



Correlations to Colorado State and National Education Standards

Tracking the Source of Disease: Koch's Postulates, Causality, and Contemporary Epidemiology

This classroom activity addresses in part or in whole the following identified sections taken from Colorado State and National Science Education Standards.

Colorado State Standard 1. Students understand the processes of scientific investigation and design, conduct, communicate about, and evaluate such investigations.

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

- creating and defending a written plan of action for a scientific investigation;
- 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;

Colorado State 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.

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.

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

- explaining how adaptations of an organism determine its niche (role) in the environment.

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.

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

- comparing and contrasting characteristics of and treatments for various types of medical problems.

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

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

- explaining why variation within a population improves the chances that the species will survive under new environmental conditions.

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

- explaining the role of exposure to certain factors that may increase the rate of mutation, and therefore the incidence of cancer and other diseases.

Colorado State Standard 5. Students know and understand interrelationships among science, technology, and human activity and how they can affect the world.

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

- demonstrating the interrelationships between science and technology; 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

- exploring the scientific and technological aspects of contemporary problems.

Colorado State Standard 6. Students understand that science involves a particular way of knowing and understand common connections among scientific disciplines.

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

- using graphs, equations, or other models to analyze systems involving change and constancy;
- identifying and predicting cause-effect relationships within a system;
- identifying and describing the dynamics of natural systems;
- identifying and testing a model to analyze systems involving change and constancy.

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

- tracing the development of an invention, theory, or discovery to demonstrate the dynamic nature of science.

NATIONAL CONTENT STANDARD A: As a result of activities in grades 9-12, all students should develop

- **Abilities necessary to do scientific inquiry**
 - Scientists usually inquire about how physical, living, or designed systems function. Conceptual principles and knowledge guide scientific inquiries.

Historical and current scientific knowledge influence the design and interpretation of investigations and the evaluation of proposed explanations made by other scientists.

- Scientists conduct investigations for a wide variety of reasons. For example, they may wish to discover new aspects of the natural world, explain recently observed phenomena, or test the conclusions of prior investigations or the predictions of current theories.
- **Understandings about scientific inquiry**
 - Mathematics is essential in scientific inquiry. Mathematical tools and models guide and improve the posing of questions, gathering data, constructing explanations and communicating results.
 - Scientific explanations must adhere to criteria such as: a proposed explanation must be logically consistent; it must abide by the rules of evidence; it must be open to questions and possible modification; and it must be based on historical and current scientific knowledge.

NATIONAL CONTENT STANDARD E: As a result of activities in grades 9-12, all students should develop

- **Abilities of technological design**
 - Students should demonstrate thoughtful planning for a piece of technology or technique. Students should be introduced to the roles of models and simulations in these processes.
 - Students should present their results to students, teachers, and others in a variety of ways, such as orally, in writing, and in other forms--including models, diagrams, and demonstrations.
- **Understandings about science and technology**
 - Scientists in different disciplines ask different questions, use different methods of investigation, and accept different types of evidence to support their explanations. Many scientific investigations require the contributions of individuals from different disciplines, including engineering. New disciplines of science, such as geophysics and biochemistry often emerge at the interface of two older disciplines.

- Science often advances with the introduction of new technologies. Solving technological problems often results in new scientific knowledge. New technologies often extend the current levels of scientific understanding and introduce new areas of research.
- Creativity, imagination, and a good knowledge base are all required in the work of science and engineering.
- Science and technology are pursued for different purposes. Scientific inquiry is driven by the desire to understand the natural world, and technological design is driven by the need to meet human needs and solve human problems. Technology, by its nature, has a more direct effect on society than science because its purpose is to solve human problems, help humans adapt, and fulfill human aspirations.

NATIONAL CONTENT STANDARD F: As a result of activities in grades 9-12, all students should develop understanding of

- **Personal and community health**
 - The severity of disease symptoms is dependent on many factors, such as human resistance and the virulence of the disease-producing organism. Many diseases can be prevented, controlled, or cured. Some diseases, such as cancer, result from specific body dysfunctions and cannot be transmitted.
- **Science and technology in local, national, and global challenges**
 - Science and technology are essential social enterprises, but alone they can only indicate what can happen, not what should happen. The latter involves human decisions about the use of knowledge.

NATIONAL CONTENT STANDARD G: As a result of activities in grades 9-12, all students should develop understanding of

- **Science as a human endeavor**
 - Individuals and teams have contributed and will continue to contribute to the scientific enterprise. Doing science or engineering can be as simple as an individual conducting field studies or as complex as hundreds of people working on a major scientific question or technological problem. Pursuing

science as a career or as a hobby can be both fascinating and intellectually rewarding.

- **Nature of scientific knowledge**

- Science distinguishes itself from other ways of knowing and from other bodies of knowledge through the use of empirical standards, logical arguments, and skepticism, as scientists strive for the best possible explanations about the natural world.
- Scientific explanations must meet certain criteria. First and foremost, they must be consistent with experimental and observational evidence about nature, and must make accurate predictions, when appropriate, about systems being studied. They should also be logical, respect the rules of evidence, be open to criticism, report methods and procedures, and make knowledge public.
- Because all scientific ideas depend on experimental and observational confirmation, all scientific knowledge is, in principle, subject to change as new evidence becomes available. In areas where data or understanding are incomplete, new data may well lead to changes in current ideas or resolve current conflicts. In situations where information is still fragmentary, it is normal for scientific ideas to be incomplete, but this is also where the opportunity for making advances may be greatest.

- **Historical perspectives**

- In history, diverse cultures have contributed scientific knowledge and technologic inventions. Modern science began to evolve rapidly in Europe several hundred years ago. During the past two centuries, it has contributed significantly to the industrialization of Western and non-Western cultures. However, other, non-European cultures have developed scientific ideas and solved human problems through technology.
- Usually, changes in science occur as small modifications in extant knowledge. The daily work of science and engineering results in incremental advances in our understanding of the world and our ability to meet human needs and aspirations. Much can be learned about the internal workings of science and the nature of science from study of individual scientists, their daily work, and their efforts to advance scientific knowledge in their area of study.

- Occasionally, there are advances in science and technology that have important and long-lasting effects on science and society. Examples of such advances include the following

Germ theory

Molecular biology

Medical and health technology

- The historical perspective of scientific explanations demonstrates how scientific knowledge changes by evolving over time, almost always building on earlier knowledge.