulate historical questions, identify patterns of events, analyze cause-and-effect relationships, and evaluate historical arguments in order to make usable conclusions. In addition, the skills needed for evaluating historical arguments are fundamental for understanding current social issues and policy.

2.1 Students know how to formulate questions and hypotheses regarding what happened in the past and to obtain and analyze historical data to answer questions and test hypotheses.



GRADES K-4

In grades K-4, what students know and are able to do includes

- posing and answering questions about the past; and
- gathering historical data from multiple sources (*for example, oral histories, interviews, diaries, letters, newspapers, literature, speeches, texts, maps, photographs, art works, and available technology*).



GRADES 5-8

As students in grades 5-8 extend their knowledge, what they know and are able to do includes

- formulating historical questions based on examination of primary* and secondary* sources including documents, eyewitness accounts, letters and diaries, artifacts, real or simulated historical sites, charts, graphs, diagrams, and written texts;
- gathering information from multiple sources, including electronic databases, to understand events from multiple perspectives; and
- determining if the information gathered is sufficient to answer historical questions.



GRADES 9-12

As students in grades 9-12 extend their knowledge, what they know and are able to do includes

- formulating historical hypotheses from multiple, historically objective perspectives, using multiple sources; and
- gathering, analyzing, and reconciling historical information, including contradictory data, from primary and secondary sources to support or reject hypotheses.

2.2 Students know how to interpret and evaluate primary and secondary sources of historical information.



GRADES K-4

In grades K-4, what students know and are able to do includes

- describing sources of historical information;
- identifying the main idea in a source of historical information; and
- identifying ways different cultures record their history.



GRADES 5-8

As students in grades 5-8 extend their knowledge, what they know and are able to do includes

- distinguishing between primary and secondary sources;
- interpreting the data in historical maps, photographs, art works, and other artifacts; and
- examining data for point of view, historical context, bias, distortion, or propaganda.

GRADES 9-12

As students in grades 9-12 extend their knowledge, what they know and are able to do includes

- explaining how historical descriptions, arguments, and judgments can reflect the bias of the author and/or the prevailing ideas of the culture and time period;
- interpreting oral traditions and legends as “histories”;
- evaluating data within the social, political, and economic context in which it was created, testing its credibility, and evaluating its bias; and
- comparing and contrasting the reliability of information received from multiple sources.

2.3 Students apply knowledge of the past to analyze present-day issues and events from multiple, historically objective perspectives.

GRADES K-4

In grades K-4, what students know and are able to do includes

- comparing past and present-day situations and events.

GRADES 5-8

As students in grades 5-8 extend their knowledge, what they know and are able to do includes

- examining current concepts, issues, events, and themes from multiple, historical perspectives.

GRADES 9-12

As students in grades 9-12 extend their knowledge, what they know and are able to do includes

- identifying historical contexts of contemporary issues;
- identifying how print and electronic media can affect perspectives regarding historical events; and
- using historical information to interpret and evaluate decisions or policies regarding contemporary issues.

STANDARD 3:

Students understand that societies are diverse and have changed over time.

RATIONALE:

An understanding of the history of societies is indispensable to an understanding of the rest of history and to the understanding by individual students of their roles in the societies in which they live. Students need to understand the interactions that led to the diversity of societies and family and kinship groupings. They need to understand how contacts and exchanges between and among individuals, peoples, and cultures since earliest times have affected societies throughout history. They also need to be able to identify and describe the cultural heritage of the United States.

3.1 Students know how various societies were affected by contacts and exchanges among diverse peoples.

GRADES K-4



In grades K-4, what students know and are able to do includes

- recognizing how the presence, interactions, and contributions of various groups and cultures have affected the school, neighborhood, community, and state; and
- describing the history, interactions, and contributions of the various peoples and cultures that have lived in or migrated to the area that is now Colorado (*for example, African-Americans, Asian Americans, European Americans, Latino Americans, and Native Americans*).



GRADES 5-8

As students in grades 5-8 extend their knowledge, what they know and are able to do includes

- describing the common traits and characteristics that unite the United States as a nation and a society;
- describing the history, interactions, and contributions of the various peoples and cultures that have lived in or migrated, immigrated, or were brought to the Western Hemisphere;
- describing the history, interactions, and contributions of various groups of people who make up the major culture regions* of the world; and
- explaining how the cultures of the earliest civilizations spread and interacted (*for example, the civilizations of the river valleys of India, Africa, Mesopotamia, and Mesoamerica*).



GRADES 9-12

As students in grades 9-12 extend their knowledge, what they know and are able to do includes

- describing the interactions and contributions of the various peoples and cultures that have lived in or migrated, immigrated, or were brought to the area that is now the United States, including African, Asian, European, Latino, and Native American;
- describing and explaining the circumstances under which past and current societies have interacted and changed, resulting in cultural diffusion* (*for example, trade, war, exploration, imperialism, social disruptions, improvements in communication, and transportation*);
- explaining the reasons for major periods of immigration to the United States and describing how different segments of U.S. society reacted and changed; and
- describing the demographic changes resulting from major migrations in history (*for example, migration of Chinese south; Islamic nomads into Northern India; Germanic migrations into the Roman Empire; Bantu migrations south; Amer-Indian migrations into Central America; trans-Pacific migration*).

3.2 Students understand the history of social organization* in various societies.



GRADES K-4

In grades K-4, what students know and are able to do includes

- identifying reasons for living in social groups;
- describing important components of the cultural heritage of the United States; and
- recognizing that there are families and cultures around the world.



GRADES 5-8

As students in grades 5-8 extend their knowledge, what they know and are able to do includes

- describing and giving examples of basic elements of culture and social organization;
- explaining how forces of tradition have acted to maintain elements of social organization throughout history;
- comparing how roles of people have differed throughout history based on various factors (*for example, gender, age, caste, racial identity, wealth, and/or social position*), and
- describing how social roles and the characteristics of social organization have both changed and endured in the United States throughout its history (*for example, family structures, community structures*).



GRADES 9-12

As students in grades 9-12 extend their knowledge, what they know and are able to do includes

- explaining how societies are maintained when individuals see benefits and fulfill obligations of membership;
- analyzing how forces of tradition and change have influenced, altered, and maintained social roles and the social organization of societies throughout history;
- explaining how, throughout history, social organization has been related to distributions of privilege and power; and
- describing how societies have become increasingly complex in responding to the fundamental issues of social organization.

STANDARD 4:

Students understand how science, technology, and economic activity have developed, changed, and affected societies throughout history.

RATIONALE:

Major scientific, technological, and economic developments have profoundly affected people's lives and the social and political structures under which they have lived. They appear first in earliest prehistoric societies and continue to today's highly technological and economically interdependent societies. Students need to understand the history of developments in science and technology and of economic activity in order to participate as informed citizens.

4.1 Students understand the impact of scientific and technological developments on individuals and societies.



GRADES K-4

In grades K-4, what students know and are able to do includes

- comparing the lives of hunters and gatherers to the lives of people who cultivated plants and raised domesticated animals for food;
- describing the impact of various technological developments on the local community and the state (*for example, irrigation, transportation, communication*); and

- identifying individual achievements of scientists and inventors from many cultures and describing their achievements (*for example, the Persian scientist and mathematician who invented equations and coined the term “algebra”; Johann Gutenberg and the printing press; Galileo and the telescope; Isaac Newton and the theory of gravity; Eli Whitney and the cotton gin; Marie Curie and radiation*).



GRADES 5-8

As students in grades 5-8 extend their knowledge, what they know and are able to do includes

- explaining the significance of the achievements of individual scientists and inventors from many cultures (*for example, the impact of germ theory on medical practice and sanitation; the impact of the steamship on transportation and trade; the impact of the printing press on who had access to books and knowledge*).
- describing and explaining how industrialization influenced the movement of people (*for example, to and from urban, suburban, and rural areas*);
- identifying and explaining the consequences of scientific and technological changes (*for example, navigation, transportation, printing, weaponry, agriculture, communication, and medicine*); and
- relating differences in technology to differences in how people live in various regions of the world.



GRADES 9-12

As students in grades 9-12 extend their knowledge, what they know and are able to do includes

- analyzing the major technological turning points in history (*for example, agricultural revolution, revolutions in transportation, industrial revolution*);
- explaining how the scientific revolution affected how people lived in and viewed the world;
- describing and explaining the social and economic changes that resulted from industrialization; and
- analyzing the impact of rapid developments in areas such as transportation, technology, and telecommunications on individuals and the world today.

4.2 Students understand how economic factors have influenced historical events.



GRADES K-4

In grades K-4, what students know and are able to do includes

- describing the economic reasons why people move to or from a location (*for example, explorers, nomadic people, miners, traders*).

GRADES 5-8

As students in grades 5-8 extend their knowledge, what they know and are able to do includes

- explaining how the economy of the Western United States has historically depended upon natural resources and how this has affected the region;
- explaining how economic factors influenced historical events in the United States and in various regions of the world (*for example, the history of Colorado's "boom and bust" economy*); and
- explaining how societies are and have been linked by economic factors.

GRADES 9-12

As students in grades 9-12 extend their knowledge, what they know and are able to do includes

- describing how systems of exchange and other economic developments influenced the growth and history of civilizations;
- explaining how economic changes led to the growth of towns, cities, and eventually, the modern nation-state; and
- analyzing the relationship between economic factors and social and political policies throughout United States history;
- explaining how the rise and expansion of trade have connected and affected the history of regions of the world; and
- describing modern historical developments in economic interdependence (*for example, the emergence of the Pacific Rim, NAFTA, the European Union*), and their impact on individuals and societies.

4.3 Students understand the historical development and know the characteristics of various economic systems.

GRADES K-4

In grades K-4, what students know and are able to do includes

- giving examples of different ways that decisions are made regarding how resources are utilized and distributed (*for example, authority, sharing, competition in a free market, tradition, "first-come, first-served", "luck of the draw"*); and
- describing different systems of exchange that can be used (*for example, barter, money*).



GRADES 5-8

As students in grades 5-8 extend their knowledge, what they know and are able to do includes

- describing the general characteristics of economic systems (*for example, scarcity, growth, distribution of goods and services, production, and consumption*); and
- describing historical events and individuals in the economic development of the United States.



GRADES 9-12

As students in grades 9-12 extend their knowledge, what they know and are able to do includes

- explaining the historical development of the economic system of the United States;
- analyzing the history of the relationship between economics systems and the role of governments throughout history;
- describing characteristics of specific economic systems and how these systems have existed in different ways at different times throughout history (*for example, manorialism, mercantilism, capitalism, socialism, communism*); and
- tracing the historical factors that lead to the transition from local and regional economies to a globally interdependent economy.

STANDARD 5:

Students understand political institutions and theories that have developed and changed over time.

RATIONALE:

People living together in societies address the issues of cooperation and control through their political systems and ideologies. All societies endeavor to preserve law and security. A theme central to this area is the evolution of democratic forms of government and the long struggle for liberty, equality, justice, and dignity. The challenge for our nation, as a constitutional republic, is to provide liberty and justice for all citizens. To become effective citizens in a democratic republic, students must be able to deal with the inherent tensions and inevitable conflicts caused by the pursuit of both principles of liberty and equality, and of individual rights and justice. Students need to understand that none of these principles can be sacrificed during difficult times if democratic government is to endure.

5.1 Students understand how democratic ideas and institutions in the United States have developed, changed, and/or been maintained.

GRADES K-4

In grades K-4, what students know and are able to do includes

- identifying historical figures from diverse backgrounds in the United States who have advanced the rights of individuals and promoted the common good;
- explaining the importance of national celebrations, symbols, and ideas in their historical context; and
- describing the historical background of the Colorado constitution.

GRADES 5-8

As students in grades 5-8 extend their knowledge, what they know and are able to do includes

- explaining the historical development of democratic governmental principles and institutions;
- describing the basic ideas set forth in the Declaration of Independence, Articles of Confederation, Constitution, and Bill of Rights; and
- giving examples of extensions and restrictions of political and civil rights in United States history.

GRADES 9-12

As students in grades 9-12 extend their knowledge, what they know and are able to do includes

- identifying and explaining the role of the ideas expressed in the documents that influenced the development of constitutional democracy (*for example, Magna Carta, English Bill of Rights, Mayflower Compact*);
- analyzing how the ideas set forth in the Declaration of Independence, Constitution and Bill of Rights, Federalist Papers, and landmark Supreme Court cases affect and operate in the contemporary United States;
- identifying and analyzing how historical events have affected the organization of the political system of the United States (*for example, the American Revolution, the Civil War, the Mexican War, the Populist and Progressive Movements*); and
- analyzing how the United States' political system has dealt with various constitutional crises (*for example, the Civil War, Alien-Sedition Acts, assassinations, Watergate*).

5.2 Students know how various systems of government have developed and functioned throughout history.

GRADES K-4

In grades K-4, what students know and are able to do includes

- explaining why rules and laws have been established and enforced in schools, communities, states, and nations; and
- giving examples of different heads of government (*for example, presidents, kings, mayors, governors*).

GRADES 5-8

As students in grades 5-8 extend their knowledge, what they know and are able to do includes

- identifying the ancient and medieval roots of governmental principles and institutions (*for example, Hammurabi's Code, Roman Republicanism, Mosaic Law, Greek Democracy, Islamic Law*);
- describing the basic forms of government, and giving examples of societies that have practiced them (*for example, monarchy, oligarchy, clan/tribal, autocracy, dynasties, theocracy, republic, democracy*); and
- describing how various other nations have pursued, established, and maintained democratic forms of government.

GRADES 9-12

As students in grades 9-12 extend their knowledge, what they know and are able to do includes

- comparing and contrasting the characteristics and effects of the various political systems that developed throughout history (*for example, republics, representative and direct democracy, feudalism, centralized monarchy, absolutism, principalities, imperial dynasties, tribal kingdoms*);
- comparing and contrasting the political traditions of Western Hemisphere nations;
- describing the characteristics and ideas of various modern political systems, and giving examples of nations that have used them (*for example, democracy, fascism, and communism*); and
- explaining why nation-states developed throughout the world and became the dominant form of contemporary political organization.

5.3 Students know how political power has been acquired, maintained, used, and/or lost throughout history.

GRADES K-4

In grades K-4, what students know and are able to do includes

- giving examples of how individuals in various groups have gained, lost, or maintained political rights, freedoms, power, or cultural identity in the history of the community, region, or state.

GRADES 5-8

As students in grades 5-8 extend their knowledge, what they know and are able to do includes

- describing how attributes of various people have affected their individual political rights (*for example, gender, racial identity, national origin, property ownership, religion, legal status*);
- describing how military and/or economic expansion resulted in the assumption or seizure of political power throughout history; and
- describing how forms of involuntary servitude have been used to maintain and expand political power throughout history (*for example, slavery, serfdom, impressment*).

GRADES 9-12

As students in grades 9-12 extend their knowledge, what they know and are able to do includes

- explaining how military conquest and invasion have been used to assume, maintain, and extend political power throughout history;
- analyzing the impact of major revolutions on the realignment of political power throughout the modern world;
- analyzing how genocide has been used to acquire or maintain political power;
- describing how the development, expansion, and collapse of empires throughout history has affected the extension of political power;
- describing and analyzing the major events in the expansion of the political power of the United States (*for example, the American Revolution, the Louisiana Purchase, the Mexican War*);
- analyzing the causes and events of major wars of the contemporary era and the resulting changes in the distribution of political power (*for example, World War I, World War II, War in Vietnam, the Russian Invasion of Afghanistan*); and
- giving examples of former colonies and dependent states throughout the world that have gained independence in the 20th century, and explaining how they have addressed the political issues related to independence.

5.4 Students know the history of relationships among different political powers and the development of international relations.

GRADES K-4

In grades K-4, what students know and are able to do includes

- giving examples of how members of families and communities depend on each other; and
- giving examples of how states and regions have become interdependent.

GRADES 5-8

As students in grades 5-8 extend their knowledge, what they know and are able to do includes

- describing how the relationships between the United States and external political powers developed with the growth of the nation; and
- identifying basic patterns of political alliances in the modern world.

GRADES 9-12

As students in grades 9-12 extend their knowledge, what they know and are able to do includes

- describing the characteristics of relationships among political entities in the past (*for example, monarchies, empires, principalities, city-states, federations*);
- explaining how the growth of nationalism affected the relationships among political powers;
- describing the eras of United States diplomacy from the Revolution through the modern period (*for example, the Monroe Doctrine, the domino theory, detente*);
- explaining how the foreign policy of the United States and other nations continues to develop and change; and
- analyzing the development of and issues associated with worldwide movements and organizations such as the League of Nations, the United Nations, and Amnesty International.

STANDARD 6:

Students know that religious and philosophical ideas have been powerful forces throughout history.

RATIONALE:

From the great questions of human existence, religious and philosophical answers have emerged with power to move entire peoples to action. Because religion plays a significant role in history and society, study about religion is essential to understanding both the nation and the world. Omission of facts about religion can give students the false impression that the religious life of humankind is insignificant or unimportant. Knowledge of the basic symbols and practices of various religions and the concepts of various philosophies help students understand history, literature, art, and contemporary life.

6.1 Students know the historical development of religions and philosophies.



GRADES K-4

In grades K-4, what students know and are able to do includes

- recognizing that people develop traditions that transmit their beliefs and ideas (*for example, marriage ceremonies, feasts, naming of infants*).



GRADES 5-8

As students in grades 5-8 extend their knowledge, what they know and are able to do includes

- describing religious traditions of various ethnic groups in the United States;
- describing religious developments in United States history (*for example, the Puritans, the Great Awakening, the Christian Abolitionists, the Mission System, the Mormon Trek, the founding of utopian religious communities*); and
- describing different religious concepts that have developed throughout history (*for example, monotheism and polytheism*).

GRADES 9-12

As students in grades 9-12 extend their knowledge, what they know and are able to do includes

- describing basic tenets of world religions that have acted as major forces throughout history including, but not limited to, Buddhism, Christianity, Hinduism, Islam, and Judaism;
- tracing the history of how principal world religions and belief systems developed and spread;
- explaining how, throughout history, conflicts among peoples have arisen because of different ways of knowing and believing; and
- describing basic ideas of various schools of philosophy that have affected societies throughout history (*for example, rationalism, idealism, liberalism, conservatism*).

6.2 Students know how societies have been affected by religions and philosophies.



GRADES K-4

In grades K-4, what students know and are able to do includes

- giving examples of how the beliefs of people are reflected in the celebrations and practices of their community.



GRADES 5-8

As students in grades 5-8 extend their knowledge, what they know and are able to do includes

- giving examples of how religious and philosophical beliefs have defined standards of right and wrong, good and evil, and justice and injustice; and
- giving and describing examples of individuals who, throughout history, acted from their religious or philosophical beliefs.

GRADES 9-12

As students in grades 9-12 extend their knowledge, what they know and are able to do includes

- giving examples of how religion and philosophical beliefs have influenced various aspects of society throughout history;
- explaining how, throughout history, the power of the state has been both derived from religious authority and/or in conflict with religious authority;
- explaining how the focus on individualism and reason expressed in Western philosophy has affected the history of Western culture, including the history of the United States; and

- explaining how the beliefs expressed in Eastern philosophy and religion have affected the history of Eastern cultures.

6.3 Students know how various forms of expression reflect religious beliefs and philosophical ideas.

GRADES K-4

In grades K-4, what students know and are able to do includes

- giving examples of forms of expression that depict the history, daily life, and beliefs of various peoples (*for example, folk tales, ballads, dance, and architecture*).

GRADES 5-8

As students in grades 5-8 extend their knowledge, what they know and are able to do includes

- describing how societies have used various forms of visual arts, dance, theater, and music to express their religious beliefs and philosophical ideas throughout history;
- giving examples of the unique art forms that characterize the various ethnic groups in the United States and the religious or philosophical ideas they express;
- explaining how stories, myths, and other forms of literature and oral traditions reflect the beliefs of cultures and societies; and
- explaining the religious or philosophical significance of structures such as pyramids, cathedrals, and burial mounds.

GRADES 9-12

As students in grades 9-12 extend their knowledge, what they know and are able to do includes

- explaining from an historical context why artistic and literary expression have often resulted in controversy; and
- giving examples of the visual arts, dance, music, theater, and architecture of the major periods of history and explaining what they indicate about the values and beliefs of various societies.

GLOSSARY

Model Content Standards for History

Culture: Refers to learned behavior of people, which includes their belief systems and languages, their social relationships, their institutions and organization, and their material goods - food, clothing, buildings, tools, and machines.

Cultural Diffusion: Refers to the process by which the artifacts, technology, customs, and ideas of one culture are spread to other areas.

Culture Region: Refers to an area with one or more common cultural characteristics which gives it a measure of homogeneity and that distinguishes it from surrounding areas.

Diverse: Refers to having a variety of forms or lands; various kinds of forms.

Ethnic Groups: Refers to a group of people of the same race or nationality who share a common and distinctive culture.

Groups: Refers to any collection of persons considered together as being related in some way. This would include ethnic groups and occupational groups (for example, miners, ranchers, farmers).

Historical Inquiry: Refers to the process of studying history to find out what, who, why, when, etc., in a logical, problem-solving manner.

Historical Narrative: Refers to written histories that "tell the story," from the simple to the complex.

Primary Sources: Refers to historical documents such as reports, maps, photographs, letters, drawing, diaries, and court records and other legal documents, created by those who participated in or witnessed the events of the past.

Secondary Sources: Refers to written accounts of events of the past that reflect the author's interpretation of these events based on the author's analysis of primary and/or secondary sources of information.

Social Organization: Refers to the structure of social relations within a group.

Society, Societies: Refers to a group of human beings living as and/or viewed as members of a community; a structure system of human organization for large-scale community living that furnishes protection, continuity, security, and identity for its members.

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COLORADO



MODEL CONTENT
STANDARDS

SCIENCE

Adopted 05/10/95
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INTRODUCTION

Colorado Model Content Standards for Science

The Colorado model standards presented here specify what all students should know and be able to do in science as a result of their school studies. Specific expectations are given for students completing grades K-4, 5-8, and 9-12. These standards reflect high expectations and outline the essential level of science knowledge and skills needed by all citizens to participate productively in our increasingly technological society. Some suggestions are also offered for those students who elect to extend their study of science beyond that specified in these content standards, based on their particular interests, motivation, career goals, and needs.

In 1992, the National Committee for Science Education Standards and Assessment (NCSESA), which directed the National Research Council's development of K-12 national science education standards, issued guiding principles for its work. This statement provides useful perspective on the purpose and eventual use of Colorado model science content standards:

“In particular, the commitment to ‘Science for All’ implies inclusion not only of those who traditionally have received encouragement and opportunity to pursue science, of women and girls, all racial and ethnic groups, the physically and educationally challenged, and those with limited English proficiency. Further, it implies attention to various styles of learning and differing sources of motivation. Every person must be brought into and given access to the ongoing conversation of science.”

NCSESA, 1992

In that spirit, these model science standards define the level of science knowledge and proficiency that all Colorado students should gain in their school studies. The goal is to have students apply scientific information and processes to practical problems in an ethical and safe manner.

The view of the nature of science conveyed in these content standards can be summarized through this excerpted material from Science for All Americans, published by the American Association for the Advancement of Science in 1990:

Science presumes that the things and events in the universe occur in consistent patterns that are comprehensible through careful, systemic study. Scientists believe that through the use of the intellect, and with the aid of instruments that extend the senses, people can discover patterns in all of nature. Science is a process for producing knowledge. Change in scientific knowledge is inevitable because new observations may challenge prevailing theories. In science, the testing and improving and occasional discarding of theories, whether new or old, go on all the time. However, the modification of ideas, rather than their outright rejection, is the norm in science, as powerful constructs tend to survive and grow more precise and to become widely accepted. Continuity and stability are as characteristic of science as change is, and confidence is as prevalent as tentativeness.

The numerical order of the six science content standards does not imply any particular judgments regarding their relative importance or teaching priorities. In fact, as the document emphasizes, Standards 1, 5, and 6—relating to scientific investigations, applications, and connections—should be addressed through teaching subject matter from the physical, life, and earth/space sciences (Standards 2, 3, and 4). Even though the six science content standards are identified separately, they represent interconnected expectations for students.

The organization of these content standards into six categories does not imply that standards-based science must be taught in separate units or courses that carry these particular titles. The student proficiencies in science can be supported within courses organized in a variety of ways, ranging from integrated and interdisciplinary approaches, to instruction built on major scientific themes, as well as more conventional subject- or discipline-specific approaches. Regardless of how science instruction is organized, these model standards specify the core knowledge and skills that all students should acquire.

Even though these science content standards represent high expectations for all students, they can be reached only if students are provided appropriate science instruction at *all* grade levels. If K-4 science content standards, for example, are designated as the responsibility of only fourth grade (or even third and fourth grade) teachers, this will place an unfair (and instructionally irresponsible) burden on both those teachers and their students. These standards are set with the expectation that science-related activities will occur at *all* grade levels—from initial explorations in kindergarten through increasingly organized and focused science instruction in higher grades.

These content standards were developed by a group of experienced Colorado science educators whose efforts have been guided—at least in part—by related work at the national level focused on defining what all students should know and do in science. The *Benchmarks* from the American Association for the Advancement of Science’s *Project 2061* and draft reports from the National Science Education Standards Project at the National Research Council have been particularly useful and influential. References to those documents and to others consulted are listed on page S-28.

Colorado Model Content Standards

SCIENCE

- 1. Students understand the processes of scientific investigation and design, conduct, communicate about, and evaluate such investigations.**
- 2. Physical Science: Students know and understand common properties, forms, and changes in matter and energy.**
- 3. Life Science: Students know and understand the characteristics and structure of living things, the processes of life, and how living things interact with each other and their environment.**
- 4. Earth and Space Science: Students know and understand the processes and interactions of Earth's systems and the structure and dynamics of Earth and other objects in space.**
- 5. Students know and understand interrelationships among science, technology, and human activity and how they can affect the world.**
- 6. Students understand that science involves a particular way of knowing and understand common connections among scientific disciplines.**

STANDARD 1:

Students understand the processes of scientific investigation and design, conduct, communicate about, and evaluate such investigations.

RATIONALE

In everyday life, we find ourselves gathering and evaluating information (data), noting and wondering about patterns and regularities, devising and testing possible explanations for how things work, and discussing ideas with others. These characteristically human activities mirror in many ways how scientists think and work. Scientific investigation (inquiry) often begins with a question or problem and usually ends with further questions to investigate. Such investigations may include long-term field studies and are not limited to direct experimentation in a lab setting. They involve the identification and control of variables. Inquiry in the science classroom helps students develop a useful base of scientific knowledge, communicated in increasingly mathematical and conceptual ways as they progress through school. In addition, scientific inquiry stimulates student interest, motivation, and creativity. Designing and conducting investigations encourages students to interpret, analyze, and evaluate what is known, how we know it, and how scientific questions are answered. The knowledge and skills related to scientific inquiry enable students to understand how science works, and are powerful ways for students to build their understanding of the scientific facts, principles, concepts, and applications that are described in the other science content standards, particularly standards two, three, and four. To comprehend the world around them, students need opportunities to pursue questions that are relevant to them and to learn how to conduct scientific investigations. Some scientific inquiries can only be investigated by the use of models since actual events are not repeatable.

GRADES K-4

In grades K-4, what students know and are able to do includes

- asking questions and stating predictions (hypotheses) that can be addressed through scientific investigation;
- selecting and using simple devices to gather data related to an investigation (for example, length, volume, and mass measuring instruments, thermometers, watches, magnifiers, microscopes, calculators, and computers);
- using data based on observations to construct a reasonable explanation; and
- communicating about investigations and explanations.

GRADES 5-8

As students in grades 5-8 extend their knowledge, what they know and are able to do includes

- **Identifying and evaluating alternative explanations and procedures;**
 - using examples to demonstrate that scientific ideas are used to explain previous observations and to predict future events (*for example, plate tectonics and future earthquake activity*);
- **Asking questions and stating hypotheses that lead to different types of scientific investigations (*for example, experimentation, collecting specimens, constructing models, researching scientific literature*);**
- **Creating a written plan for an investigation;**
 - using appropriate tools, technologies, and measurement units to gather and organize data;
 - interpreting and evaluating data in order to formulate conclusions;
- **Communicating results of their investigations in appropriate ways (*for example, written reports, graphic displays, oral presentations*);**
 - using metric units in measuring, calculating, and reporting results;
 - explaining that scientific investigations sometimes result in unexpected findings that lead to new questions and more investigations; and
 - giving examples of how collaboration can be useful in solving scientific problems and sharing findings.

GRADES 9-12

As students in grades 9-12 extend their knowledge, what they know and are able to do includes

- **Asking questions and stating hypotheses, using prior scientific knowledge to help guide their development;**
- **Creating and defending a written plan of action for a scientific investigation;**
 - selecting and using appropriate technologies to gather, process, and analyze data and to report information related to an investigation;
- **Identifying major sources of error or uncertainty within an investigation (*for example, particular measuring devices and experimental procedures*);**
 - constructing and revising scientific explanations and models, using evidence, logic, and experiments that include identifying and controlling variables;
- **Communicating and evaluating scientific thinking that leads to particular conclusions;**
 - recognizing and analyzing alternative explanations and models; and
 - explaining the difference between a scientific theory and a scientific hypothesis.

For students continuing their science education beyond the standards, what they know and are able to do **may** include

- designing and completing an advanced scientific investigation—either individually or as part of a student team—that extends over several days or weeks; and
- continuing to practice and apply inquiry skills as they extend their understanding of science content through further study.

STANDARD 2:

Physical Science: Students know and understand common properties, forms, and changes in matter and energy. (*Focus: Physics and Chemistry*)

2.1 Students know that matter has characteristic properties, which are related to its composition and structure.

RATIONALE

Everyone has experience with matter in a variety of forms. Such experiences help build students' understanding of similarities and differences in the properties of matter. Their personal experiences help students understand common properties such as hardness, strength, color, shape, and states of matter (solid, liquid, and gaseous). Knowledge of observable properties of matter and its structure and composition is helpful in considering matter's varied uses, availability, and limitations in our world.

GRADES K-4

In grades K-4, what students know and are able to do includes

- Examining, describing, classifying, and comparing tangible objects in terms of common physical properties (*for example, state of matter, size, shape, texture, flexibility, color*);
- Measuring common physical properties of objects (*for example, length, mass, volume, temperature*); and
- creating mixtures and separating them based on differences in properties (*for example, salt and sand, iron filings and soil, oil and water*).

GRADES 5-8

As students in grades 5-8 extend their knowledge, what they know and are able to do includes

- Examining, describing, comparing, measuring, and classifying objects based on common physical and chemical properties (*for example, states of matter, mass, volume, electrical charge, temperature, density, boiling points, pH, magnetism, solubility*);
- separating mixtures of substances based on their properties (*for example, solubility, boiling points, magnetic properties, densities*);
- Classifying and describing matter in terms of elements, compounds, mixtures, atoms, and molecules (*for example, copper is an element, water is a compound, air is a mixture*); and
- Developing simple models to explain observed properties of matter (*for example, using a particle model to account for the solubility of a substance*).

GRADES 9-12

As students in grades 9-12 extend their knowledge, what they know and are able to do includes

- examining, describing, measuring, classifying, and predicting common properties of substances (for example, electrical charge, chemical reactivity, acidity, electrical conductivity, radioactivity, relationships in the periodic table);
- describing and explaining properties and composition of samples of matter using models (for example, atomic and molecular structure, the periodic table);
- separating substances based on their chemical and physical properties (for example, color, solubility, chemical reactivity, melting point, boiling point); and
- using word and chemical equations to relate observed changes in matter to its composition and structure.

Page S-13 contains content suggestions for students who continue their science study beyond the scope of this standard.

2.2 Students know that energy appears in different forms, and can move (be transferred) and change (be transformed).

RATIONALE

Energy is a central concept in science because all physical interactions involve changes in energy. Students need to understand that all physical events involve transferring energy or changing one form of energy into another. When a transformation of energy takes place, some of it is likely to appear as heat. Knowledge of forms of energy, its transfer and transformation, is essential to interpreting, explaining, predicting, and influencing change in our world.

GRADES K-4

In grades K-4, what students know and are able to do includes

- recognizing that energy (for example, light, heat, motion, sound, mechanical) can affect common objects and is involved in common events;
- making observations and gathering data on quantities associated with energy, movement, and change (for example, distances for a bean-launcher, time for a melting ice cube); and
- comparing quantities associated with energy movement and change by constructing simple diagrams or charts (for example, graph of launch distances, chart of melting time).

GRADES 5-8

As students in grades 5-8 extend their knowledge, what they know and are able to do includes

- Measuring quantities associated with energy forms (for example, temperature, mass, speed, distance, electrical charge, current, voltage); and
- Describing qualitative and quantitative relationships, using data and observations and graphs, associated with energy transfer or energy transformation (for example, speed of object vs. height of ramp; length of string vs. pitch of sound; electric current vs. volume of gas produced in electrolysis, with length of time kept constant).

GRADES 9-12

As students in grades 9-12 extend their knowledge, what they know and are able to do includes

- Identifying, measuring, calculating, and analyzing quantitative relationships involved with energy forms (for example, heat transfer in a system involving mass, specific heat, and change in temperature of matter); and
- Identifying, measuring, calculating, and analyzing qualitative and quantitative relationships associated with energy transfer or energy transformation (for example, changes in temperature, velocity, potential energy, kinetic energy, conduction, convection, radiation, voltage, current).

Page S-13 contains content suggestions for students who continue their science study beyond the scope of this standard.

2.3 Students understand that interactions can produce changes in a system, although the total quantities of matter and energy remain unchanged.

RATIONALE

Interactions between matter and energy account for changes observed in everyday events. Understanding how matter and energy interact extends students' knowledge of the physical world and allows them to monitor and explain a wide variety of changes and to predict future physical and chemical changes. Students gain both a practical and conceptual understanding of the laws of conservation of matter and energy.

GRADES K-4

In grades K-4, what students know and are able to do includes

- Observing and describing parts of system (for example, water in a closed jar, water in an open jar, a plant terrarium);
- describing an observed change (for example, a melting ice cube, crystal growth, burning candle, physical breakage) in terms of starting conditions, type of change, and ending conditions, using words, diagrams, or graphs; and

- predicting what changes and what remains unchanged when matter experiences an external influence (*for example, a push or pull, addition or removal of heat, division of clay into pieces, melting an ice cube, changing a ball of clay to a flattened shape*).

GRADES 5-8

As students in grades 5-8 extend their knowledge, what they know and are able to do includes

- identifying and classifying factors causing change within a system (*for example, force, light, heat*);
- identifying and predicting what will change and what will remain unchanged when matter experiences an external force or energy change (*for example, boiling a liquid; comparing the force, distance, and work involved in simple machines*);
- observing and gathering data to support the concept of conservation of mass within a closed system (*for example, precipitation reaction, forming mixtures, gas production*);
- describing, measuring (*for example, temperature, mass, volume, melting point of a substance*) and calculating quantities before and after a chemical or physical change within a system (*for example, temperature change, mass change, specific heat*); and
- describing, measuring (*for example, time, distance, mass, force*) and calculating quantities that characterize moving objects and their interactions within a system (*for example, force, velocity, acceleration, potential energy, kinetic energy*).

GRADES 9-12

As students in grades 9-12 extend their knowledge, what they know and are able to do includes

- identifying, describing, and explaining physical and chemical changes involving the conservation of matter and energy (*for example, oscillating pendulum/spring, chemical reactions, nuclear reactions*);
- observing, measuring, and calculating quantities to demonstrate conservation of matter and energy in chemical changes (*for example, acid-base, precipitation, oxidation-reduction reactions*), and physical interactions of matter (*for example, force, work, power*);
- describing and predicting chemical changes (*for example, combustion, simple chemical reactions*), and physical interactions of matter (*for example, velocity, force, work, power*), using word or symbolic equations; and
- describing and explaining physical interactions of matter using conceptual models (*for example, conservation laws of matter and energy, particle model for gaseous behavior*).

For students continuing their science education beyond the standards, what they know and are able to do **may** include

- relating their prior knowledge and understanding of properties of matter to observable characteristics of materials and emerging technologies (*for example, semiconductors, superconductors, photovoltaics, ceramics*);
- modeling quantitative aspects of chemical and physical interactions (*for example, rates of reactions, stoichiometry, electromagnetic phenomena, statics and dynamics, electrochemistry*);
- applying knowledge and understanding of chemical and physical interactions to explore factors that influence or govern change (*for example, equilibrium constants, kinetics, thermodynamics*); and
- distinguishing among different types of constancy (*for example, static and dynamic equilibrium, symmetry, uniform/accelerated motion*) and different types of change (*for example, qualitative and quantitative trends, cyclic change, chaotic systems*).

STANDARD 3:

Life Science: Students know and understand the characteristics and structure of living things, the processes of life, and how living things interact with each other and their environment. (*Focus: Biology--Anatomy, Physiology, Botany, Zoology, Ecology*)

3.1 Students know and understand the characteristics of living things, the diversity of life, and how living things interact with each other and with their environment.

RATIONALE

As a result of their study of a variety of organisms and where they live, students gain a better understanding of their world. Students have a natural curiosity about life and the great diversity of organisms. Their curiosity leads to the study of organisms and how the organisms interact with the world. Through the study of similarities and differences of organisms, students learn the importance of classification as a tool used by scientists. In their future as citizens, students will need to think about and make decisions about the diversity and extinction of organisms in their communities and the world.

GRADES K-4

In grades K-4, what students know and are able to do includes

- distinguishing living from nonliving things;
- classifying a variety of organisms according to selected characteristics (*for example, backbone vs. no backbone*);
- describing the basic needs (*for example, food, water, air, shelter, space*) of an organism; and
- giving examples of how organisms interact with each other and with nonliving parts of their habitat.

GRADES 5-8

As students in grades 5-8 extend their knowledge, what they know and are able to do includes

- constructing and using classification systems based on the structure of organisms;
- describing the importance of plant and animal adaptations, including local examples;

- **Creating and interpreting food chains and food webs;**
- explaining the interaction and interdependence of nonliving and living components within ecosystems; and
- describing how an environment's ability to provide food, water, space, and essential nutrients determines carrying capacity.

GRADES 9-12

As students in grades 9-12 extend their knowledge, what they know and are able to do includes

- **Using and producing a variety of classification systems for organisms (*for example, the five-kingdom classification, classification based on behavior*);**
- predicting and describing the interactions of populations and ecosystems;
- explaining how adaptations (*for example, structure, behavior*) of an organism determine its niche (role) in the environment;
- **Explaining how changes in an ecosystem can affect biodiversity and how biodiversity contributes to an ecosystem's stability; and**
- analyzing the dynamic equilibrium of ecosystems, including interactions among living and nonliving components (*for example, tropical deforestation is linked to decreased global precipitation; Mount St. Helens' eruption had impact on the local ecosystem*).

Page S-20 contains suggestions for students who continue their science study beyond the scope of this standard.

3.2 Students know and understand interrelationships of matter and energy in living systems.

RATIONALE

From experience, students know that they must eat food to live. As a result of their study of energy movement (transfer) and change (transformation) in living organisms, students understand that the Sun is the primary and ultimate source of energy for living organisms. They learn why a constant input of matter and energy is critical for life. Photosynthetic organisms are critical to all organisms and need to be maintained. If one or more components are altered in an ecosystem, all other components are affected. Through studying the interrelationships of organisms, students learn that they can have a critical impact on other organisms.

GRADES K-4

In grades K-4, what students know and are able to do includes

- recognizing that green plants need energy from sunlight and various raw materials to live, and animals consume plants and other organisms to live; and
- recognizing the interrelationships of organisms by tracing the flow of matter and energy in a food chain.

GRADES 5-8

As students in grades 5-8 extend their knowledge, what they know and are able to do includes

- describing the basic processes of photosynthesis and respiration and their importance to life (for example, set up a terrarium or aquarium and make changes such as blocking out light);
- comparing and contrasting food webs within and between different ecosystems (for example, grasslands, tundra, marine) and predicting the consequences of disrupting one of the organisms in a food web;
- describing ways (for example, digestion, transport of nutrients by circulatory system) that multicellular organisms get food and other matter to their cells;
- explaining the recycling of materials by determining a pathway of a substance that is important for life (for example, trace water through an ecosystem); and
- describing the role of organisms in the decomposition and recycling of dead organisms (for example, bacteria's role in the decomposition and recycling of matter from a dead animal).

GRADES 9-12

As students in grades 9-12 extend their knowledge, what they know and are able to do includes

- comparing and contrasting the processes of photosynthesis and respiration (for example, in terms of energy and products);
- explaining how simple molecules can be built into larger molecules within organisms (for example, amino acids serve as building blocks of proteins; carbon dioxide and water are the basic materials for building sugars through photosynthesis);
- explaining how large molecules (for example, starch, protein) are broken down into smaller molecules, serving as an energy source or as basic building blocks in organisms;
- explaining how energy is used in the maintenance, repair, growth, and development of tissues (for example, in the production of new skin cells requires energy); and
- describing the cycling of matter and the movement and change of energy through the ecosystem (for example, some energy dissipates as heat as it is transferred through a food web).

Page S-16 contains suggestions for students who continue their science study beyond the scope of this standard.

3.3 Students know and understand how the human body functions, factors that influence its structures and functions, and how these structures and functions compare with those of other organisms.

RATIONALE

Students are interested in learning about their bodies and how they relate biologically to other forms of life. The study of structure and function, body organization, growth and development, and maintenance of other organisms enhances students' understanding of human development, health, and disease. Knowledge of these areas can assist students in making informed choices regarding nutrition, exercise, and other factors that influence how their body functions.

GRADES K-4

In grades K-4, what students know and are able to do includes

- describing human body systems (*for example, digestive, respiratory, circulatory, skeletal, muscular*);
- describing the basic food requirements for humans as summarized in the nutrition pyramid; and
- describing life cycles of selected organisms (*for example, frog, chicken, butterfly, radish, bean plant*).

GRADES 5-8

As students in grades 5-8 extend their knowledge, what they know and are able to do includes

- describing the observable components and functions of a cell (*for example, cell membrane, nucleus, cytoplasm, chloroplasts; movement of molecules into and out of cells*);
- comparing and contrasting the basic structures and functions of different types of cells (*for example, single-celled organisms in pond water, Elodea, onion cell, human cheek cell*);
- describing the growth and development of several organisms (*for example, embryonic development of a vertebrate*);
- describing the structures and functions of human body systems; and
- describing and giving examples of noncommunicable diseases and communicable diseases (*for example, heart disease and chicken pox*).

GRADES 9-12

As students in grades 9-12 extend their knowledge, what they know and are able to do includes

- **describing cellular organelles and their function (for example, the relationship of ribosomes to protein synthesis; the relationship of mitochondria to energy transformation);**
- differentiating among levels of organization (*cells, tissues, and organs*) and their roles within the whole organism;
- explaining human body functions in terms of interacting organ systems composed of specialized structures that maintain or restore health (*for example, mechanisms involved in homeostasis [balance], such as feedback in the endocrine system*);
- **comparing and contrasting characteristics of and treatments for various types of medical problems (for example, accidental, infectious, genetic);**
- using examples to explain the relationship of structure and function in organisms; and
- describing the pattern and process of reproduction and development in several organisms (*for example, earthworm, chick, human*).

Page S-20 contains suggestions for students who continue their science study beyond the scope of this standard.

3.4 Students know and understand how organisms change over time in terms of biological evolution and genetics.

RATIONALE

Students study the scientific concept of biological evolution--the changes in populations of organisms through time--in order to understand diversity and relatedness within the living world. Inquiries into evolution explain the ways in which natural processes produce life's diversity. These studies help students understand that evolution is the major unifying concept in the biological sciences and that it explains a wide variety of observations that can be made about the living world. In particular, students see that the study of evolution initiates questions about biodiversity, adaptation, genetics, mutations, the geological record, and the observed unity at molecular and whole-organism levels. This content standard does not define any student expectations related to the origin of life.

GRADES K-4

In grades K-4, what students know and are able to do includes

- identifying characteristics that are common to all individuals of a species (*for example, offspring resemble their parents*);
- **recognizing that there are differences in appearance among individuals of the same population or group;**

- Identifying characteristics of plants and animals that allow them to live in specific environments; and
- describing examples of extinct organisms based on fossil evidence (*for example, dinosaurs*).

GRADES 5-8

As students in grades 5-8 extend their knowledge, what they know and are able to do includes

- Describing the purpose of body cell division and sex cell division;
- describing the role of chromosomes and genes in heredity (*for example, genes control traits, while chromosomes are made up of many genes*); and
- describing evidence that reveals changes or constancy in groups of organisms over geologic time.

GRADES 9-12

As students in grades 9-12 extend their knowledge, what they know and are able to do includes

- Comparing and contrasting the purpose and process of cell division (mitosis) with the production of sex cells (meiosis);
- giving examples to show how some traits can be inherited while others are due to the interaction of genes and the environment (*for example, skin cancer triggered by over-exposure to sunlight or contact with chemical carcinogens*);
- describing how DNA serves as the vehicle for genetic continuity and the source of genetic diversity upon which natural selection can act;
- describing how mutation, natural selection, and reproductive isolation can lead to new species and explain the planet's biodiversity;
- explaining why variation within a population improves the chances that the species will survive under new environmental conditions;
- Describing the general structure and function of the gene (DNA) and its role in heredity and protein synthesis (*for example, replication of DNA and the role of RNA in protein synthesis*); and
- calculating the probability that an individual will inherit a particular single gene trait (*for example, calculating the probability of offspring inheriting cystic fibrosis when both parents are carriers for the disease*).

For students continuing their science education beyond the standards, what they know and are able to do **may** include

- describing how, over long periods of time, ecosystems can remain stable and, if altered by factors such as climatic change, return to stability;
- explaining specializations that allow different types of cells to perform different functions;
- describing how balance (homeostasis) is maintained within an organism when its environment is altered (*for example, the relationship between blood glucose level and insulin production; carbon dioxide and oxygen balance in the body*);
- describing the role of gene mutations that result in uncontrolled cell division (*for example, cancer*);
- explaining the role of exposure to certain factors (*for example, chemical, biological, radiation*) that may increase the rate of mutation, and therefore the incidence of cancer and other diseases;
- determining the degree of kinship between organisms or species from estimations of the similarity of their nucleic acid sequences, which often closely match classifications based on anatomical similarities; and
- explaining how the rate of environmental change may exceed the capacity of organisms to respond to change, leading to the extinction of species.

STANDARD 4:

Earth and Space Science: Students know and understand the processes and interactions of Earth's systems and the structure and dynamics of Earth and other objects in space. (*Focus: Geology, Meteorology, Astronomy, Oceanography*)

4.1 Students know and understand the composition of Earth, its history, and the natural processes that shape it.

RATIONALE

By studying Earth, its composition, history, and the processes that shape it, students gain a better understanding of the planet on which they live. Landforms, resources, and natural events such as earthquakes, flooding, and volcanic eruptions affect the location of population centers. Life throughout geologic time has been, and continues to be, affected by changes that occur at a varying rate on Earth's surface. Knowledge of the structure and composition of the Earth provides a basis for making informed decisions. Understanding geologic events, such as earthquakes and volcanic eruptions, allows students to make responsible choices, evaluate the consequences, and predict the impact of future occurrences.

GRADES K-4

In grades K-4, what students know and are able to do includes

- describing different types and uses of Earth materials (*for example, rocks, soil, minerals*);
- recognizing that fossils are evidence of past life;
- identifying major features of Earth's surface (*for example, mountains, rivers, plains, hills, oceans, plateaus*);
- describing natural processes that change Earth's surface (*for example, weathering, erosion, mountain building, volcanic activity*); and
- recognizing that humans are affected by natural events (*for example, earthquakes, volcanoes, floods*).

GRADES 5-8

As students in grades 5-8 extend their knowledge, what they know and are able to do includes

- explaining how minerals, rocks, and soils form;
- explaining how fossils are formed and used as evidence to indicate that life has changed through time;
- modeling natural processes that shape Earth's surface (*for example, weathering, erosion, mountain building, volcanic activity*); and
- explaining the distribution and causes of natural events (*for example, earthquakes, volcanoes, landslides*).

GRADES 9-12

As students in grades 9-12 extend their knowledge, what they know and are able to do includes

- describing the composition and structure of Earth's interior;
- using the theory of plate tectonics to explain relationships among earthquakes, volcanoes, mid-ocean ridges, and deep-sea trenches;
- using evidence (*for example, fossils, rock layers, ice cores, radiometric dating*) to investigate how Earth has changed or remained constant over short and long periods of time (*for example, Mount St. Helens' eruption*);
- evaluating the feasibility of predicting and controlling natural events (*for example, earthquakes, floods, landslides*); and
- analyzing the costs, benefits, and consequences of natural resource exploration, development, and consumption.

Page S-22 contains content suggestions for students who continue their science study beyond the scope of this standard.


4.2 Students know and understand the general characteristics of the atmosphere and fundamental processes of weather.

RATIONALE

Our Earth's atmosphere is vital to life. The Sun and atmosphere affect every aspect of our lives, including work productivity, food supply, energy use, transportation, recreation, environmental quality, and human health and safety. Weather-related choices we make range from selecting appropriate clothing to more complex situations, including preparing for and responding to hazardous weather. Preparedness and response to weather conditions require knowledge of how energy transfer influences atmospheric changes. The more we know about weather, the greater the chances that we will make informed decisions concerning its impact.



GRADES K-4

In grades K-4, what students know and are able to do includes

- recognizing that the Sun is a principal source of Earth's heat and light;
- recognizing how our daily activities are affected by the weather (*for example, types of clothing, travel plans, recreational activity*); and
-  Describing existing weather conditions by collecting and recording weather data (*for example, temperature, precipitation, amount of cloud cover*).



GRADES 5-8

As students in grades 5-8 extend their knowledge, what they know and are able to do includes

-  Describing the basic composition, properties, and structure of the atmosphere (*for example, the range and distribution of temperature and pressure in the troposphere and stratosphere*);
-  Observing, measuring, and recording changes in weather conditions (*for example, humidity, temperature, air pressure, cloud types, wind, precipitation*);
- explaining how atmospheric circulation is driven by solar heating (*for example, the transfer of energy by radiation, convection, conduction*); and
- describing large-scale and local weather systems (*for example, fronts, air masses, storms*).

GRADES 9-12

As students in grades 9-12 extend their knowledge, what they know and are able to do includes

- analyzing the structure of, and changes in, the atmosphere, and its significance for life on Earth;
- explaining and analyzing general weather patterns by collecting, plotting, and interpreting data;
-  Describing how energy transfer within the atmosphere influences weather (*for example, the role of conduction, radiation, convection, and heat of condensation in clouds, precipitation, winds, storms*);
- investigating and explaining the occurrence and effects of storms on human populations and the environment; and
-  Describing and explaining factors that may influence weather and climate (*for example, proximity to oceans, prevailing winds, fossil fuel burning, volcanic eruptions*).

Page S-26 contains content suggestions for students who continue their science study beyond the scope of this standard.

4.3 Students know major sources of water, its uses, importance, and cyclic patterns of movement through the environment.

RATIONALE

The world's water is vital to life. Both subtle and wholesale changes in Earth's water can have profound effects on human existence. In order to preserve both the quality and quantity of water for daily living, wise management of water resources is crucial. As the population and economies of the world grow, water becomes an even more important political and economic issue. Knowing the properties of water, its influences on weather, and its availability is necessary for understanding its importance to life. Knowledge of Earth's oceans is important for an understanding of how they affect weather, climate, and life. It is important to understand the circulation of water because the amount of water on Earth is finite.

GRADES K-4

In grades K-4, what students know and are able to do includes

- identifying major sources of water (*for example, oceans, glaciers, rivers, groundwater, atmosphere*);
- identifying and describing the states (*solid, liquid, gaseous*) in which water can be found on Earth; and
- recognizing the importance and uses of water (*for example, drinking, washing, irrigating*).

GRADES 5-8

As students in grades 5-8 extend their knowledge, what they know and are able to do includes

- investigating and comparing the properties and behavior of water in its solid, liquid, and gaseous states;
- describing the distribution and circulation of the world's water through oceans, glaciers, rivers, groundwater, and atmosphere; and
- describing the composition and physical characteristics of oceans (*for example, currents, waves, features of the ocean floor, salinity*).

GRADES 9-12

As students in grades 9-12 extend their knowledge, what they know and are able to do includes

- identifying and explaining factors that influence the quality of water needed to sustain life;
- identifying and analyzing the costs, benefits, and consequences of using water resources;
- explaining interactions between water and other Earth systems (*for example, the biosphere, lithosphere, and atmosphere*); and
- explaining interrelationships between the circulation of oceans and weather and climate.

Page S-26 contains content suggestions for students who continue their science study beyond the scope of this standard.


4.4 Students know the structure of the solar system, composition and interactions of objects in the universe, and how space is explored.


RATIONALE

Observing the sky has always fascinated human cultures and civilizations. These observations resulted in the development of ways to measure time and predict natural phenomena. All bodies in space, including Earth, are influenced by forces acting throughout the solar system and the universe. Studying the universe enhances our understanding of Earth's origins, its place in the universe, and its future. Much of what we know about Earth's atmosphere and our solar system is due to space exploration. Modern society benefits from many of the technological advances developed for space exploration, including robotics, telecommunications, satellites, and miniaturized components used in computers and other electronic devices. Knowledge of the universe and past space exploration enables people to make informed decisions about the future of space exploration.


GRADES K-4

In grades K-4, what students know and are able to do includes

 describing what can be readily observed by the unaided eye in the daytime and nighttime sky (for example, the Sun, Moon, planets, stars, constellations);

 describing the motion of Earth in relation to the Sun, including the concepts of day, night, and year;

- recognizing the characteristics of seasons;


 identifying basic components of the solar system (for example, Sun, planets, moons); and


- describing a space exploration event such as a manned or unmanned space mission.

GRADES 5-8

As students in grades 5-8 extend their knowledge, what they know and are able to do includes

- describing the basic components, composition, size, and theories of origin of the solar system;


 explaining the effects of relative motion and positions of the Sun, Earth, and Moon (*for example, seasons, eclipses, moon phases, tides*);

 comparing Earth to other planets (*for example, size, composition, relative distance from the Sun*); and


- identifying technology needed to explore space (*for example, telescopes, spectroscopes, spacecraft, life support systems*).


GRADES 9-12

As students in grades 9-12 extend their knowledge, what they know and are able to do includes

 explaining the causes of and modeling the varied lengths of days, seasons, and phases of the Moon;

- describing the effect of gravitation on the motions observed in the solar system and beyond;

 describing electromagnetic radiation produced by the Sun and other stars (*for example, X-ray, ultraviolet, visible light, infrared, radio*);

 comparing the Sun with other stars (*for example, size, color, temperature*); and

- identifying and describing the everyday impact of recent space technology (*for example, more sophisticated computers, remote sensing, medical imaging*).

For students continuing their science education beyond the standards, what they know and are able to do **may** include

- explaining relationships and interactions between living things and Earth systems (*for example, the atmosphere, geosphere, and hydrosphere*);
- predicting possible climatic changes and their effects based on past and present climatic data;
- identifying and predicting natural hazards, using historical data;
- describing the life cycle of a star; and
- describing evidence that supports past and current scientific theories of the origin of the universe.

STANDARD 5:


Students know and understand interrelationships among science, technology, and human activity and how they can affect the world.

RATIONALE

Our world is shaped in many ways by scientific advances, technology (involving applications of science), and human activity. Science and technology provide useful connections between the natural world and the designed world. Since the invention of stone tools, technological applications have provided, and will continue to provide, humans the ability to modify their environment. Because scientific advances and technology affect all of Earth's living and non-living systems, it is vital that students understand the interrelationships of science, technology, and human activity.

GRADES K-4


In grades K-4, what students know and are able to do includes

- recognizing the diversity of resources provided by the Earth and Sun (*for example, soil, fuels, minerals, medicines, food*);
-  inventing a device that addresses an everyday problem (or task), and communicating the problem (or task), design, and solution;
- describing resource-related activities in which they could participate that can benefit their communities (*for example, recycling, water conservation*); and
- identifying careers that use science and technology.

GRADES 5-8

As students in grades 5-8 extend their knowledge, what they know and are able to do includes

- investigating and describing the extent of human uses of renewable and non-renewable resources (*for example, forests, fossil fuels*);
- describing advantages and disadvantages that might accompany the introduction of a new technology (*for example, mountain bikes, cellular telephones, pagers*);
- describing how the use of technology can help solve an individual or community problem (*for example, using catalytic converters on automobiles to help reduce air pollution*), and

 describing how people use science and technology in their professions.

GRADES 9-12

As students in grades 9-12 extend their knowledge, what they know and are able to do includes

- analyzing benefits, limitations, costs, and consequences involved in using technology or resources (*for example, X-rays, agricultural chemicals, natural gas reserves*);
- analyzing how the introduction of a new technology has affected or could affect human activity (*for example, invention of the telescope, applications of modern telecommunications*);
- demonstrating the interrelationships between science and technology (*for example, building a bridge, designing a better running shoe*); and

 explaining the use of technology in an occupation.

For students continuing their science education beyond the standards, what they know and are able to do **may** include

- applying their knowledge and understanding of chemical and physical interactions to explain present and anticipated technologies (*for example, lasers, ultrasound, superconducting materials, photocopy machines*); and
- exploring the scientific and technological aspects of contemporary problems (*for example, issues related to nutrition, air quality, natural resources*).

STANDARD 6:

Students understand that science involves a particular way of knowing and understand common connections among scientific disciplines.

RATIONALE

Human societies have long asked questions about, observed and collected data on, and offered explanations for natural phenomena. Scientific evidence and knowledge are distinguished from other ways of knowing and other bodies of knowledge in terms of the criteria that must be met. These criteria include the use of empirical standards and rules of evidence, a logical structure, rational thought, questioning, and openness to criticism. Scientific disciplines differ from one another in what is studied, techniques used, and outcomes sought. They share a common purpose—to explain and predict events and phenomena—and offer strategies to solve defined problems. Scientific knowledge is dynamic. Although some scientific theories have withstood the test of time and are still used, other knowledge claims have been altered by new scientific evidence. Change, continuity, and stability are characteristic features of science.

Although acquiring scientific knowledge of laws, concepts, and theories is central to learning science, it does not necessarily lead to an understanding of how science itself works. Students need to understand that science works by weaving different aspects of science together so that they reinforce one another. To bring coherence to seemingly diverse sets of ideas or facts involving natural phenomena, scientific themes such as change, systems, models, and organization are highly useful. Themes can encompass and connect large quantities of basic data and evidence in science and can be used to integrate science with other disciplines.

GRADES K-4


In grades K-4, what students know and are able to do includes

- recognizing that when a science experiment is repeated with the same conditions, the experiment generally works the same way;
- comparing knowledge gained from direct experience to knowledge gained indirectly (for example, collecting data about student heights in their class and comparing the results to similar data collected in another class or school);
- identifying observable patterns and changes in their lives and predicting future events based on those patterns (for example, seasonal weather patterns);
- describing and comparing the components and interrelationships of a simple system (for example, tracing the continuous flow of water through an aquarium, filter, and pump); and
- comparing a model with what it represents (for example, comparing a map of the school to the actual school; a model of the Earth to the Earth itself).


GRADES 5-8

As students in grades 5-8 extend their knowledge, what they know and are able to do includes

- explaining why a controlled experiment must have comparable results when repeated;
- giving examples of how scientific knowledge changes as new knowledge is acquired and previous ideas are modified (*for example, through space exploration*);

 describing contributions to the advancement of science made by people in different cultures and at different times in history;

- identifying, comparing, and predicting variables and conditions related to change (*for example, climate, population, motion*);


 identifying and illustrating natural cycles within systems (*for example, water, planetary motion, geological changes, climate*); and


- using a model to predict change (*for example, computer simulation, video sequence, stream table*).


GRADES 9-12

As students in grades 9-12 extend their knowledge, what they know and are able to do includes

- evaluating print and visual media for scientific evidence, bias, or opinion;
- explaining that the scientific way of knowing uses a critique and consensus process (*for example, peer review, openness to criticism, logical arguments, skepticism*);
- using graphs, equations, or other models to analyze systems involving change and constancy (*for example, comparing the geologic time scale to shorter time frames*);

 analyzing and comparing models of cyclic change as used within and among scientific disciplines (*for example, water cycle, circular motion, sound waves, weather cycles*);

 identifying and predicting cause-effect relationships within a system (*for example, the effect of temperature on gas volume, effect of carbon dioxide level on the greenhouse effect, effects of changing nutrients at the base of a food pyramid*);

 identifying and describing the dynamics of natural systems (*for example, weather systems, ecological systems, body systems, systems at dynamic equilibrium*);

- identifying and testing a model to analyze systems involving change and constancy (*for example, a mathematical expression for gas behavior; constructing a closed ecosystem such as an aquarium*);
- explaining an exponential model (*for example, pH scale, population growth, Richter scale*); and
- refining a hypothesis based on an accumulation of data over time (*for example, Alvarez's theory on dinosaur extinction*).

For students continuing their science education beyond the standards, what they know and are able to do **may** include

- relating small-scale phenomena to large-scale properties (*for example, intermolecular forces related to physical properties*); and
- tracing the development of an invention, theory, or discovery to demonstrate the dynamic nature of science.

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Pueblo South High School
Creekside Elementary School
Colfax Elementary School
Lemuel Middle School
George Washington High School
Harrison High School
Woodlin Jr./Sr. High School
Agate Jr./Sr. High School
Horizon High School
Nevin Platt Middle School
Horizon High School
Adams 12 Schools
Edwards Elementary School
Campus Middle School
Douglas County High School
Skinner Middle School
Heritage Elementary School
Montrose High School
Estes Park Elementary School
Air Academy High School
York Junior High School
Boulder Valley High School
Centennial Middle School
Sheridan Middle School
George Washington High School
West Middle School
Green Mountain High School
Southeast Elementary School
Leo Wm. Butler Elementary School
M. Scott Carpenter Middle School
Air Academy High School
Adams City High School
Brighton High School
Widefield High School
Florence R. Sabin Junior High School
Centauri Middle School
West Middle School
Estes Park High School
Monte Vista Sr. High School
Denver Schools

Colorado School of Mines
St. Vrain Valley RE 1J
Pueblo City 60
Cherry Creek 5
Denver County 1
Pueblo City 60
Denver County 1
Harrison 2
Woodlin R-104
Agate 300
Adams 12
Boulder Valley RE 2
Adams 12
Adams 12
Eagle County RE 50
Cherry Creek 5
Douglas County RE 1
Denver County 1
Pueblo City 60
Montrose County RE 1J
Park R-3
Academy 20
Mapleton 1
Boulder Valley RE 2
Boulder Valley RE 2
Sheridan 2
Denver County 1
Adams-Arapahoe 28J
Jefferson County R 1
Brighton 27J
Fort Lupton RE-8
Westminster 50
Academy 20
Adams County 14
Brighton School 27J
Widefield 3
Colorado Springs 11
North Conejos RE-1J
Cherry Creek 5
Park R-3
Monte Vista C-8
Denver County 1

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Laboratory School
Eaglecrest High School

Colorado Springs 11
Greeley 6
University of Northern Colorado
Jefferson County R 1
Mesa County Valley 51
Greeley 6
Denver County 1
Harrison 2
Jefferson County
Greeley 6
University of Northern Colorado
Cherry Creek 5

**COLORADO
MODEL CONTENT STANDARDS
FOR
MATHEMATICS**

INTRODUCTION

Colorado Model Content Standards for Mathematics

Responsible and productive members of today's technological society need to have a broad, connected, and useful knowledge of mathematics. The Colorado Model Content Standards for Mathematics are designed to serve as a guide for school districts as they define standards that will enable every Colorado student to develop the mathematical literacy needed for citizenship and employment in the 21st century.

“Today's students will live and work in the 21st century, in an era dominated by computers, by worldwide communication, and by a global economy. Jobs that contribute to this economy will require workers who are prepared to absorb new ideas, to perceive patterns, and to solve unconventional problems. Mathematics is the key to opportunity for these jobs.”¹

Mathematics is not simply a collection of facts and procedures, and doing mathematics is not simply recalling these facts, nor performing memorized procedures. Mathematics is a coherent and useful discipline that has expanded dramatically in the last 25 years. The mathematics students study in school must reflect these changes, and the ways students study mathematics must capitalize on the growth in our understanding of how students learn.

"There has been a mentality that you have to be ... special to be successful in mathematics, that you have to be the best and the brightest. Well, we are demystifying mathematics. We can no longer say that there is any segment of society that doesn't need mathematics."²

Three questions have guided the development of the Colorado Model Content Standards for Mathematics: What is mathematics? What does it mean to know, use, and do mathematics? What mathematics should *every* Colorado student learn?

Responses to these questions have resulted in six goals, adapted from those of the National Council of Teachers of Mathematics³, that serve as the framework for the Colorado Model Content Standards for Mathematics. The six goals that Colorado students should reach are stated on the following page.

¹ L. Steen, (1989), "Teaching Mathematics for Tomorrow's World", *Educational Leadership*, 47: 18-22.

² Quote by Iris Carl found in A. Wheelock, (1992), *Crossing the Tracks*, (New York: The New Press).

³ National Council of Teachers of Mathematics, (1989), *Curriculum and Evaluation Standards for School Mathematics*, (Reston, VA: author).

Colorado Model Content Standards

MATHEMATICS

- 1. Students develop number sense* and use numbers and number relationships in problem-solving situations* and communicate the reasoning used in solving these problems.**
- 2. Students use algebraic methods* to explore, model*, and describe patterns* and functions* involving numbers, shapes, data, and graphs in problem-solving situations and communicate the reasoning used in solving these problems.**
- 3. Students use data collection and analysis, statistics*, and probability* in problem-solving situations and communicate the reasoning used in solving these problems.**
- 4. Students use geometric concepts, properties, and relationships in problem-solving situations and communicate the reasoning used in solving these problems.**
- 5. Students use a variety of tools and techniques to measure, apply the results in problem-solving situations, and communicate the reasoning used in solving these problems.**
- 6. Students link concepts and procedures as they develop and use computational techniques, including estimation, mental arithmetic*, paper-and-pencil, calculators, and computers, in problem-solving situations and communicate the reasoning used in solving these problems.**

STANDARD 1:

Students develop number sense and use numbers and number relationships in problem-solving situations and communicate the reasoning used in solving these problems.

In order to meet this standard, a student will

- construct and interpret number meanings through real-world experiences* and the use of hands-on materials;
- represent and use numbers in a variety of equivalent forms (*for example, fractions, decimals, percents, exponents*, scientific notation**);
- know the structure and properties of the real number system* (*for example, primes*, factors, multiples, relationships among sets of numbers*); and
- use number sense, including estimation and mental arithmetic, to determine the reasonableness of solutions.

RATIONALE

Numbers play a vital role in our daily lives, from cooking to reading the newspaper to performing jobs. Because we use numbers to measure, to count, to order, and to label, it is important to understand the many uses of numbers. These include knowing both the symbols for and the meanings of various kinds of numbers, including whole numbers, fractions, decimals, percents, roots, exponents, logarithms, and scientific notation.*

Number sense is "common sense" about numbers. Students with number sense recognize the relative magnitudes of numbers and relationships between numbers; for example, $1/2$ is equivalent to $.5$ and 50% . In addition, they have references for measures of common objects and situations in the environment. They know how much a million is and how much a loaf of bread costs. Developing number sense strengthens students' ability to acquire basic facts, to solve problems, and to determine the reasonableness of results.*

GRADES K-4

In grades K-4, what students know and are able to do includes



demonstrating meanings for whole numbers, and commonly-used fractions and decimals (*for example, $\frac{1}{3}$, $\frac{3}{4}$, 0.5, 0.75*), and representing equivalent forms of the same number through the use of physical models, drawings, calculators, and computers;

- reading and writing whole numbers and knowing place-value concepts and numeration through their relationships to counting, ordering, and grouping;



using numbers to count, to measure, to label, and to indicate location;

- developing, testing, and explaining conjectures* about properties of whole numbers, and commonly-used fractions and decimals (*for example, $\frac{1}{3}$, $\frac{3}{4}$, 0.5, 0.75*); and



using number sense to estimate and justify the reasonableness of solutions to problems involving whole numbers, and commonly-used fractions and decimals (*for example, $\frac{1}{3}$, $\frac{3}{4}$, 0.5, 0.75*).

GRADES 5-8

As students in grades 5-8 extend their knowledge, what they know and are able to do includes

- demonstrating meanings for integers*, rational numbers*, percents, exponents, square roots*, and pi (π) using physical materials and technology in problem-solving situations;
- reading, writing, and ordering integers, rational numbers, and common irrational numbers* such as $\sqrt{2}$, $\sqrt{5}$, and π ;
- applying number theory concepts (*for example, primes, factors, multiples*) to represent numbers in various ways;
- using the relationships among fractions, decimals, and percents, including the concepts of ratio and proportion, in problem-solving situations;
- developing, testing, and explaining conjectures about properties of integers and rational numbers; and
- using number sense to estimate and justify the reasonableness of solutions to problems involving integers, rational numbers, and common irrational numbers such as $\sqrt{2}$, $\sqrt{5}$, and π .

GRADES 9-12

As students in grades 9-12 extend their knowledge, what they know and are able to do includes

- demonstrating meanings for real numbers, absolute value*, and scientific notation using physical materials and technology in problem-solving situations;
- developing, testing, and explaining conjectures about properties of number systems and sets of numbers; and
- using number sense to estimate and justify the reasonableness of solutions to problems involving real numbers.

For students continuing their mathematics education beyond these standards, what they will know and are able to do **may** include

- investigating limiting processes by examining infinite sequences and series; and
- explaining relationships among real numbers, complex numbers*, and vectors* using models.

STANDARD 2:

Students use algebraic methods to explore, model, and describe patterns and functions involving numbers, shapes, data, and graphs in problem-solving situations and communicate the reasoning used in solving these problems.

In order to meet this standard, a student will

- identify, describe, analyze, extend, and create a wide variety of patterns in numbers, shapes, and data;
- describe patterns using mathematical language;
- solve problems and model real-world situations using patterns and functions;
- compare and contrast different types of functions; and
- describe the connections among representations of patterns and functions, including words, tables, graphs, and symbols.


RATIONALE


The study of patterns, functions, and algebra helps learners to recognize and generalize patterns; identify and clarify functional relationships; and represent and manipulate these relationships verbally, numerically, symbolically, and graphically. Symbolic representation, including the many interpretations of the concept of variable*, is important but only one of many ways to represent patterns and functions. Students who are adept at identifying and classifying patterns and functional relationships are better able to use these relationships in real situations, both in school and out. The portrayal of functions and algebra in this standard is broader, deeper, more connected, and more useful to learners than in the traditional high school algebra curriculum.*


Because the understandings developed through this standard are critical to success in mathematics and to the appropriate use of quantitative reasonings in other disciplines, students should explore and use the ideas of functions, patterns, and algebra from kindergarten through 12th grade.

GRADES K-4

In grades K-4, what students know and are able to do includes

 reproducing, extending, creating, and describing patterns and sequences using a variety of materials (for example, beans, toothpicks, pattern blocks, calculators, unifix cubes, colored tiles);

 describing patterns and other relationships using tables, graphs, and open sentences*;

 recognizing when a pattern exists and using that information to solve a problem; and

- observing and explaining how a change in one quantity can produce a change in another (for example, the relationship between the number of bicycles and the numbers of wheels).

GRADES 5-8

As students in grades 5-8 extend their knowledge, what they know and are able to do includes

- representing, describing, and analyzing patterns and relationships using tables, graphs, verbal rules, and standard algebraic notation;
- describing patterns using variables, expressions, equations, and inequalities in problem-solving situations;
- analyzing functional relationships to explain how a change in one quantity results in a change in another (for example, how the area of a circle changes as the radius increases, or how a person's height changes over time);
- distinguishing between linear* and nonlinear functions through informal investigations; and
- solving simple linear equations in problem-solving situations using a variety of methods (informal, formal, graphical) and a variety of tools (physical materials, calculators, computers).

GRADES 9-12

As students in grades 9-12 extend their knowledge, what they know and are able to do includes

- modeling real-world phenomena (*for example, distance-versus-time relationships, compound interest, amortization tables, mortality rates*) using functions, equations, inequalities, and matrices*;
- representing functional relationships using written explanations, tables, equations, and graphs, and describing the connections among these representations;
- solving problems involving functional relationships using graphing calculators and/or computers as well as appropriate paper-and-pencil techniques;
- analyzing and explaining the behaviors, transformations*, and general properties of types of equations and functions (*for example, linear, quadratic*, exponential**); and
- interpreting algebraic equations and inequalities geometrically and describing geometric relationships algebraically.

For students continuing their mathematics education beyond these standards, what they know and are able to do **may** include

- using rational, polynomial, trigonometric, and inverse functions to model real-world phenomena;
- representing and solving problems using linear programming and difference equations;
- solving systems of linear equations using matrices and vectors;
- describing the concept of continuity of a function;
- performing operations on and between functions; and
- making the connections between trigonometric functions and polar coordinates, complex numbers, and series.

STANDARD 3:

Students use data collection and analysis, statistics, and probability in problem-solving situations and communicate the reasoning used in solving these problems.

In order to meet this standard, a student will


- solve problems by systematically collecting, organizing, describing, and analyzing data using surveys, tables, charts, and graphs;
- make valid inferences, decisions, and arguments based on data analysis; and
- use counting techniques, experimental probability, or theoretical probability, as appropriate, to represent and solve problems involving uncertainty.

RATIONALE


Statistics are used to understand how information is processed and translated into usable knowledge. Through the study of statistics, students learn to collect, organize, and summarize information. Students also need to know how to interpret data and make decisions based on their interpretations. Probability is part of this standard because statistical data are often used to predict the likelihood of future events and outcomes. Students learn probability — the study of chance — so that numerical data can be used to predict future events as well as record the past. A command of statistics and probability is important in adult life.

GRADES K-4

In grades K-4, what students know and are able to do includes

 constructing, reading, and interpreting displays of data including tables, charts, pictographs, and bar graphs;

- interpreting data using the concepts of largest, smallest, most often, and middle;
- generating, analyzing, and making predictions based on data obtained from surveys and chance devices; and

 solving problems using various strategies for making combinations* (for example, determining the number of different outfits that can be made using two blouses and three skirts).

GRADES 5-8

As students in grades 5-8 extend their knowledge, what they know and are able to do includes

- reading and constructing displays of data using appropriate techniques (*for example, line graphs, circle graphs, scatter plots*, box plots*, stem-and-leaf plots**) and appropriate technology;
- displaying and using measures of central tendency*, such as mean, median, and mode, and measures of variability*, such as range and quartiles;
- evaluating arguments that are based on statistical claims;
- formulating hypotheses, drawing conclusions, and making convincing arguments based on data analysis;
- determining probabilities through experiments or simulations;
- making predictions and comparing results using both experimental and theoretical probability drawn from real-world problems; and
- using counting strategies to determine all the possible outcomes from an experiment (*for example, the number of ways students can line up to have their picture taken*)

GRADES 9-12

As students in grades 9-12 extend their knowledge, what they know and are able to do includes

- designing and conducting a statistical experiment to study a problem, and interpreting and communicating the results using the appropriate technology (*for example, graphing calculators, computer software*);
- analyzing statistical claims for erroneous conclusions or distortions;
- fitting curves to scatter plots, using informal methods or appropriate technology, to determine the strength of the relationship between two data sets and to make predictions;
- drawing conclusions about distributions of data based on analysis of statistical summaries (*for example, the combination of mean and standard deviation, and differences between the mean and median*);
- using experimental and theoretical probability to represent and solve problems involving uncertainty (*for example, the chance of playing professional sports if a student is a successful high school athlete*); and
- solving real-world problems with informal use of combinations and permutations* (*for example, determining the number of possible meals at a restaurant featuring a given number of side dishes*).

For students continuing their mathematics education beyond these standards, what they know and are able to do **may** include

- creating and interpreting discrete and continuous probability distributions, and understanding their application to real-world situations (*for example, insurance*);
- testing hypotheses using appropriate statistics;
- exploring the effect of sample size on the results of statistical surveys using experiments and simulations; and
- solving real-world problems with formal use of combinations and permutations.

STANDARD 4:

Students use geometric concepts, properties, and relationships in problem-solving situations and communicate the reasoning used in solving these problems.

In order to meet this standard, a student will


- connect various physical objects with their geometric representation;
- connect mathematical concepts from across the standards with their geometric representations;
- recognize, draw, describe, and analyze geometric shapes in one, two, and three dimensions;
- make, investigate, and test conjectures about geometric ideas; and
- solve problems and model real-world situations using geometric concepts.

RATIONALE


Long before humans computed, they observed that the full moon, the iris of an eye, and circular ripples of water emanating from a cast stone all have the same shape. Recording and analyzing shapes and their properties eventually gave us the branch of mathematics called geometry. The process continues today as mathematicians develop powerful models of our world (for example, non-Euclidean geometry and fractals*). Students who understand the concepts and language of geometry are better prepared to learn number and measurement ideas as well as other advanced mathematical topics. Students' spatial capabilities frequently exceed their numerical skills and tapping these strengths can foster an interest in mathematics and improve number understandings and skills.*

GRADES K-4

In grades K-4, what students know and are able to do includes

 recognizing shapes and their relationships (for example, symmetry*, congruence*) using a variety of materials (for example, pasta, boxes, pattern blocks);

- identifying, describing, drawing, comparing, classifying, and building physical models of geometric figures;
- relating geometric ideas to measurement and number sense;
- solving problems using geometric relationships and spatial reasoning* (for example, using rectangular coordinates* to locate objects, constructing models of three-dimensional objects); and

 recognizing geometry in their world (for example, in art and in nature).

GRADES 5-8

As students in grades 5-8 extend their knowledge, what they know and are able to do includes

- constructing two- and three-dimensional models using a variety of materials and tools;
- describing, analyzing, and reasoning informally about the properties (for example, parallelism, perpendicularity, congruence) of two- and three-dimensional figures ;
- applying the concepts of ratio, proportion, and similarity* in problem-solving situations;
- solving problems using coordinate geometry*;
- solving problems involving perimeter and area in two dimensions, and involving surface area and volume* in three dimensions; and
- transforming geometric figures using reflections*, translations*, and rotations* to explore congruence.

GRADES 9-12

As students in grades 9-12 extend their knowledge, what they know and are able to do includes

- finding and analyzing relationships among geometric figures using transformations (*for example, reflections, translations, rotations, dilations**) in coordinate systems*;
- deriving and using methods to measure perimeter, area, and volume of regular and irregular geometric figures;
- making and testing conjectures about geometric shapes and their properties, incorporating technology where appropriate; and
- using trigonometric ratios* in problem-solving situations (*for example, finding the height of a building from a given point, if the distance to the building and the angle of elevation are known*).

For students continuing their mathematics education beyond these standards, what they know and are able to do **may** include

- deducing properties of figures using vectors*;
- applying transformations, coordinates, and vectors in problem-solving situations; and
- describing, analyzing, and extending patterns produced by processes of geometric change (*for example, limits and fractals*).

STANDARD 5:

Students use a variety of tools and techniques to measure, apply the results in problem-solving situations, and communicate the reasoning used in solving these problems.

In order to meet this standard, a student will


- understand and apply the attributes of length, capacity*, weight, mass, time, temperature, perimeter, area, volume, and angle measurement in problem-solving situations;
- make and use direct and indirect measurements to describe and compare real-world phenomena;
- understand the structure and use of systems of measurement;
- describe and use rates of change (*for example, temperature as it changes throughout the day, or speed as the rate of change of distance over time*) and other derived measures; and
- select appropriate units, including metric and U. S. customary, and tools (*for example, rulers, protractors, compasses, thermometers*) to measure to the degree of accuracy required to solve a given problem.

RATIONALE

Every day, people measure to answer common questions: How long will it take? How high is it? How much will it hold? Using agreed-upon units, such as inches, paper clips, kilograms, heartbeats, paces, or degrees Celsius, we quantify the world in which we live. Measurement is one way to make numbers meaningful to students. Naturally, measurement is closely allied with geometry (for example, through angular, linear, area, and volume measurements), but measurement involves more than using a ruler and a protractor. Measuring diverse quantities involves making connections within mathematics and across the curriculum.

GRADES K-4

In grades K-4, what students know and are able to do includes

 knowing, using, describing, and estimating measures of length, perimeter, capacity, weight, time, and temperature;



comparing and ordering objects according to measurable attributes (*for example, longest to shortest, lightest to heaviest*);

- demonstrating the process of measuring and explaining the concepts related to units of measurement;
- using the approximate measures of familiar objects (*for example, the width of your finger, the temperature of a room, the weight of a gallon of milk*) to develop a sense of measurement; and
- selecting and using appropriate standard and non-standard units of measurement in problem-solving situations.

GRADES 5-8

As students in grades 5-8 extend their knowledge, what they know and are able to do includes

- estimating, using, and describing measures of distance, perimeter, area, volume, capacity, weight, mass, and angle comparison;
- estimating, making, and using direct and indirect measurements to describe and make comparisons;
- reading and interpreting various scales including those based on number lines, graphs, and maps;
- developing and using formulas and procedures to solve problems involving measurement;
- describing how a change in an object's linear dimensions affects its perimeter, area, and volume; and
- selecting and using appropriate units and tools to measure to the degree of accuracy required in a particular problem-solving situation.

GRADES 9-12

As students in grades 9-12 extend their knowledge, what they know and are able to do includes

- measuring quantities indirectly using techniques of algebra, geometry, or trigonometry*;
- selecting and using appropriate techniques and tools to measure quantities in order to achieve specified degrees of precision, accuracy, and error (or tolerance) of measurements; and
- determining the degree of accuracy of a measurement (*for example, by understanding and using significant digits*).

For students continuing their mathematics education beyond these standards, what they know and are able to do **may** include

- demonstrating the meanings of area under a curve and length of an arc.

STANDARD 6:

Students link concepts and procedures as they develop and use computational techniques, including estimation, mental arithmetic, paper-and-pencil, calculators, and computers, in problem-solving situations and communicate the reasoning used in solving these problems.

In order to meet this standard, a student will

- model, explain, and use the four basic operations — addition, subtraction, multiplication, and division — in problem-solving situations;
- develop, use, and analyze algorithms*; and
- select and apply appropriate computational techniques to solve a variety of problems and determine whether the results are reasonable.

RATIONALE

Computation is an indispensable part of mathematics and our daily lives. We use it to balance our checkbooks, figure our taxes, and make business decisions. The basic facts of addition, subtraction, multiplication, and division are similarly indispensable. Today's students must be able to use a variety of computational tools and techniques including estimation, mental arithmetic, paper-and-pencil, calculators, and computers. Estimation and mental arithmetic serve a practical function in our daily lives, and help students develop meaning for numbers and understanding of number relationships. The use of calculators and computers is not intended to replace proficiency with basic facts. Appropriate uses of calculators and computers include solving real-world problems that may involve tedious or time-consuming computations or exploring number patterns to develop understanding of numbers and number relationships. Proficiency with basic facts is essential for knowing when and how to use each of these tools and techniques.

Computational skill is related to “operation sense”. Students with operation sense know when and how to use addition, subtraction, multiplication, and division, and are able to apply them to solve real-world problems. Students build operation sense by modeling their understanding of number operations and their properties, by describing how number operations are related to one another, and by seeing how the use of a particular operation changes the value of the numbers involved.

Computational skill and operation sense go hand in hand with number sense. When children have a well-developed sense of number and operations, they can more easily evaluate the reasonableness of their solutions. The ability to apply computational skills and operation sense will extend students' mathematical power by giving them confidence in their ability to work with numbers and to solve problems in a variety of situations.

GRADES K-4

In grades K-4, what students know and are able to do includes

- demonstrating conceptual meanings for the four basic arithmetic operations of addition, subtraction, multiplication, and division;
- adding and subtracting commonly-used fractions and decimals using physical models (for example, $\frac{1}{3}$, $\frac{3}{4}$, 0.5, 0.75);
- demonstrating understanding of and proficiency with basic addition, subtraction, multiplication, and division facts without the use of a calculator;
- constructing, using, and explaining procedures to compute and estimate with whole numbers; and
- selecting and using appropriate methods for computing with whole numbers in problem-solving situations from among mental arithmetic, estimation, paper-and-pencil, calculator, and computer methods.

GRADES 5-8

As students in grades 5-8 extend their knowledge, what they know and are able to do includes

- using models to explain how ratios, proportions, and percents can be used to solve real-world problems;
- constructing, using, and explaining procedures to compute and estimate with whole numbers, fractions, decimals, and integers;
- developing, applying, and explaining a variety of different estimation strategies in problem-solving situations, and explaining why an estimate may be acceptable in place of an exact answer; and
- selecting and using appropriate methods for computing with commonly used fractions and decimals, percents, and integers in problem-solving situations from among mental arithmetic, estimation, paper-and-pencil, calculator, and computer methods, and determining whether the results are reasonable.

GRADES 9-12

As students in grades 9-12 extend their knowledge, what they know and are able to do includes

- using ratios, proportions, and percents in problem-solving situations;
- selecting and using appropriate methods for computing with real numbers in problem-solving situations from among mental arithmetic, estimation, paper-and-pencil, calculator, and computer methods, and determining whether the results are reasonable; and
- describing the limitations of estimation, and assessing the amount of error resulting from estimation within acceptable limits.

For students continuing their mathematics education beyond these standards, what they know and are able to do **may** include

- analyzing and solving optimization problems*;
- analyzing different algorithms (*for example, sorting*) for efficiency;
- analyzing and using critical path algorithms (*for example, determining in which order to perform a set of tasks in a large project*); and
- investigating problem situations that arise in connection with computer validation and the application of algorithms.

Six Goals for Colorado Students of Mathematics

- ***Become mathematical problem solvers.*** To be problem solvers, students need to know how to find ways to reach a goal when no routine path is apparent. To develop the flexibility, perseverance, and wealth of strategies that are characteristic of good problem solvers, students need to be challenged frequently and regularly with non-routine problems, including those they pose themselves.
- ***Learn to communicate mathematically.*** The development of students' power to use mathematics involves learning the signs, symbols, and terms of mathematics. This is best accomplished in problem situations where students have an opportunity to read, write, and discuss ideas in the language of mathematics. As students communicate their ideas, they learn to clarify, refine, and consolidate their thinking.
- ***Learn to reason mathematically.*** Students who reason mathematically gather data, make conjectures*, assemble evidence, and build an argument to support or refute these conjectures. Such processes are fundamental to doing mathematics.
- ***Make mathematical connections.*** The study of mathematics should provide students with many opportunities to make connections among mathematical ideas (for example, the connection between geometric and algebraic concepts) and among mathematics and other disciplines (for example, art, music, psychology, science, business). The curriculum should portray mathematics as an integrated whole that permeates activities both in and out of school. These connections make mathematics meaningful and useful to each Colorado student.
- ***Become confident of their mathematical abilities.*** As a result of studying mathematics, students need to view themselves as capable of using their growing mathematical power to make sense of new problem situations in the world around them. School mathematics must endow all students with a realization that doing mathematics is a common human activity. Students learn to trust their own mathematical thinking by having numerous and varied experiences.
- ***Learn the value of mathematics.*** In addition to providing the tools to solve problems, mathematics provides a way of thinking about and understanding the world around us. Students should have numerous and varied opportunities to think mathematically about their world. They should also explore the cultural, historical, and scientific evolution of mathematics so that they can appreciate the role of mathematics in the development of our contemporary society.

The following Colorado Model Content Standards for Mathematics provide a new vision of the content students should study in order to achieve these goals. The standards reinforce the need for technical skills, long a goal of school mathematics, and also the need to know when to apply them and why they work. They also broaden considerably the context in which these technical skills might be attained. Students who have a working knowledge of the mathematics in each of these standards will be better able to reason critically, vote responsibly, and work productively in today's complex world.

*A glossary of terms can be found on page Mathematics - 22.

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GLOSSARY

Colorado Model Content Standards for Mathematics

Absolute value — A number's distance from zero on a number line. The absolute value of -6 , shown as $|-6|$, is 6 , and the absolute value of 6 , shown as $|6|$, is 6 .

Algebra — The branch of mathematics that is the generalization of the ideas of arithmetic.

Algebraic methods — The use of symbols to represent numbers and signs to represent their relationships.

Algorithm — A step-by-step procedure.

Basic facts — Addition facts through 10 ($0 + 0$, $1 + 0$, ... , $10 + 10$), subtraction facts which are the inverses of the addition facts ($20 - 10$, ... , $1 - 0$, $0 - 0$), multiplication facts (1×1 , 1×2 , ... , 10×10), and division facts which are the inverses of the multiplication facts ($1 \div 1$, $2 \div 1$, ... , $100 \div 10$).

Box plot (also called a box-and-whiskers plot) — A graphic method for showing a summary of data using median, quartiles, and extremes of data. A box plot makes it easy to see where the data are spread out and where they are concentrated. The longer the box, the more the data are spread out.

Capacity — The volume of a container given in units of liquid measure. The standard units of capacity are the liter and the gallon.

Combinations — Subsets chosen from a larger set of objects in which the order of the items doesn't matter (for example, the number of different committees of three that can be chosen from a group of twelve members).

Complex numbers — Numbers that can be written in the form $a + bi$, for example, $-2.7 + 8.9i$, where a and b are real numbers and $i = \sqrt{-1}$.

Congruent or the concept of congruence — Two figures are said to be congruent if they are the same size and shape.

Coordinate geometry — Geometry based on the coordinate system.

Coordinate system (also called rectangular coordinate system) — A method of locating points in the plane or in space by means of numbers. A point in a plane can be located by its distances from both a horizontal and a vertical line called the axes. The horizontal line is called the x-axis. The vertical line is called the y-axis. The pairs of numbers are called ordered pairs. The first number, called the x-coordinate, designates the distance along the horizontal axis. The second number, called the y-coordinate, designates the distance along the vertical axis. The point at which the two axes intersect has the coordinates $(0,0)$ and is called the origin.

Conjecture — A statement that is to be shown true or false. A conjecture is usually developed by examining several specific situations.

Dilation — A transformation that either enlarges or reduces a geometric figure proportionally.

Exponential function — A function that has an equation of the form $y = a^x$. These functions are used to study population growth or decline, radioactive decay, and compound interest.

Exponent — A number used to tell how many times a number or variable is used as a factor. For example, 5^3 indicates that 5 is a factor 3 times, that is, $5 \times 5 \times 5$. The value of 5^3 is 125.

Fractal — A geometric shape that is self-similar and has fractional dimensions. Natural phenomena such as the formation of snowflakes, clouds, mountain ranges, and landscapes involve patterns. Their pictorial representations are fractals and are usually generated by computers.

Function — A relationship between two sets of numbers (or other mathematical objects). Functions can be used to understand how one quantity varies in relation to another, for example, the relationship between the number of cars and the number of tires.

Geometry — A branch of mathematics that deals with the measurement, properties, and relationships of points, lines, angles, and two- and three-dimensional figures.

Integers — The set of numbers consisting of the counting numbers (that is, 1, 2, 3, 4, 5, ...), their opposites (that is, negative numbers, -1, -2, -3, ...), and zero.

Irrational numbers — The set of numbers which cannot be represented as fractions. Examples are $\sqrt{2}$, $\sqrt[3]{29}$, e , and π .

Linear function — A function that has a constant rate of change.

Logarithm — Alternate way to express an exponent. For example, $\log_2 8 = 3$ is equivalent to $2^3 = 8$.

Matrix (pl. matrices) — A rectangular array of numbers (or letters) arranged in rows and columns.

Measures of central tendency — Numbers which in some sense communicate the "center" or "middle" of a set of data. The mean, median, and mode of statistical data are all measures of central tendency.

Measures of variability — Numbers which describe how spread out a set of data is, for example, range and quartile.

Mental arithmetic — Performing computations in one's head without writing anything down. Mental arithmetic strategies include finding pairs that add up to 10 or 100, doubling, and halving.

Model — To make or construct a physical or mathematical representation.

Number sense — An understanding of number. This would include number meanings, number relationships, number size, and the relative effect of operations on numbers.

Open sentence — a statement that contains at least one unknown. It becomes true or false when a quantity is substituted for the unknown. For example, $3 + x = 5$.

Optimization problems — Real-world problems in which, given a number of constraints, the best solution is determined. For example, finding the best number of nonstop flights from Denver to San Francisco given the cost of fuel, number of passengers, number of crew required, etc.

Patterns — Regularities in situations such as those in nature, events, shapes, designs, and sets of numbers (*for example, spirals on pineapples, geometric designs in quilts, the number sequence 3,6,9,12,...*).

Permutations — All possible arrangements of a given number of items in which the order of the items makes a difference. For example, the different ways that a set of four books can be placed on a shelf.

Prime number — A counting number that can only be evenly divided by two different numbers, 1 and the number itself. The first ten prime numbers are: 2, 3, 5, 7, 11, 13, 17, 19, 23, 29.

Probability — The likeliness or chance of an event occurring.

Problem solving — Refer to the introduction (page Mathematics - 4).

Problem-solving situations — Contexts in which problems are presented that apply mathematics to practical situations in the real world, or problems that arise from the investigation of mathematical ideas.

Quadratic function — A function that has an equation of the form $y = ax^2 + bx + c$, where $a \neq 0$. These functions are used to describe the flight of a ball and the stream of water from a fountain.

Rational numbers — A number that can be expressed in the form $\frac{a}{b}$, where a and b are integers and $b \neq 0$, for example, $\frac{3}{4}$, $\frac{2}{1}$, or $\frac{11}{3}$. Every integer is a rational number, since it can be expressed in the form $\frac{a}{b}$, for example, $5 = \frac{5}{1}$. Rational numbers may be expressed as fractional or decimal numbers, for example, $\frac{3}{4}$ or $.75$. Finite decimals, repeating decimals, and mixed numbers all represent rational numbers.

Real numbers — All rational and irrational numbers.

Real-world problems (also called real-world experiences) — Quantitative problems that arise from a wide variety of human experiences which may take into consideration contributions from various cultures (for example, Mayan or American pioneers), problems from abstract mathematics, and applications to various careers (for example, making change or calculating the sale price of an item).

Reflection (also called a flip) — A transformation which produces the mirror image of a geometric figure.

Rotation (also called a turn) — A transformation which turns a figure about a point a given number of degrees.

Scatter plots (also called scatter diagram or scattergram) — A graph of the points representing a collection of data.

Scientific notation — A short-hand way of writing very large or very small numbers. A number expressed in scientific notation is expressed as a decimal number between 1 and 10 multiplied by a power of 10, for example, $4.53 \times 10^3 = 4350$.

Similarity — Objects or figures that are the same shape are similar figures. They are not necessarily the same size. If two figures are similar, we say that there is similarity between the figures.

Spatial visualization (also called spatial reasoning) — A type of reasoning in which a person can draw upon one's understanding of relationships in space, the three-dimensional world. For example, spatial reasoning is demonstrated by one's ability to build a three-dimensional model of a building shown in a picture. A person who uses spatial visualization is said to have spatial sense.

Square root — That number which when multiplied by itself produces the given number. For example, 5 is the square root of 25, because $5 \times 5 = 25$.

Statistics — The branch of mathematics which is the study of the methods of collecting and analyzing data. The data are collected on samples from various populations of people, animals, or products. Statistics are used in many fields, such as biology, education, physics, psychology, and sociology.

Stem-and-leaf plot — A frequency distribution made by arranging data. It is one way of visually portraying data that is frequently used in newspapers and magazines because it provides an efficient way of showing information as well as comparing different sets of data.

Symmetry — The correspondence in size, form, and arrangement of parts on opposite sides of a plane, line, or point. For example, a figure that has line symmetry has two halves which coincide if folded along its line of symmetry.

Transformation — The process of changing one configuration or expression into another in accordance with a rule. Common geometric transformations include translations, rotations, and reflections.

Translation (also called a slide) — A transformation that moves a geometric figure by sliding. Each of the points of the geometric figure moves the same distance in the same direction.

Trigonometric ratios — The ratios of the lengths of pairs of sides in a right triangle. There are three basic trigonometric ratios used in trigonometry: sine (sin), cosine (cos), and tangent (tan).

Trigonometry — A branch of mathematics that combines arithmetic, algebra, and geometry. Trigonometry is used in surveying, navigation, and various sciences such as physics.

Variable — A quantity that may assume any one of a set of values. In the equation $2x + y = 9$, x and y are variables.

Vector — A quantity which has both magnitude and direction. Vectors may be interpreted as physical quantities such as velocity and force.

Volume — The measure of the interior of a three-dimensional figure. A unit for measuring volume is the cubic unit.

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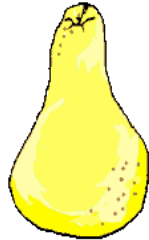




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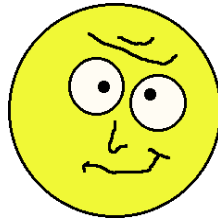
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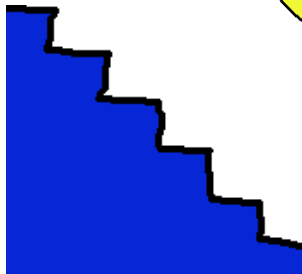
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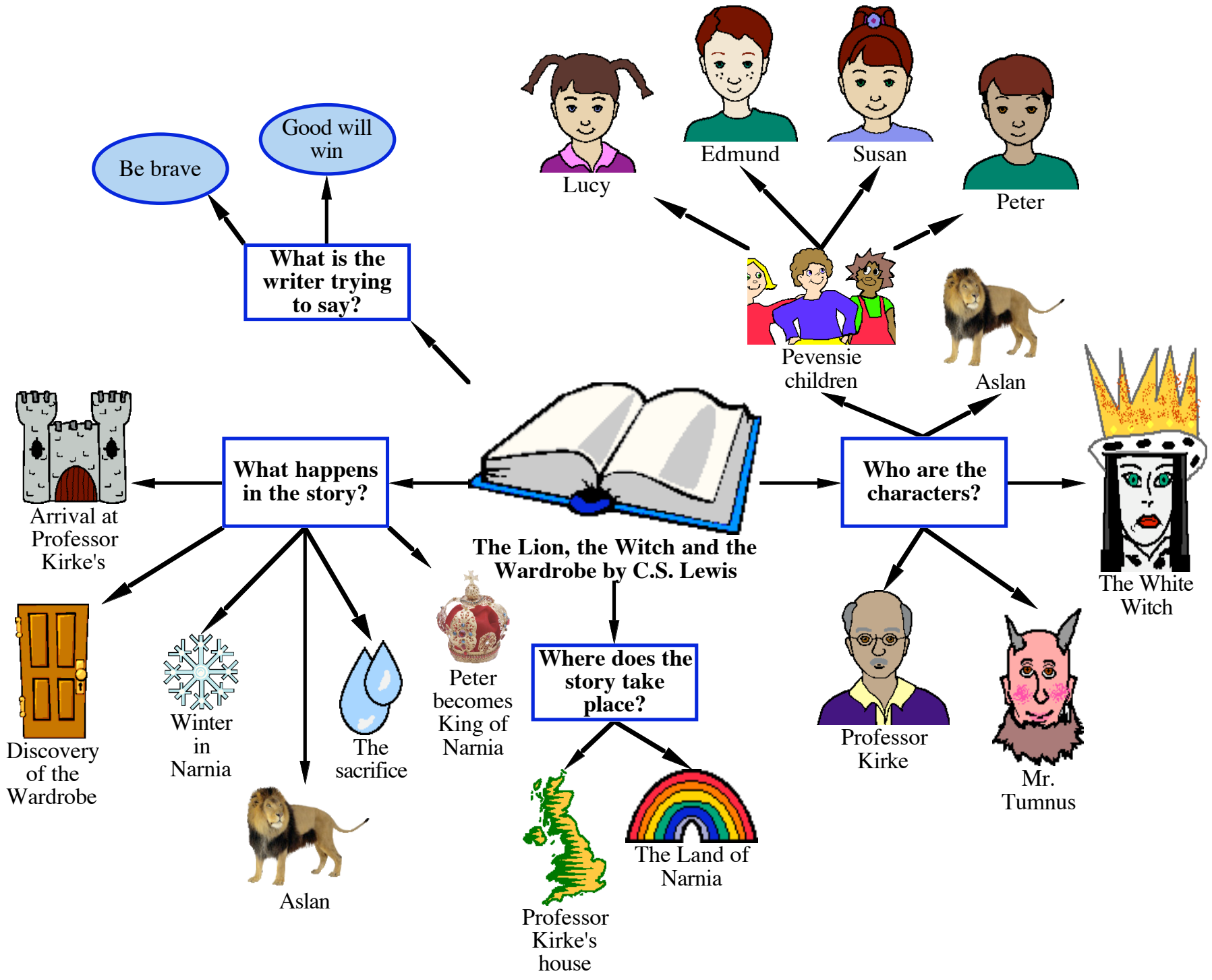
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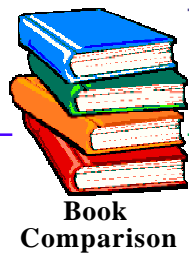


cheer

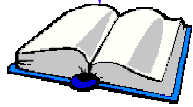


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Conclusions



These Happy Golden Years



My Antonia

Other works

Laura Ingalls Wilder

Willa Cather

Other works

Theme
Life may change, but it just gets better.

Theme

Theme

How are the t...
Cather's book is more issue-oriented (for example, immigrants).

What do the author's lives have in common?

Tone, mood, style

Tone, mood, style

How are the themes similar or different?

How are the tone, mood, and style alike or different?

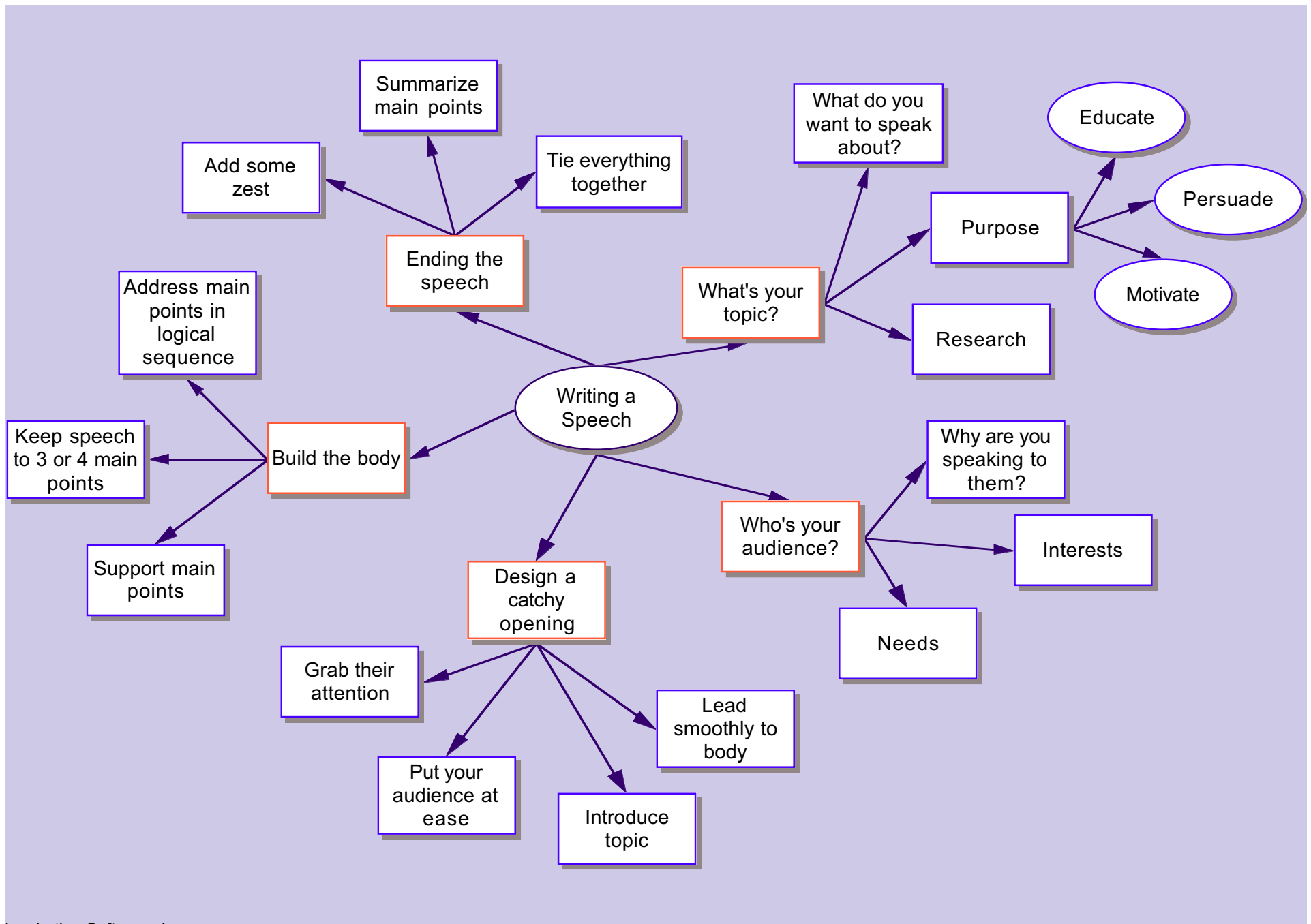
Message...
Be thankful for the simple things and appreciate family.

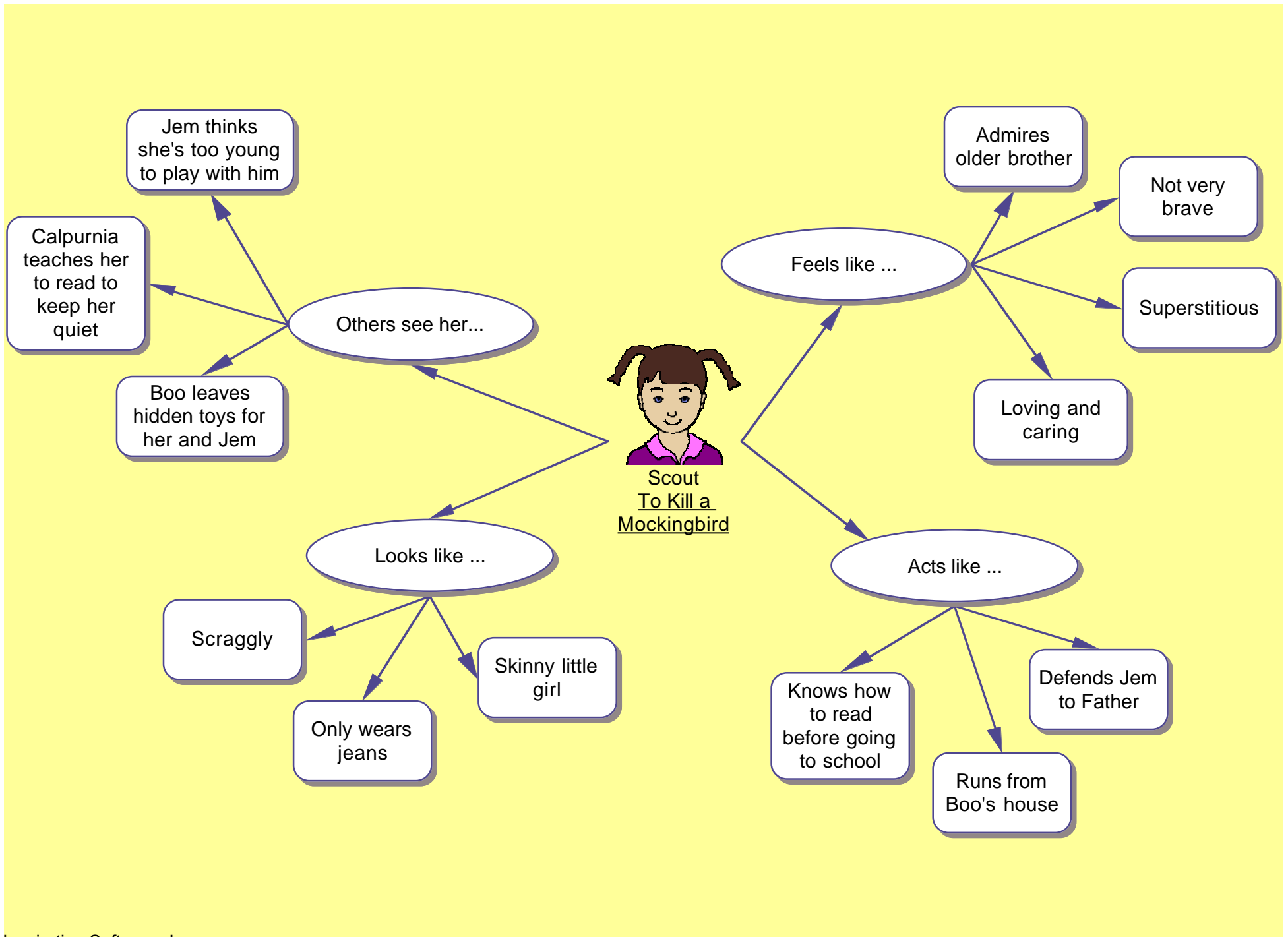
Message to the reader

Message to the reader

Message...
Strength, humor, and goodness help one to overcome trials and misfortunes.

How are the books' messages alike or different?

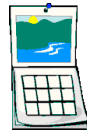




Social Studies Examples

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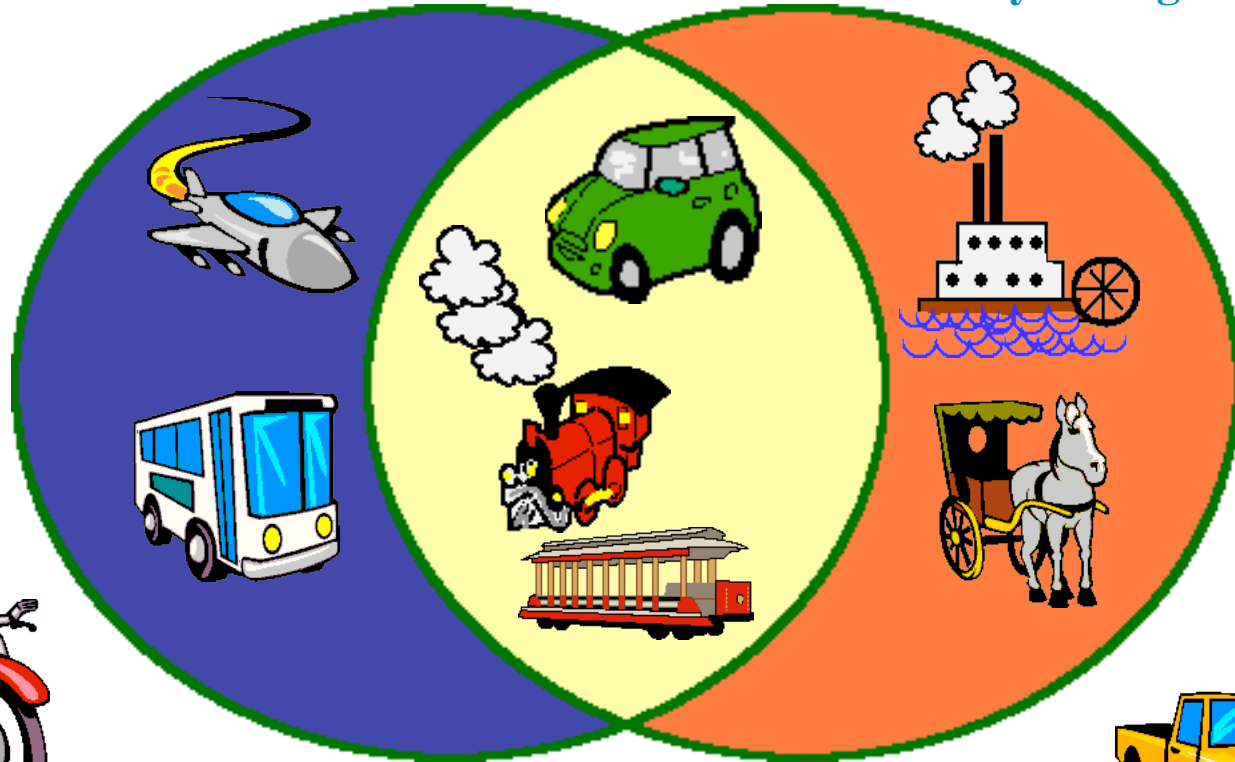




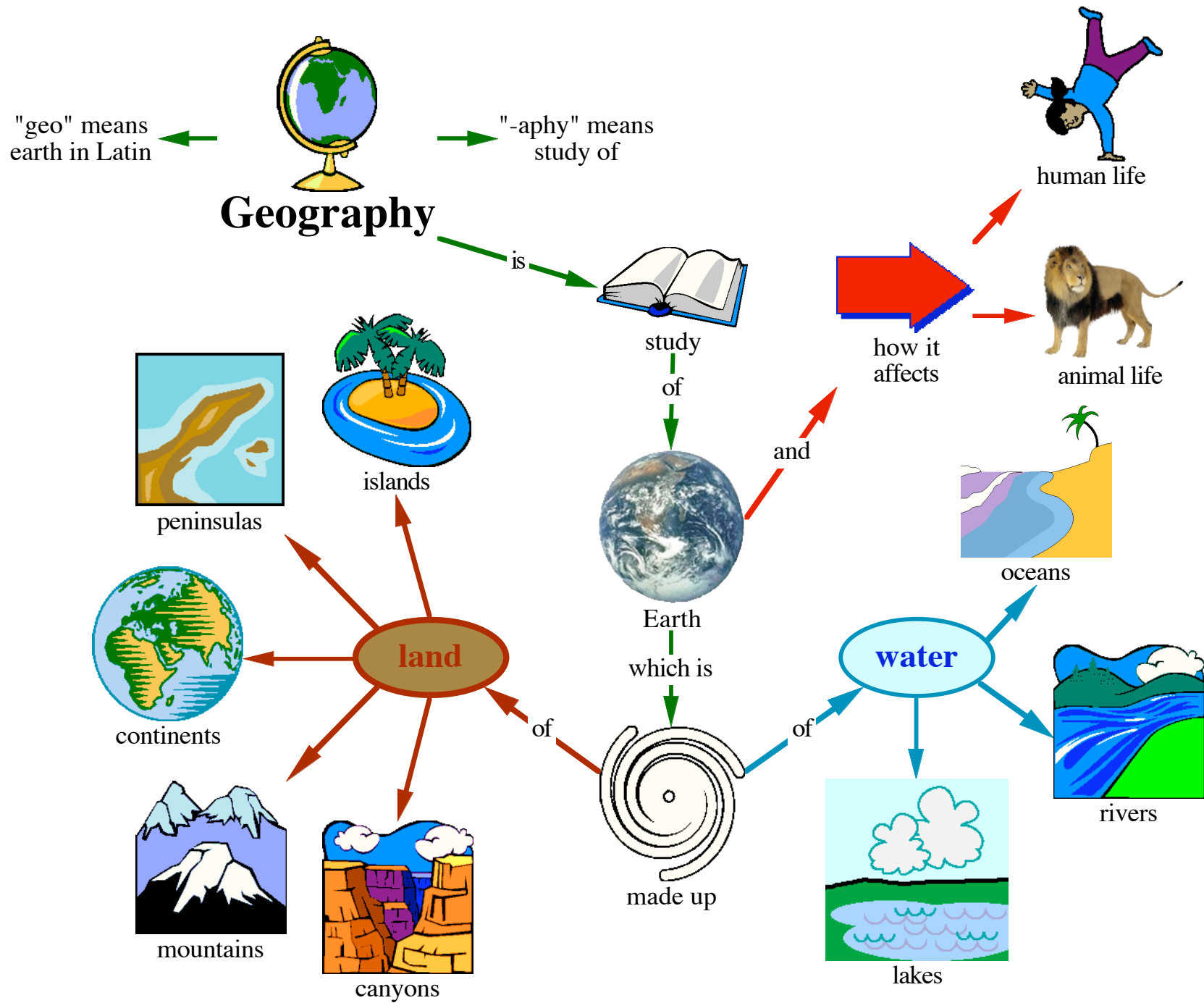
Transportation over time

Now

100 years ago



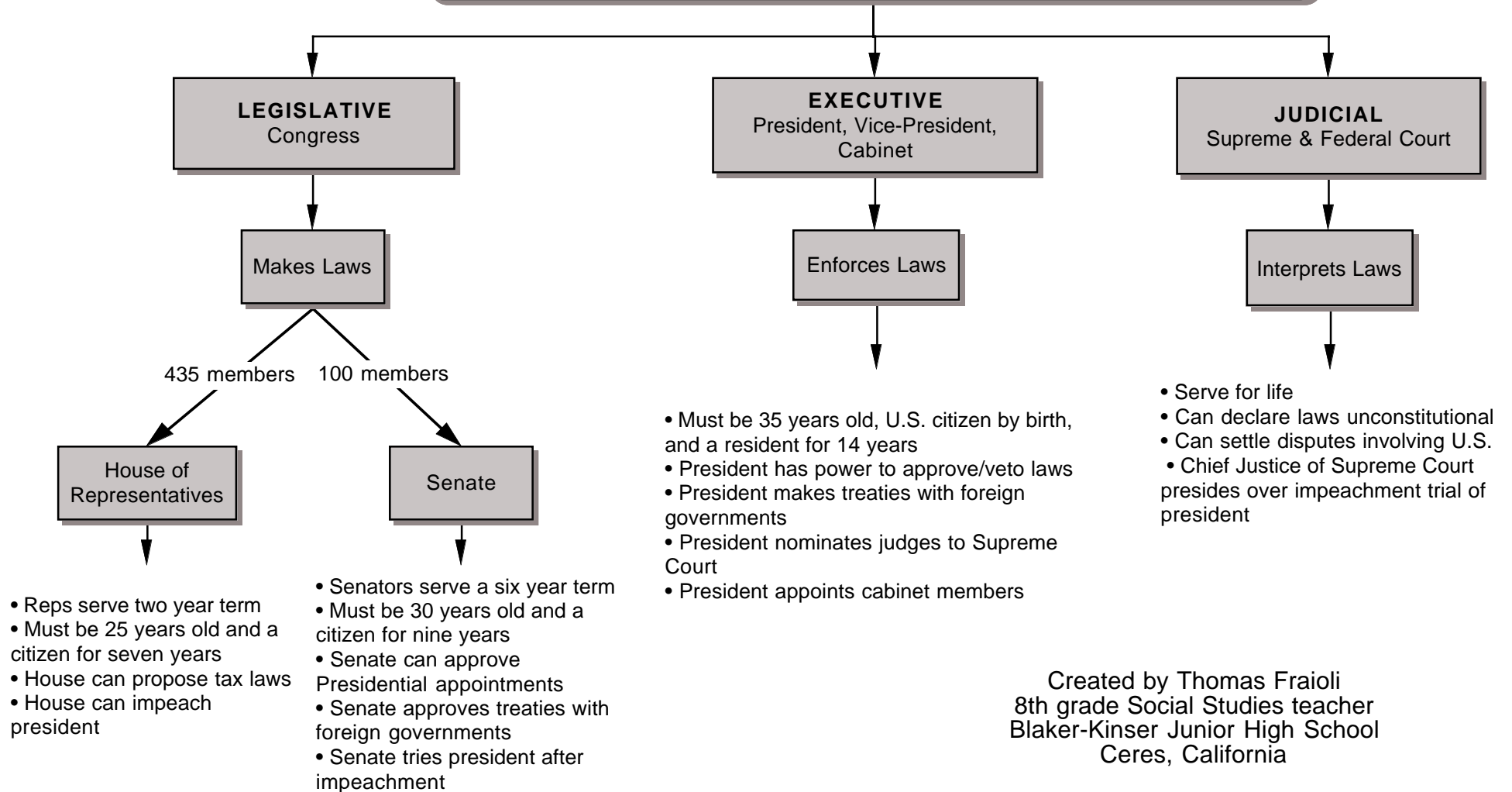
Johnnie

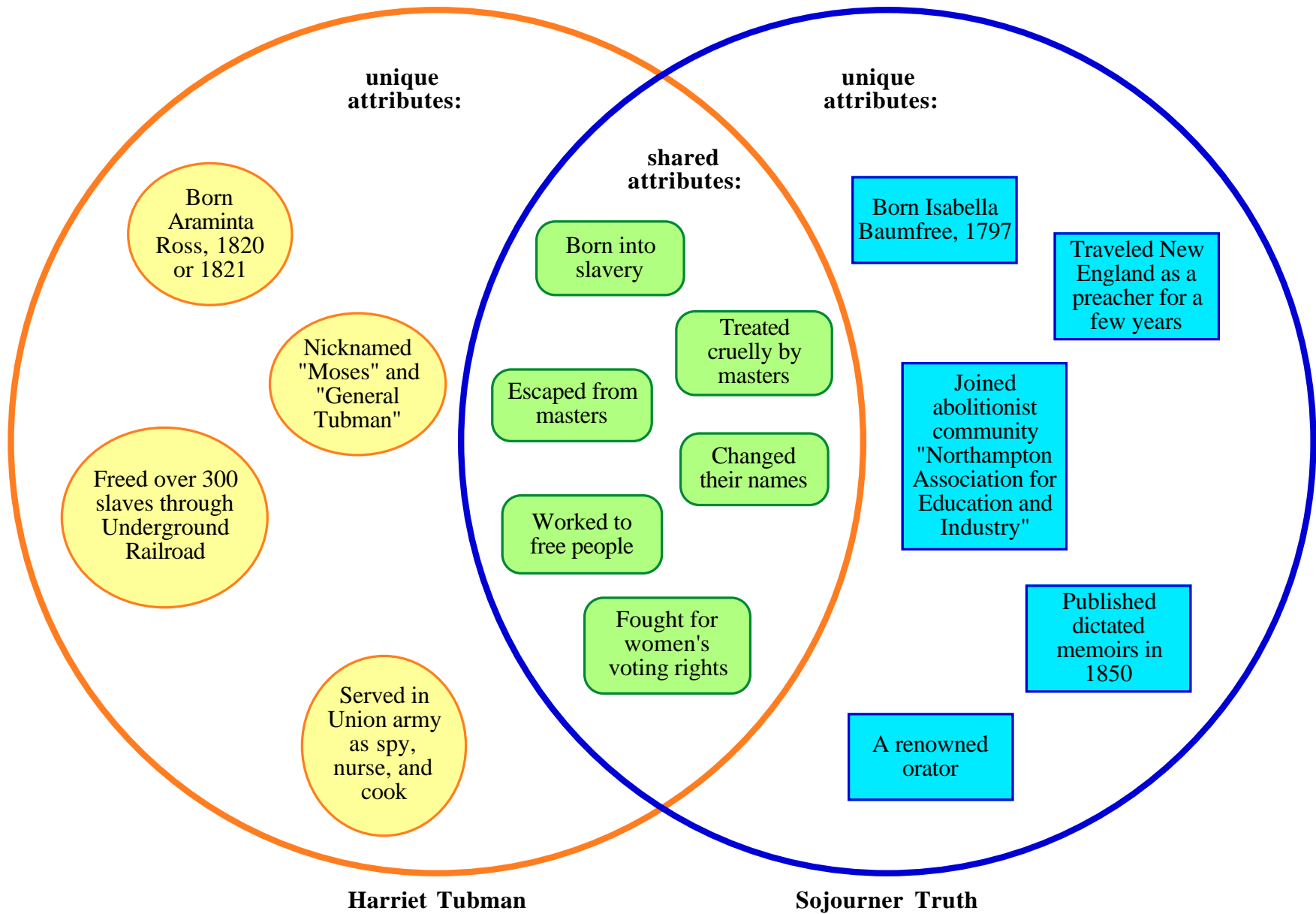


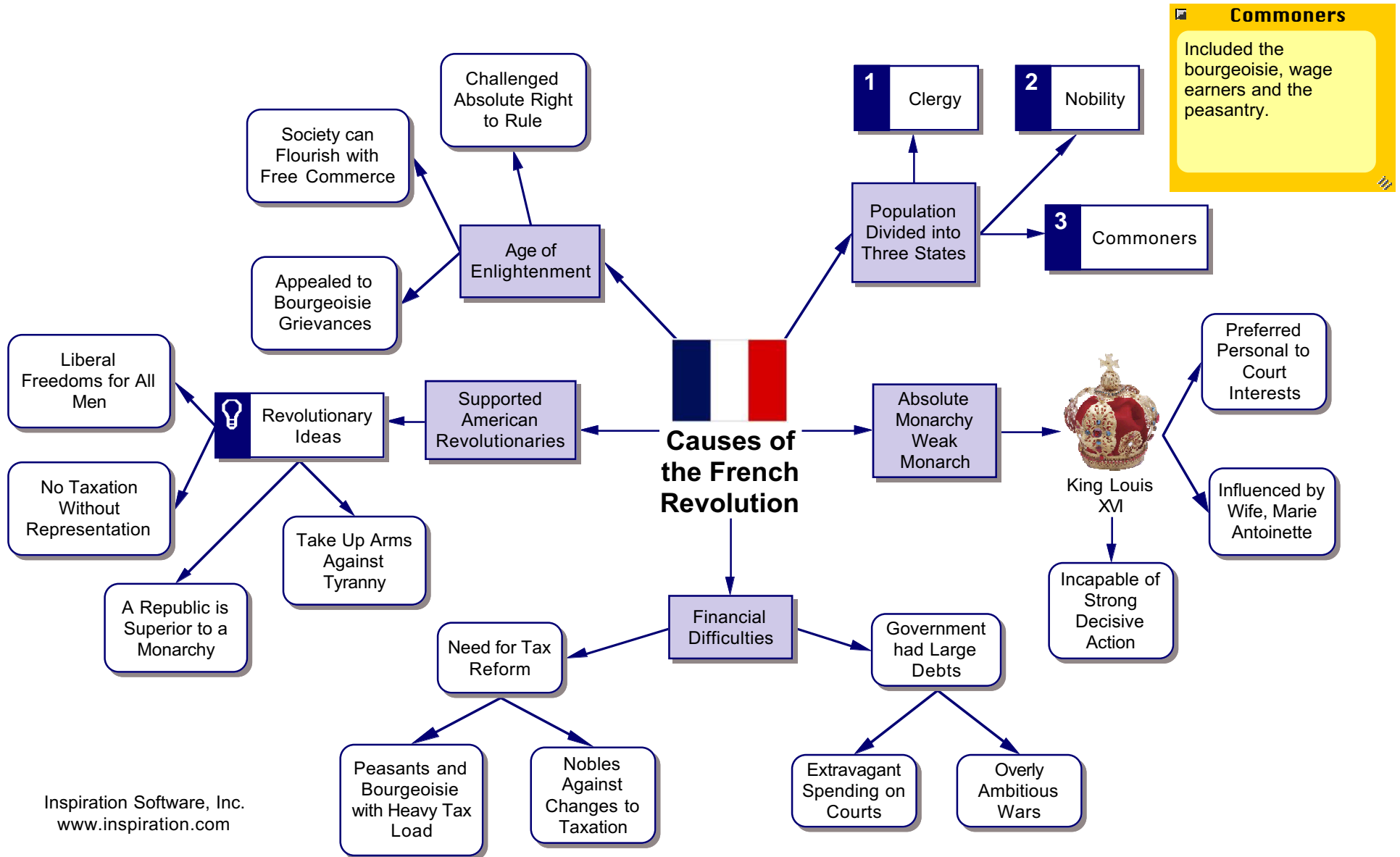
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Branches of U.S. Government





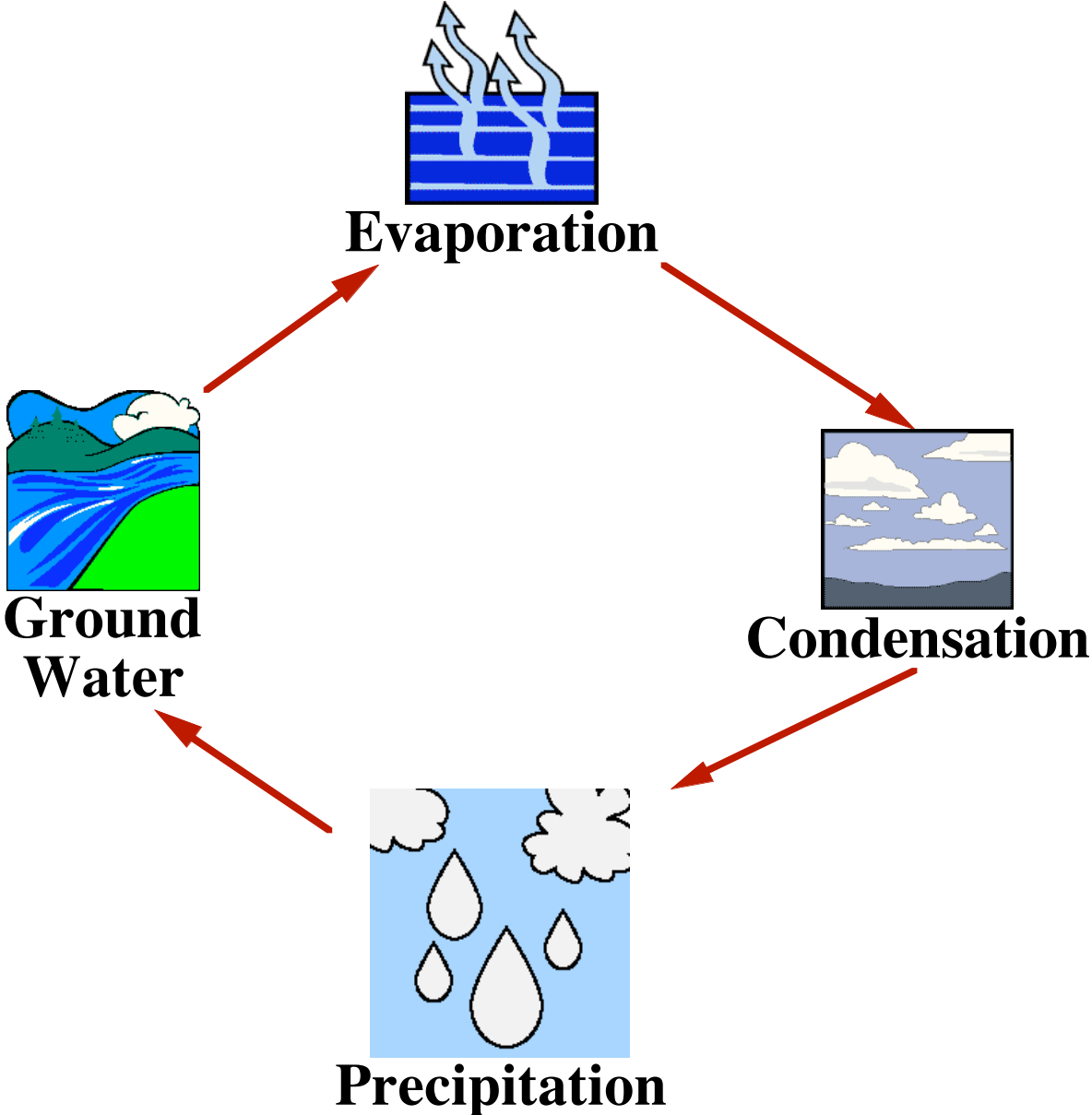


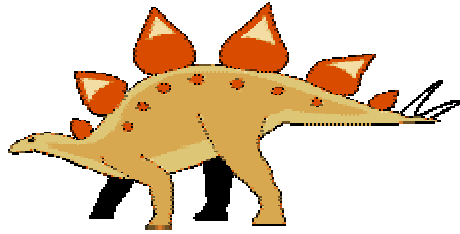
Science Examples

kidspiration™

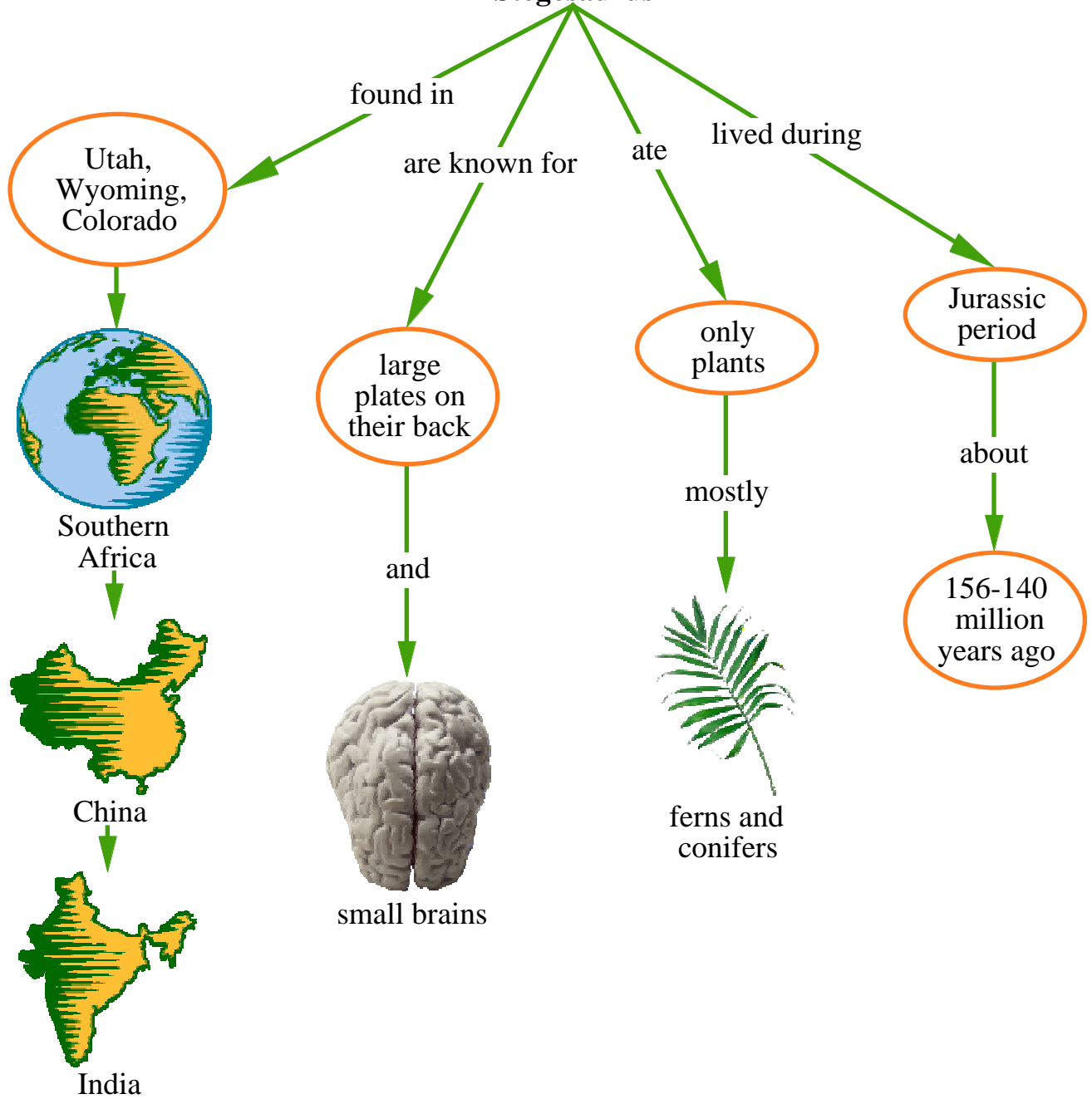


Bobby



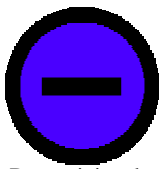


Stegosaurus



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Determining the Mass of an Electron (m_e)

J.J. Thomson
1856-1940

Cathode ray
experiment

Won the Nobel
Prize in Physics
in 1906

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

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

$$e/m = E/B^2r$$

E, B, and r are
known
quantities

$$e/m = 1.76 \times 10^{11} \text{ C/kg}$$

Conclusion: the
negative particles
were common to
all kinds of atoms

$$m_e = 9.1 \times 10^{-31} \text{ kg}$$

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

Measured mass
of droplet in
absence of
electric field

Each carried an
electric charge

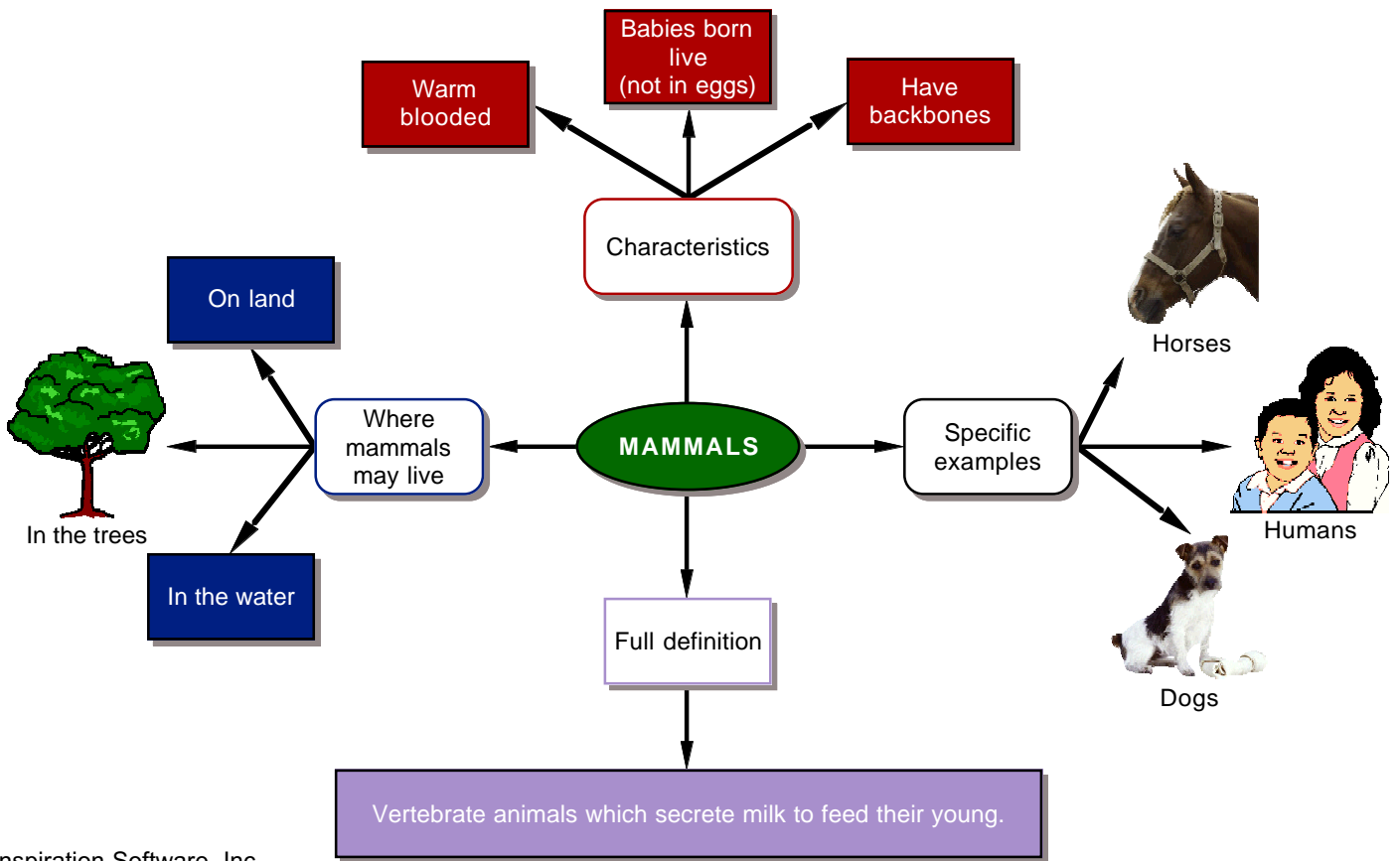
Oil droplets
became
suspended
between the two
plates

$$e = 1.6 \times 10^{-19} \text{ C}$$

$$qE = mg$$

$$q = mg/E$$

m, g, and E are
known
quantities



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SOUND

was first broken by

General Chuck Yeager

in a



named

"Glamorous Glennis"

after

Yeager's wife

Bell X-1

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



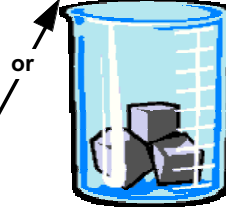
Gases

such as

air

whose

speed



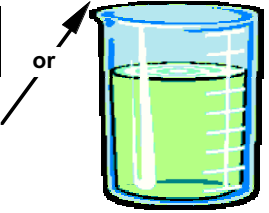
Solids

such as

steel

which travels

5000 m/s



Liquids

such as

water

which travels

1482 m/s @ 20° C

density

and

temperature

which vary with

altitude

which is a function of

frequencies

of

20-20,000 Hz

the range of

human hearing

15-50,000 Hz

the range of

canine hearing

1000-150,000 Hz

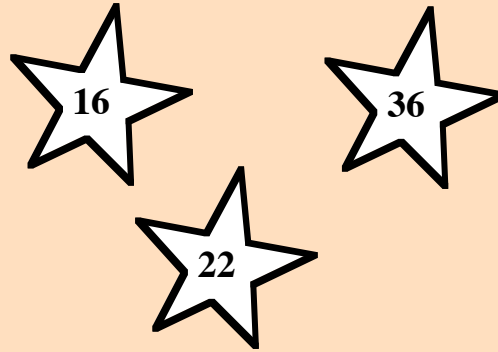
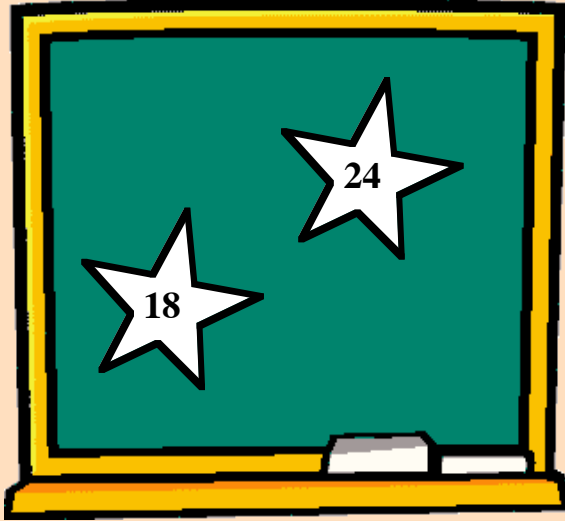
the range of

bat hearing

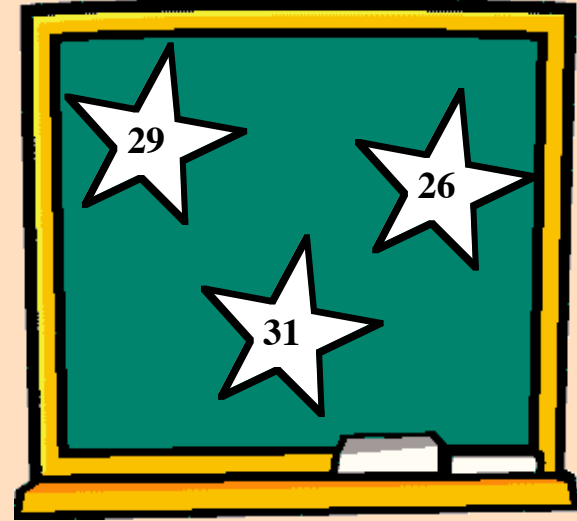
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Math Examples

20

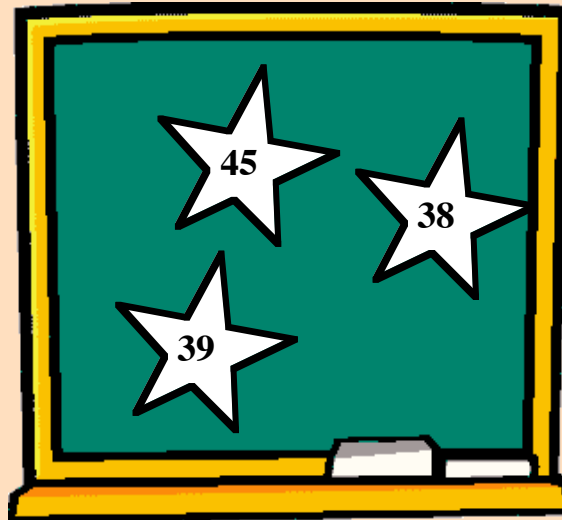


30



Round these
numbers to the
nearest 10!

40



Math Puzzles

$$\square - 6 = 7$$

A number minus 6 equals 7

1 The number has to be 6 bigger than 7

2 So if I add 6 to 7 I should get the number

$$7 + 6 = 13$$

The Missing Number =

13

$$4 \times \square = 16$$

4 times a number equals 16

1 The number has to be 16 when I add it to itself 4 times

2 I tried 6 and that was too big, so I tried 3 and that was too small

3 I tried 5 and got 20

The Missing Number =

4

$$\square \div 4 = 8$$

A number divided by 4 equals 8

1 The number has to be bigger than eight

2 I think it has to be four times bigger than eight

3 If I add eight to itself 4 times I get the number

The Missing Number =

32

Colorado Model Mathematics Standards Task Force

Fran Berry	Principal Investigator	CONNECT Colorado's Statewide Systemic Initiative
Glenn Bruckhart	Mathematics Teacher	Arapahoe High School Littleton Public Schools
Annette Cooper	Associate Professor of Mathematics	Fort Lewis College
Ceri Dean	Mathematics/Science Associate	Eisenhower High Plains Consortium for Math and Science
Christine Delaney-Haynes	Mathematics/Science Teacher	Telluride Middle School Telluride Public Schools
Rosanne Fulton	Curriculum Specialist	Boulder Valley Schools
Janet Iona	Mathematics Curriculum Specialist	Adams Twelve Five Star Schools
Bill Juraschek	Associate Professor of Mathematics and Education	University of Colorado at Denver
Jean Klanica	Mathematics Educator	Eaglecrest High School Cherry Creek School District 5
Marge Lindskog	Elementary Teacher and Standards Council Member	Pueblo School District 60
Gale Nash	Professor of Mathematics	Western State College
Matty Pollard-Cole	Mathematics Senior Consultant	School Effectiveness Unit Colorado Department of Education
Lew Romagnano	Assistant Professor of Mathematical Sciences	Metropolitan State College of Denver
Sherri Stephens-Carter	Mathematics Teacher-On-Special-Assignment	St. Vrain Valley School District
Mary Thurman	Executive Director and District Mathematics Coordinator	Academy School District 20
Diane Weaver	Mathematics Teacher	Morey Middle School Denver Public Schools
Art Wilson, Ed.D.	Mathematics Teacher	Abraham Lincoln High School Denver Public Schools