Chariho Regional School District - Science Curriculum
September, 2016

PLANT SCIENCE CURRICULUM

Unit 1: Taxonomy & The Plant Kingdom

OVERVIEW

Summary

Students will be introduced to the characteristics of all living things. They will review levels of organization within the plant kingdom. They will identify characteristics of the major divisions within the plant kingdom and break the divisions into class. Identification of common greenhouse plants will be introduced.

Content to Be Learned

- Distribution of agricultural plants worldwide.
- The value of plant products in providing for a variety of purposes.
- Characteristics of plants.
- Classification of plants.
- Introduction to structure of plants.

Practices

- Obtaining, evaluating, and communicating information regarding global plant distribution and importance.
- Analyzing and interpreting data to develop an explanation of the importance of plants worldwide.
- Constructing an explanation as to the importance of plants.

Crosscutting Concepts

- Structure and function.

Essential Questions

- How are commonly cultivated plants useful to humans based on their basic characteristics?
- How is binomial nomenclature useful in describing living things worldwide, despite language differences?

AFNR Content Standards

- PS.02. Performance Element: Apply principles of classification, plant anatomy, and plant physiology to plant production and management.
    - PS.02.01. Classify plants according to taxonomic systems.

Next Generation Science Standards

Students who demonstrate understanding can:

HS-LS1-2. **Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.** [Clarification Statement: Emphasis is on functions at the organism system level such as nutrient uptake, water delivery, and organism movement in response to neural stimuli. An example of an interacting system could be an artery depending on the proper function of elastic tissue and smooth muscle to regulate and deliver the proper amount of blood within the circulatory system.] [*Assessment Boundary: Assessment does not include interactions and functions at the molecular or chemical reaction level.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds. • Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.	**LS1.A: Structure and Function** • Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level.	**Systems and System Models** • Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales.

Connections to other DCIs in this grade-band: N/A

Articulation of DCIs across grade-bands:
MS.LS1.A

Common Core State Standards Connections:
ELA/Literacy -
SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. *(HS-LS1-2)*

* The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

The section entitled "Disciplinary Core Ideas" is reproduced verbatim from *A Framework for K-12 Science Education: Practices, Cross-Cutting Concepts, and Core Ideas*. Integrated and reprinted with permission from the National Academy of Sciences.

Unit 2: Structure & Anatomy of Cultivated Plants

OVERVIEW

Summary

Students will learn the common and scientific names of commonly cultivated greenhouse crops. Students will also learn the important industry terms to refer to plant species. Additionally, students will be able to describe the structure and function of plant structures unique to monocots and dicots and how they function in the lifecycle of a plant.

Content to Be Learned

- Life cycle of plants.
- Functions of plant structures.
- Grass plants reproduction - sexual and asexual.

Practices

- Constructing and explaining the importance of taxonomic names when referring to plants and organisms in general.
- Asking questions about the form and function of plant anatomical structures.
- Obtaining, evaluating, and communicating information on the lifecycle of plants and how it can be manipulated to best serve the purpose of the plant.
- Use a model to illustrate plant structures and their functions.

Crosscutting Concepts

- Structure and function.
- Energy and matter.

Essential Questions

- How is binomial nomenclature useful in describing living things world-wide, despite language differences?
- How can agricultural plant products have a large economic impact?

AFNR Standards

- PS.02. Performance Element: Apply principles of classification, plant anatomy, and plant physiology to plant production and management.
    - PS.02.02. Apply knowledge of plant anatomy and the functions of plant structures to activities associated with plant systems.
    - PS.02.03. Apply knowledge of plant physiology and energy conversion to plant systems.
- PS.03. Performance Element: Propagate, culture and harvest plants and plant products based on current industry standards.
    - PS.03.01. Demonstrate plant propagation techniques in plant system activities.

-LS1: From Molecules to Organisms: Structures and Processes.

-LS1.A: Structure and Function.

Next Generation Science Standards

HS-LS1-2 From Molecules to Organisms: Structures and Processes

Students who demonstrate understanding can:

HS-LS1-2. **Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.** [Clarification Statement: Emphasis is on functions at the organism system level such as nutrient uptake, water delivery, and organism movement in response to neural stimuli. An example of an interacting system could be an artery depending on the proper function of elastic tissue and smooth muscle to regulate and deliver the proper amount of blood within the circulatory system.] [*Assessment Boundary: Assessment does not include interactions and functions at the molecular or chemical reaction level.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Developing and Using Models
Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.
- Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.

Disciplinary Core Ideas

LS1.A: Structure and Function
- Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level.

Crosscutting Concepts

Systems and System Models
- Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales.

Connections to other DCIs in this grade-band: N/A

Articulation of DCIs across grade-bands:
MS.LS1.A

Common Core State Standards Connections:
ELA/Literacy -
SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. *(HS-LS1-2)*

* The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

Unit 3: Environmental Requirements and Biological Interactions of Plants

OVERVIEW

Summary

Cultivated plants rely on an environment that is controlled either in part or entirely by humans. In this unit, students will be able to describe the environmental requirements of cultivated plants: water, nutrients, light, and temperature. Specifically, they will be able to explain how water, nutrients, light and temperature affect plant growth. Additionally, students will learn the basics of integrated pest management as a means of adapting to biological interactions with other organisms.

Content to Be Learned

- The soil profile, soil characteristics and components such as texture and structure.
- Effective methods of soil modification.
- Basic principles of soil fertility.
- Soil pH and plant growth.
- Plant essential nutrients.
- The effects of light on plant growth.

- Temperature dependency of specific crops.
- Principles of Integrated Pest Management.

Practices

- Planning and carrying out an investigation to determine the quality of a variety of soils.
- Analyzing and interpreting soil quality data.
- Constructing an explanation describing how a lack of nutrients/poor pH affect plant health.
- Constructing an explanation based on evidence for how essential nutrients affect the health of cultivated plants.

Crosscutting Concepts

- Energy and matter.
- Cause and effect.

Essential Questions

- Why do growers need to control both biological and environmental conditions in a greenhouse?

AFNR Standards

- PS.01. Develop and implement a crop management plan for a given production goal that accounts for environmental factors.
    - PS.01.01. Determine the influence of environmental factors on plant growth.
    - PS.01.02. Prepare and manage growing media for use in plant systems.
    - PS.01.03. Develop and implement a fertilization plan for specific plants or crops.

  PS.02. Performance Element: Apply principles of classification, plant anatomy, and plant physiology to plant production and management.
    - PS.02.02. Apply knowledge of plant anatomy and the functions of plant structures to activities associated with plant systems.
    - PS.02.03. Apply knowledge of plant physiology and energy conversion to plant systems.

  PS.03. Performance Element: Propagate, culture and harvest plants and plant products based on current industry standards.
    - PS.03.03. Develop and implement a plan for integrated pest management for plant production.
    - PS.03.04. Apply principles and practices of sustainable agriculture to plant production.
    - PS.03.05. Harvest, handle and store crops according to current industry standards.

Next Generation Science Standards

Students who demonstrate understanding can:

HS-LS2-6. **Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.** [Clarification Statement: Examples of changes in ecosystem conditions could include modest biological or physical changes, such as moderate hunting or a seasonal flood; and extreme changes, such as volcanic eruption or sea level rise.]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Engaging in Argument from Evidence
Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science.

- Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments.

Connections to Nature of Science

Scientific Knowledge is Open to Revision in Light of New Evidence

- Scientific argumentation is a mode of logical discourse used to clarify the strength of relationships between ideas and evidence that may result in revision of an explanation.

Disciplinary Core Ideas

LS2.C: Ecosystem Dynamics, Functioning, and Resilience

- A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability.

Crosscutting Concepts

Stability and Change

- Much of science deals with constructing explanations of how things change and how they remain stable.

Connections to other DCIs in this grade-band:
HS.ESS2.E

Articulation of DCIs across grade-bands:
MS.LS2.A ; **MS.LS2.C** ; **MS.ESS2.E** ; **MS.ESS3.C**

Common Core State Standards Connections:

ELA/Literacy -

RST.9-10.8	Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem. (HS-LS2-6)
RST.11-12.1	Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS-LS2-6)
RST.11-12.7	Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. *(HS-LS2-6)*
RST.11-12.8	Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. (HS-LS2-6)

Mathematics -

MP.2	Reason abstractly and quantitatively. (HS-LS2-6)
HSS-ID.A.1	Represent data with plots on the real number line. *(HS-LS2-6)*
HSS-IC.A.1	Understand statistics as a process for making inferences about population parameters based on a random sample from that population. *(HS-LS2-6)*
HSS-IC.B.6	Evaluate reports based on data. (HS-LS2-6)

Unit 4: Greenhouse Management

OVERVIEW

Summary

Students will take previously learned theory of plant growth and put it into practice in the greenhouse laboratory. The focus will be on the economically important annual vegetable and herb crops. Practices will

include the cultivation of plants through sexual and asexual propagation. Marketing techniques will be explored, and the concept of risk and the management of risk in an agricultural business will be addressed.

Content to Be Learned

- A comprehensive greenhouse management program results in productive crops.
- Identification of important annual and vegetable species.
- Methods of controlling greenhouse pests and diseases.
- Diagnosis of injury caused by pests and diseases.
- Marketing of popular ornamental annuals, vegetables and herbs.
- Techniques to manage risk in a greenhouse growing operation.

Practices

- Engaging in arguments from evidence to determine the best course of action when treating diseases and pests.
- Analyzing and interpreting data and observation regarding signs of pest and disease damage.
- Analyzing and interpreting data and observation regarding risk in the business place.
- Obtaining, evaluating, and communicating information regarding signs of pest and disease damage and develop a best practice treatment plan.
- Participating in the marketing and sale of greenhouse crops.
- Participating in a simulation that exhibits risk and reward in an agricultural business.

Crosscutting Concepts

- Structure and function.
- Cause and effect.

Essential Question

- What are the best practices involved with growing and marketing greenhouse crops?

AFNR Standards

- PS.01. Performance Element: Develop and implement a crop management plan for a given production goal that accounts for environmental factors.
    - PS.01.01. Determine the influence of environmental factors on plant growth.
- PS.03. Performance Element: Propagate, culture and harvest plants and plant products based on current industry standards.
    - PS.03.02. Develop and implement a management plan for plant production.
- PS.04. Performance Element: Apply principles of design in plant systems to enhance an environment (e.g. floral, forest landscape, and farm).
        - PS.04.02. Create designs using plants.

Next Generation Science Standards

Students who demonstrate understanding can:

HS-LS2-6. **Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.** [Clarification Statement: Examples of changes in ecosystem conditions could include modest biological or physical changes, such as moderate hunting or a seasonal flood; and extreme changes, such as volcanic eruption or sea level rise.]

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Crosscutting Concepts

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Articulation of DCIs across grade-bands:
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RST.11-12.1	Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS-LS2-6)
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RST.11-12.8	Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. (HS-LS2-6)

Mathematics -

MP.2	Reason abstractly and quantitatively. (HS-LS2-6)
HSS-ID.A.1	Represent data with plots on the real number line. *(HS-LS2-6)*
HSS-IC.A.1	Understand statistics as a process for making inferences about population parameters based on a random sample from that population. *(HS-LS2-6)*
HSS-IC.B.6	Evaluate reports based on data. (HS-LS2-6)