

AQUAPONICS II CURRICULUM

Unit 1: Anatomy and Physiology of Aquatic Species

OVERVIEW

Summary

Students will examine the structure and function of the internal and external features of three categories of aquatic species: finfish, mollusks and crustaceans. This study will start at the cellular level and ultimately examine the body systems and their interrelationships. In particular, there will be an in-depth examination of the digestive and respiratory systems; their similarities and differences. Students will also make the connection between the anatomy of aquatic species and growth requirements.

Content to Be Learned

- Structure and function of internal and external structures of finfish, mollusks and crustaceans.
- The workings of aquatic body systems.
- The relationship between anatomy and growth requirements.

Practices

- Identifying and summarizing the properties, locations, functions and types of animal cells, tissues, organs and body systems.
- Comparing and contrasting animals cells, tissues, organs, body system types and functions among animal species.
- Dissecting a finfish, mollusk and crustacean.

Crosscutting Concepts

- Cause and effect.
- Stability and change.

Essential Questions

- What features of aquatic organisms allow for efficient production as a farm raised animal?

Agriculture, Food and Natural Resources (AFNR) Career Cluster Content Standards

- AS.O6. Performance Element: Classify, evaluate and select animals based on anatomical and physiological characteristics.
- AS.06.02. Performance Indicator: Apply principles of comparative anatomy and physiology to uses within various animal systems.
 - AS.06.02.01.a. Research and summarize characteristics of a typical animal cell and identify the organelles.
 - AS.06.02.01.b. Analyze the functions of each animal cell structure.

- AS.06.02.01.c. Correlate the functions of animal cell structures to animal growth, development, health and reproduction.
- AS.06.02.03.a. Identify and summarize the properties, locations, functions and types of animal cells, tissues, organs and body systems.
- AS.06.02.03.b. Compare and contrast animals cells, tissues, organs, body system types and functions among animal species.

Unit 2: Feeds, Feeding and Nutrition for Aquatic Species

OVERVIEW

Summary

After examining the anatomy and physiology of aquatic species, students will focus on the digestive system and the role it plays in efficient production of growth, health maintenance and reproduction of aquatic species. The role of proper nutrition and feeding of high quality appropriate feeds will be determined as a key component of commercial production.

Content to Be Learned

- The role of essential nutrients in a feed program.
- The purpose of ingredients used in aquatic feeds.
- Research and technology that can enhance and promote industry growth.

Practices

- Evaluating animal feeds.
- Determining optimal feeding programs for targeted animal production.

Crosscutting Concepts

- System and system models.
- Structure and function.

Essential Questions

- What is the optimal feeding program for any given cultured aquatic species?

AFNR Career Cluster Content Standards

- AS.03. Performance element: Design and provide proper animal nutrition to achieve desired outcomes for performance, development, reproduction and/or economic production.
- AS.03.01 Performance Indicator: Analyze the nutritional needs of animals.
 - AS.03.01.a. Identify and summarize essential nutrients required for animal health and analyze each nutrient's role in growth and performance.
 - AS.03.01.01.b. Differentiate between nutritional needs of animals in different growth stages and production systems.
 - AS.03.01.01.c. Assess nutritional needs for an individual animal based on its growth stage and production

system.

- AS.03.01.02.a. Differentiate between nutritional needs of animal species.
- AS.03.01.02.b. Correlate a species' nutritional needs to feedstuffs that could meet those needs.
- AS.03.01.02.b. Design and defend the use of a nutritional program by demonstrating the relationship between the nutrient requirements and the feedstuffs provided.
- AS.03.02. Performance Indicator: Analyze feed rations and assess if they meet the nutritional needs of animals.
 - AS.03.02.01.a. Compare and contrast common types of feedstuffs and the roles they play in the diets of animals.
 - AS.03.02.01.b. Select appropriate feedstuffs for animals based on a variety of factors.
 - AS.03.02.02.a. Examine the importance of a balanced ration for animals based on the animal's growth stage.
 - AS.03.02.03.a. Examine the purpose, impact and mode of action of feed additives and growth promotants
In animal production.
 - AS.03.02.03.b. Compare and contrast methods that utilize feed additives and growth promotants with production practices that do not.
 - AS.03.02.03.c. Make and defend decisions regarding whether to use feed additives and growth promotants after researching and considering scientific evidence, production system needs and goals, and input from industry professionals.
- AS.03.03. Performance Indicator: Utilize industry tools to make animal nutrition decisions.
 - AS.03.03.02.a. Examine and summarize the meaning of various components of feed labels and feeding directions.
 - AS.03.03.02.b. Analyze and apply information from a feed label and feeding directions to feed animals.
 - AS.03.03.02.c. Evaluate and summarize the potential impacts, positive and negative, of compliance and/or noncompliance with a feed label and feeding directions.
 - AS.03.03.03.a. Examine the use of technology to provide animal nutrition.
 - AS.03.03.03.b. Analyze technologies used to provide animal nutrition and summarize their potential benefits and consequences.

Unit 3: Aquatic Animal Care and Health

OVERVIEW

Summary

Students will determine effective methods for the health and welfare of cultured species. A program will be created to prevent disease, parasites, or other disorders for species found in the classroom culture tank. Students will research common health problems associated with commonly cultured commercial species.

Content to Be Learned

- Disorders and diseases of commonly cultured species.
- Elements necessary for ideal aquatic habitats.

Practices

- Developing a health management plan for classroom culture of aquatic species.
- Researching common diseases and disorders.

Crosscutting Concepts

- Cause and effect.
- Systems and system models.

Essential Questions

- What are requirements for the culture of healthy aquatic species?

AFNR Career Cluster Content Standards

- AS.07. Performance Element: Apply principles of effective animal health care.
- AS.07.01. Performance Indicator: Design programs to prevent animal diseases, parasites and other disorders and ensure animal welfare.
 - AS.07.01.a. Identify and summarize specific tools and technology used in animal health management.
 - AS.07.01.01.b. Describe and demonstrate the proper use and function of specific tools and technology related to animal health management.
 - AS.07.01.01. a. Explain methods of determining animal health and disorders.
 - AS.07.01.03.a. List and summarize the characteristics of wounds, common diseases, parasites and physiological disorders that affect animals.
 - AS.07.01.03.b. Identify and describe common illnesses and disorders of animals based on symptoms and problems caused by wounds, diseases, parasites and physiological disorders.
 - AS.07.01.04.a. Identify and summarize characteristics of causal agents and vectors of diseases and disorders in animals.
 - AS.07.01.04.b. Research and analyze data to evaluate preventive measures of diseases, parasites and disorders among animals.
- AS.08. Performance Element: Analyze environmental factors associated with animal production
- AS.08.02. Performance Indicator: Evaluate the effects of environmental conditions on animals and create plans to ensure favorable environments for animals.
 - AS.08.02.01. a. Research and summarize environmental conditions that impact animals.
 - AS.08.02.02.a. Identify and summarize methods for ensuring optimal environmental conditions for Animals.
 - AS.08.02.02.b. Implement and evaluate the effectiveness of methods to ensure optimal environmental conditions for animals.
 - AS.08.02.02.c. Devise and improve plans to establish favorable environmental conditions for animal growth and performance based on a variety of factors.

HS-LS1-2

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 *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.

HS-ETS1-1

Students who demonstrate understanding can:

- HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.**

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

Science and Engineering Practices

Asking Questions and Defining Problems

Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.

- Analyze complex real-world problems by specifying criteria and constraints for successful solutions.

Disciplinary Core Ideas

ETS1.A: Defining and Delimiting Engineering Problems

- Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them.
- Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities.

Crosscutting Concepts

----- Connections to Engineering, Technology, and Applications of Science

Influence of Science, Engineering, and Technology on Society and the Natural World

- New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology.

Unit 4: Genetics and Reproduction

OVERVIEW

Summary

As time has gone on, humans have improved animal management and production techniques. In this unit, students will be able to outline modern management techniques as they apply to genetics and reproduction. Students will research the parameters of reproduction in aquatic species. A focus will be on broodstock and hatcheries in commercial aquatic production. Students will take part in a simulation to examine different commercial breeding programs and the effects seen through successive generations. Research will include current reproductive technologies and their impact on the aquaculture industry.

Content to Be Learned

- Basic genetics as applied to aquatic organisms.
- Reproduction of aquatic species.
- The pros and cons of a variety of commercial breeding programs.
- Technological advances of aquatic genetics and reproduction.

Practices

- Examining genetic traits through successive generations.
- Engaging in a simulation that exhibits generational traits.
- Evaluating commercial breeding programs.
- Researching technology in aquatic reproductive technologies.

Crosscutting Concepts

- Cause and effect.
- Stability and change.

Essential Questions

- How can reproduction management be enhanced to allow for more efficient production of aquatic species?

Agriculture, Food and Natural Resource AFNR

- AS.04. Performance Element: Apply principles of animal reproduction to achieve desired outcomes for performance, development and/or economic production.
- AS.04.02. Performance Indicator: Apply scientific principles to select and care for breeding animals.
 - AS.04.02.01.a. Summarize genetic inheritance in animals.
 - AS.04.02.01.b. Compare and contrast the use of genetically superior animals in the production of animals and animal products.
 - AS.04.02.01.c. Select and evaluate a breeding system based on the principles of genetics.
 - AS.04.02.a. Identify and summarize inheritance and terms related to inheritance in animal breeding.

- AS.04.02.02.b. Demonstrate how to determine probability trait inheritance in animals.
- AS.04.02.02.c. Select and evaluate breeding animals and determine the probability of a given trait in their offspring.

Unit 5: Marketing Aquatic Products

OVERVIEW

Summary

Aquatic organisms are produced for a variety of purposes: food, recreation, feed and ornamental culture. Students will research the habits of consumers and marketing strategies that aquatic producers take to run a successful business. A focus will be on the assessment and classification of risk in the business place and strategies that can be used to manage or mitigate risk.

Content to Be Learned

- Explain and describe the process of marketing aquaculture products.
- Describe the processing of aquaculture products and the demand of such products.
- The challenges of marketing and selling aquatic products.
- Risk in the aquaculture industry.

Practices

- Researching current market trends.
- Analyzing and interpreting consumer data to identify future trends in the industry.
- Engaging in a simulation to show risk in an aquatic business.

Crosscutting Concepts

- Cause and effect.
- Stability and change.

Essential Questions

- Where are growth opportunities in the aquaculture industry?

Agriculture, Food and Natural Resource AFNR

- AS.06. Performance Element: Classify, evaluate and select animals based on anatomical and physiological characteristics.
- AS.06.01. Performance Indicator: Classify animals according to taxonomic classification systems and use.
 - Recommend different uses for an animal species based upon analysis of local market needs.
- ABS.01. Performance Element: Apply management planning principles in AFNR businesses.
- ABS.01.03. Performance Indicator: Devise and apply management skills to organize and run an AFNR business in an efficient, legal and ethical manner.
 - ABS.01.03.01.a. Define and provide examples of management skills used to organize an AFNR

business.

- ABS.01.03.01.b. Analyze the effectiveness of different management skills used in an AFNR business.
- ABS.04. Performance Element: Develop a business plan for an AFNR business.
- ABS.04.03. Performance Indicator: Identify and apply strategies to manage or mitigate risk.
 - ABS.04.03.01.a. Assess and classify sources of risk for an AFNR business.
 - ABS.04.03.02.b. Risk management strategies for AFNR businesses.
 - ABS.04.03.01.c. Determine methods to match risk management strategies to risk situations in an AFNR business.
 - ABS.04.03.02.a. Research and summarize examples that illustrate the importance of risk and uncertainty within AFNR businesses.
 - ABS.04.03.02.b. Analyze alternative approaches to reducing risk for AFNR businesses.