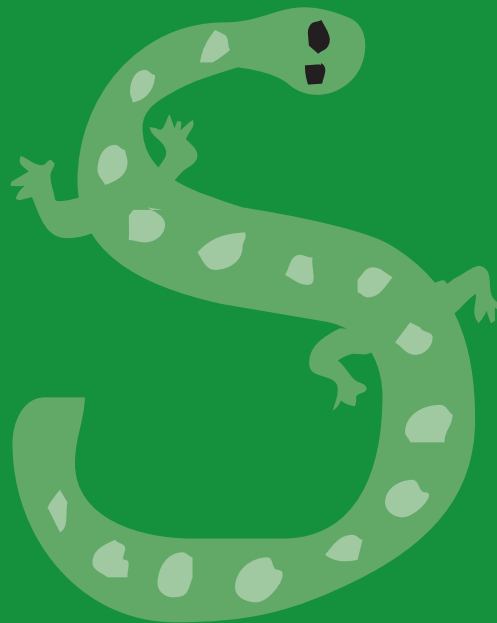


Life Science

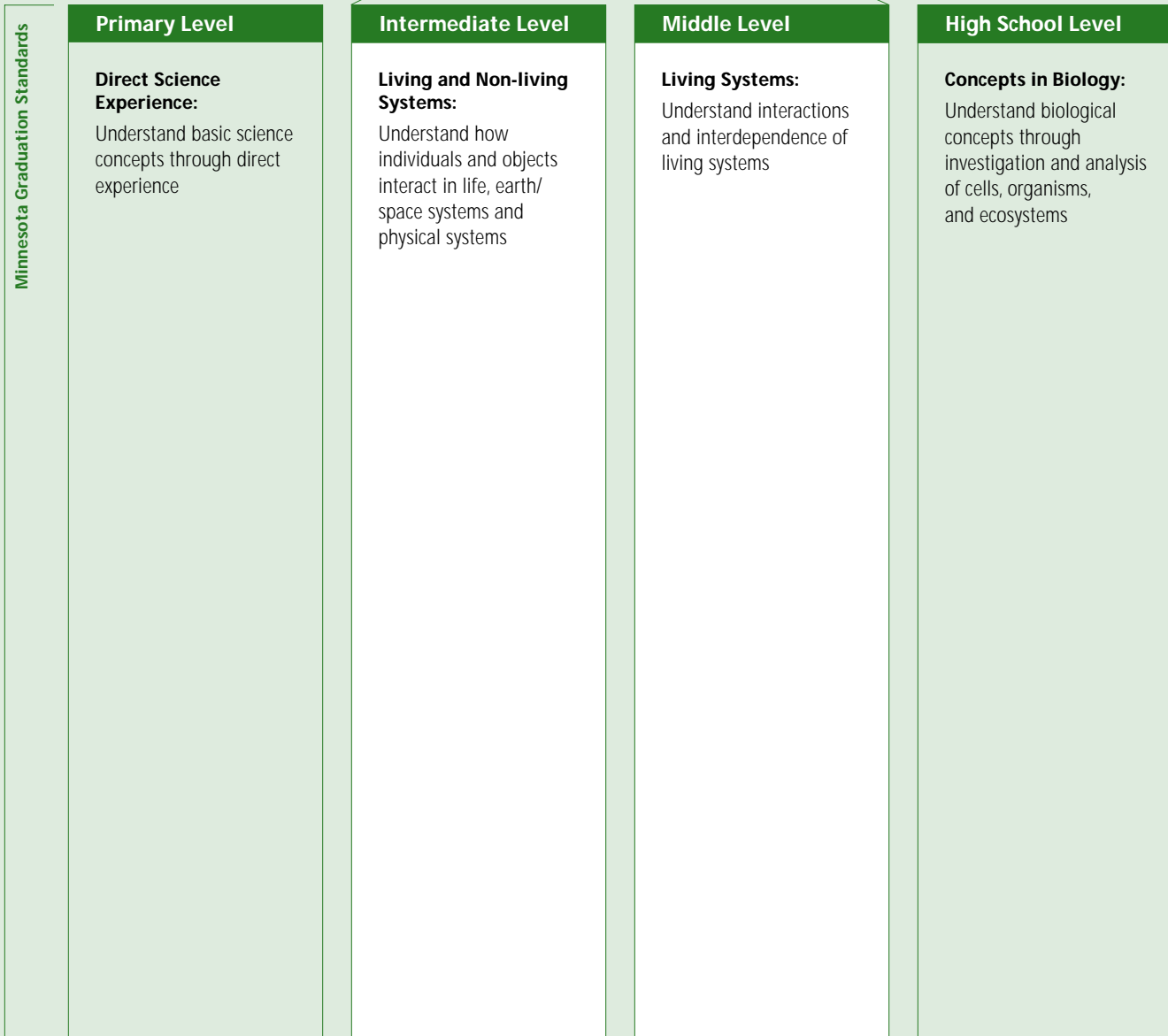
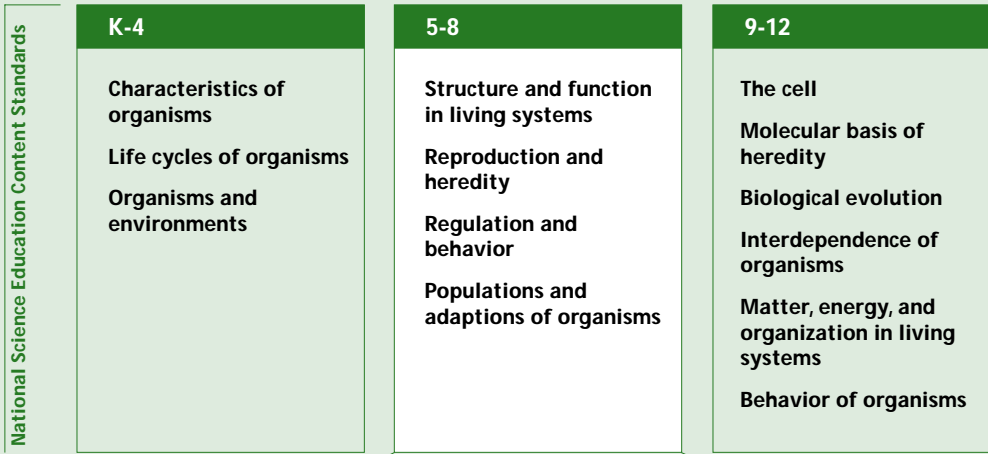
Content Standard C:

As a result of their activities in grades 5-8, all students should develop understanding of

- Structure and function in living systems
- Reproduction and heredity
- Regulation and behavior
- Populations and ecosystems
- Diversity and adaptations of organisms



Content Summary



Focus K-12

Grade	Early	Late
K-4	The focus of instruction for all students early in this grade range is on building understandings of biological concepts through direct experiences with living things, their life cycles, and their habitats.	The focus of instruction later in this grade range is on providing opportunities for all students to investigate how organisms live in their environments and developing a basic understanding of interdependence.
5-8	The focus of instruction for all students early in this grade range is on developing a basic understanding of the organization of living systems and an awareness of the diversity and interdependence among organisms.	The focus of instruction for all students later in this grade range is on developing an understanding of human biology, recognizing patterns in ecosystems and basic understandings about the cellular dimensions of living systems.
9-12	The focus of instruction in life science for all students at the high school level is on developing an understanding of cell structure and function, the relationship of matter and energy in biological systems, heredity, biological evolution, the behavior and interdependence of organisms and apply their understandings in a variety of situations.	The focus of instruction for students pursuing further study in life science is on providing opportunities to explore and expand their understandings of molecular genetics, biological evolution and interactions, the structure and function of living systems, natural ecosystems and apply their understandings in a variety of situations.

Close-up 5-8

The focus of instruction for all students early in this grade range is on developing a basic understanding of the organization of living systems and an awareness of the diversity and interdependence among organisms.

Building on their basic understanding of the way individual species live in their environment, students begin to investigate the ways populations and communities of species interact with each other and with their environment. Teachers facilitate systematic exploration of a wide variety of organisms through which students learn that animals and plants have a variety of interdependent functions in ecosystems. Through their investigations, they discover that plants and animals respond to environmental changes such as weather, day length, and precipitation. They learn that other species are similar in the way they grow and maintain life. Students explore the organization of living things at the level of organs and systems. By drawing and interpreting their observations, they become familiar with relationships between structure and function. Students and teachers observe established science safety procedures.

The focus of instruction for all students later in this grade range is on developing an understanding of human biology, recognizing patterns in ecosystems and basic understandings about the cellular dimensions of living systems.

Students have many experiences in a variety of sites, from school yards to environmental learning centers, to learn how ecosystems work. These studies also include inquiry investigations of model communities and ecosystems in which environmental conditions are controlled. Through such work, students begin to understand roles and relationships within ecosystems. The interaction of humans with their environment and the effects of these interactions is also explored. Students expand their investigations of living systems as they begin to study cells. Through the use of light microscopes they observe the structure of single-cell organisms and the cellular nature of all living things. Student investigations of the organization of living systems helps them to expand their understanding of structure and function. The study of reproduction includes the mechanisms of sexual and asexual reproduction and the idea of genes. Young adolescents are particularly interested in human biology, including the study of human organ systems, inherited traits, diseases, and behaviors. Students and teachers observe established science safety procedures.

On Location 5-8

In middle school life science, students study structure and function in living systems, reproduction and heredity, regulation and behavior, diversity and adaptation of organisms, and populations and ecosystems. This unit explores aspects of several of the standards. Most of all, it is intended as a motivator, as students will get caught up in the unit and will want to know more about insects. Notice that the teacher uses a hands-on approach, and expects students to do much of the work with a minimum of direction.

When students arrive in the fall, the students in Ms. C's class each receive a small butterfly egg (monarch in this case, but life science catalogs offer several types that can be reared in a typical elementary or secondary classroom). The class discusses the project which will involve caring for the larvae, pupae, and the adult butterflies over the next month. They research appropriate environments in which to raise the butterflies through each stage of development and talk about their responsibilities for providing proper care. Then students make daily observations of the metamorphosis of the butterflies through a series of growth periods from larva to pupa, and finally, an adult.

Once the adult butterflies (monarchs) hatch, students learn to hold them, feed them, and then tag them. By tagging and releasing the butterflies, students become part of a nationwide monarch migration study. Students release their butterflies and wait excitedly for information from central Mexico where monarchs transmigrate over winter, to see if one of their tagged butterflies is found. The record of recaptured butterflies along the migratory route and in Mexico helps scientists learn more about the migration of monarch butterflies.

Student teams divide their work into separate tasks for each student in the group. They visit the library to find out more about their butterflies: where they migrate over winter, the necessary climate for winter survival, the economic value of monarchs, and life cycles of other insects such as grasshoppers, cicadas, bees and mealworms. As the students collect general information about insects, the students attempt to rear some of the insects they studied from adult to egg to adult. Each student team compiles a complete log of what they have done, including information, diagrams, recipes for feeding, optimal conditions for growing, and life cycles. Their information is then presented to their classmates and at parents' night.

National Science Education Content Standards

5-8 Content Standard C

Structure and Function in Living Systems

- Living systems at all levels of organization demonstrate the complementary nature of structure and function. Important levels of organization for structure and function include cells, organs, tissues, organ systems, whole organisms, and ecosystems.
- All organisms are composed of cells—the fundamental unit of life. Most organisms are single cells; other organisms, including humans, are multicellular.
- Cells carry on the many functions needed to sustain life. They grow and divide, thereby producing more cells. This requires that they take in nutrients, which they use to provide energy for the work that cells do and to make the materials that a cell or an organism needs.
- Specialized cells perform specialized functions in multicellular organisms. Groups of specialized cells cooperate to form a tissue, such as a muscle. Different tissues are in turn grouped together to form larger functional units, called organs. Each type of cell, tissue, and organ has a distinct structure and set of functions that serve the organism as a whole.
- The human organism has systems for digestion, respiration, reproduction, circulation, excretion, movement, control, and coordination, and for protection from disease. These systems interact with one another.
- Disease is a breakdown in structures or functions of an organism. Some diseases are the result of intrinsic failures of the system. Others are the result of damage by infection by other organisms.

Reproduction and Heredity

- Reproduction is a characteristic of all living systems; because no individual organism lives forever, reproduction is essential to the continuation of every species. Some organisms reproduce asexually. Other organisms reproduce sexually.
- In many species, including humans, females produce eggs and males produce sperm. Plants also reproduce sexually—the egg and sperm are produced in the flowers of flowering plants. An egg and sperm unite to begin development of a new individual. That new individual receives genetic information from its mother (via the egg) and its father (via the sperm). Sexually produced offspring never are identical to either of their parents.
- Every organism requires a set of instructions for specifying its traits. Heredity is the passage of these instructions from one generation to another.
- Hereditary information is contained in genes, located in the chromosomes of each cell. Each gene carries a single unit of information. An inherited trait of an individual can be determined by one or by many genes, and a single gene can influence more than one trait. A human cell contains many thousands of different genes.
- The characteristics of an organism can be described in terms of a combination of traits. Some traits are inherited and others result from interactions with the environment.

National Science Education Content Standards

5-8 Content Standard C (continued)

Regulation and Behavior

- All organisms must be able to obtain and use resources, grow, reproduce, and maintain stable internal conditions while living in a constantly changing external environment.
- Regulation of an organism's internal environment involves sensing the internal environment and changing physiological activities to keep conditions within the range required to survive.
- Behavior is one kind of response an organism can make to an internal or environmental stimulus. A behavioral response requires coordination and communication at many levels, including cells, organ systems, and whole organisms. Behavioral response is a set of actions determined in part by heredity and in part from experience.
- An organism's behavior evolves through adaptation to its environment. How a species moves, obtains food, reproduces, and responds to danger are based in the species' evolutionary history.

Populations and Ecosystems

- A population consists of all individuals of a species that occur together at a given place and time. All populations living together and the physical factors with which they interact compose an ecosystem.
- Populations of organisms can be categorized by the function they serve in an ecosystem. Plants and some micro-organisms are producers—they make their own food. All animals, including humans, are consumers, which obtain food by eating other organisms. Decomposers, primarily bacteria and fungi, are consumers that use waste materials and dead organisms for food. Food webs identify the relationships among producers, consumers, and decomposers in an ecosystem.
- For ecosystems, the major source of energy is sunlight. Energy entering ecosystems as sunlight is transferred by producers into chemical energy through photosynthesis. That energy then passes from organism to organism in food webs.
- The number of organisms an ecosystem can support depends on the resources available and abiotic factors, such as quantity of light and water, range of temperatures, and soil composition. Given adequate biotic and abiotic resources and no disease or predators, populations (including humans) increase at rapid rates. Lack of resources and other factors, such as predation and climate, limit the growth of populations in specific niches in the ecosystem.

Diversity and Adaptations of Organisms

- Millions of species of animals, plants, and micro-organisms are alive today. Although different species might look dissimilar, the unity among organisms becomes apparent from an analysis of internal structures, the similarity of their chemical processes, and the evidence of common ancestry.
- Biological evolution accounts for the diversity of species developed through gradual processes over many generations. Species acquire many of their unique characteristics through biological adaptation, which involves the selection of naturally occurring variations in populations. Biological adaptations include changes in structures, behaviors, or physiology that enhance survival and reproductive success in a particular environment.
- Extinction of a species occurs when the environment changes and the adaptive characteristics of a species are insufficient to allow its survival. Fossils indicate that many organisms that lived long ago are extinct. Extinction of species is common; most of the species that have lived on the earth no longer exist.

Minnesota Graduation Standards

Intermediate Level

**Living and
Non-Living
Systems:**

Understand how individuals and objects interact in life, earth/space systems, and physical systems.

What students should know:

1. Understand characteristics of organisms:
 - a. plants
 - b. animals
 - c. micro-organisms
2. Understand basic structures and functions of the human body
3. Understand cycles and patterns in:
 - a. living organisms
 - b. earth systems
 - c. physical systems
4. Understand how human behavior and technology impact the environment
5. Understand characteristics of the physical world (e.g., land forms, solar system, electro-magnetism, chemical reactions)

What students should do:

1. Measure and classify objects, organisms and materials on the basis of their properties and relationships
2. Make systematic observations of objects, events and/or phenomena:
 - a. record data
 - b. predict change
3. Create a model to illustrate a concept, law, theory or principle
4. Identify personal behaviors and use of materials which have a positive impact on the environment

In Addition:

1. Performance packages should include tasks which address earth, life and physical science.
2. Whenever possible this standard should be combined with the Inquiry standard.
3. Tasks should be related to students' environment.
4. Students must demonstrate basic safety procedures and skills when using tools and equipment.

Minnesota Graduation Standards

Middle Level

Living Systems:

Understand interactions and interdependence of living systems.

What students should know:

1. Understand the human body:
 - a. heredity and reproduction
 - b. regulation and behavior
2. Understand plants, animals and micro-organisms:
 - a. diversity and adaptation of organisms
 - b. populations and ecosystems
3. Understand the dynamic effect of humans interacting with the environment

What students should do:

1. Formulate questions to be answered based on systematic observation
2. Design and conduct investigations and field studies
3. Analyze data to support or refute hypotheses:
 - a. identify patterns in data
 - b. compare results to known scientific theories, current models and/or personal experience
 - c. consider multiple interpretations of data
4. Describe how a premise (e.g., medical procedure, invention, claim) is supported by scientific concepts, principles, theories or laws
5. Create a model to illustrate a contemporary or historical concept, principle, theory or law

In Addition:

1. Students should work with teacher guidance.
2. This standard should be paired with an Inquiry standard whenever appropriate.
3. When possible, students should be given opportunities to work in authentic settings.
4. Students must demonstrate basic safety procedures and skills when using tools and equipment.

