Aquaponics-Physical Science Grades 9-12
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Content Area: **Science**
Course(s): **Sample Course**
Time Period: **Sept-June**
Length: **2-5 weeks**
Status: **Published**

Unit Overview

- Many of the poor have health problems from not getting enough food, while many people in affluent countries suffer health problems from eating too much.
- More sustainable food production involves reducing overgrazing and overfishing, irrigating more efficiently, using integrated pest management, promoting agrobiodiversity, and providing government subsidies only for more sustainable agriculture, fishing, and aquaculture.
- The greatest obstacles to providing enough food for everyone are poverty, political upheaval, corruption, war, and the harmful environmental effects of food production
- We can improve food security by creating programs to reduce poverty and chronic malnutrition, relying more on locally grown food, and cutting waste.
- Future food production may be limited by soil erosion and degradation, desertification, water and air pollution, climate change from greenhouse gas emissions, and loss of biodiversity.
- We have used high-input industrialized agriculture and lower-input traditional methods to greatly increase supplies of food.
- Much of the complex behavior of the Earth system can be thought of as cycles involving physical, chemical and biological processes that transfer components among various storage locations over time.

Title Section

Department of Curriculum and Instruction

Belleville Public Schools

Curriculum Guide

Aquaponics Grades 9-12

Physical Science

Belleville Board of Education

102 Passaic Avenue

Belleville, NJ 07109

Prepared by: Joy Alfano, Ph.D

Dr. Richard Tomko, Ph.D., M.J., Superintendent of Schools

Ms. LucyAnn Demikoff, Director of Curriculum and Instruction K-12

Ms. Nicole Shanklin, Director of Elementary Education K-8

Mr. Joseph Lepo, Director of Secondary Education

Board Approved:

Enduring Understandings

- About 925 million people have health problems because they do not get enough to eat and 1.6 billion people face health problems from eating too much.
- Modern industrialized agriculture has a greater harmful impact on the environment than any other human activity.
- More sustainable forms of food production will greatly reduce the harmful environmental impacts of current systems while increasing food security and national security for all countries.
- More sustainable food production involves reducing overgrazing and overfishing, irrigating more efficiently, using integrated pest management, promoting agrobiodiversity, and providing government subsidies only for more sustainable agriculture, fishing, and aquaculture.
- We can sharply cut pesticide use without decreasing crop yields by using a mix of cultivation techniques, biological pest controls, and small amounts of selected chemical pesticides as a last resort (integrated pest management).
- Future food production may be limited by soil erosion and degradation, desertification, water and air pollution, climate change from greenhouse gas emissions, and loss of biodiversity.
- We have used high-input industrialized agriculture and lower-input traditional methods to greatly increase supplies of food.
- The greatest obstacles to providing enough food for everyone are poverty, political upheaval, corruption, war, and the harmful environmental effects of food production.

Essential Questions

- What is the affect of abotic factors in plant growth and biodiversity
- What affect does soil composition influence total production
- What is the affect of pH on agriculture and aquaculture

Exit Skills

- Use statistical analysis of data collected to make an argument based on purely scientific evidence
- Develop a vernacular of scientific terms and current environmental problems
- Data mine from scientific journals and articles evaluating their scientific methodology for validity
- Conduct scientific evidence gathering and analyze data
- Analyze a problem, developing hypothesis, and design a scientific experiment to test those hypothesis

New Jersey Student Learning Standards (NJSLS)

SCI.HS-ESS3-3	Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.
SCI.HS-ESS3-1	Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.
SCI.HS-ESS2-4	Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.
SCI.HS-ESS1-5	Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks.
SCI.HS-ESS2-1	Develop a model to illustrate how Earth’s internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.
SCI.HS-ETS1-4	Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

SCI.HS-ETS1-3	Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.
SCI.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.
SCI.HS-ETS1-2	Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
SCI.HS-LS1-5	Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.
SCI.HS-LS1-3	Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.

Interdisciplinary Connections

LA.RH.11-12.1	Accurately cite strong and thorough textual evidence, (e.g., via discussion, written response, etc.), to support analysis of primary and secondary sources, connecting insights gained from specific details to develop an understanding of the text as a whole.
MA.A-SSE.A.1a	Interpret parts of an expression, such as terms, factors, and coefficients.
LA.RH.11-12.2	Determine the theme, central ideas, information and/or perspective(s) presented in a primary or secondary source; provide an accurate summary of how key events, ideas and/or author's perspective(s) develop over the course of the text.
LA.RH.11-12.3	Evaluate various perspectives for actions or events; determine which explanation best accords with textual evidence, acknowledging where the text leaves matters uncertain.
LA.RST.11-12.1	Accurately cite strong and thorough evidence from the text to support analysis of science and technical texts, attending to precise details for explanations or descriptions.
LA.WHST.11-12.2.B	Develop the topic thoroughly by selecting the most significant and relevant facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.
LA.WHST.11-12.2.C	Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts.
LA.WHST.11-12.2.D	Use precise language, domain-specific vocabulary and techniques such as metaphor, simile, and analogy to manage the complexity of the topic; convey a knowledgeable stance in a style that responds to the discipline and context as well as to the expertise of likely readers.
LA.WHST.11-12.2.E	Provide a concluding paragraph or section that supports the argument presented.
MA.A-REI.C.5	Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions.
MA.A-REI.C.6	Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.

Learning Objectives

- Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.
- Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.
- Evaluate the role of oxygen on the uptake of root water and mineral nutrients.
- Review of photosynthesis and respiration.
- Draw connections between root to shoot ratios and nutrient requirements of plants.
- Analyze the role of transpiration and how to calculate a water transpiration budget and how much make-up water would need to be added to the fish tanks

Suggested Activities & Best Practices

Plan-

- Chapter Lesson Plans -
- Chapter Presentation -
- Bell Ringer - Fish Farms of the Future

Central Case Studies

- 3D GeoTour -
- Extension of Reading
- Local Case Study -

Labs and Activities

- Modeling Activity -
- Scientific Method Laboratory -
- Local Case Study
- 21 st Century Skills Online -

Activities

- Guided Reading -
- Graphing Activity -
- Mapping -
- Writing Activity -

Assessment

- Self Assessment
- Tests A and B
- Quizzes and Practice

Assessment Evidence - Checking for Understanding (CFU)

- Chapter Quizzes and Tests (Summative)
- Socratic Questioning (Formative)
- Lab Journal (Alternative)
- Common Department Benchmark (Benchmark)
- Oncourse Assessment Tools (Formative)
- Do Now and Exit Tickets (Formative)

- Admit Tickets
- Create a Multimedia Poster
- Define
- Evaluate
- Evaluation rubrics
- Exit Tickets
- Explaining
- Multimedia Reports
- Quizzes
- Self- assessments
- Surveys
- Teacher Observation Checklist
- Think, Pair, Share
- Think, Write, Pair, Share
- Web-Based Assessments

- Written Reports

Primary Resources & Materials

- Aquasource Aquaponics Curriculum

Ancillary Resources

- Teacher and Publisher supplied power points, notes, guides, labs, and worksheets
- Resource manuals
- Internet Resources
- Computer Activities

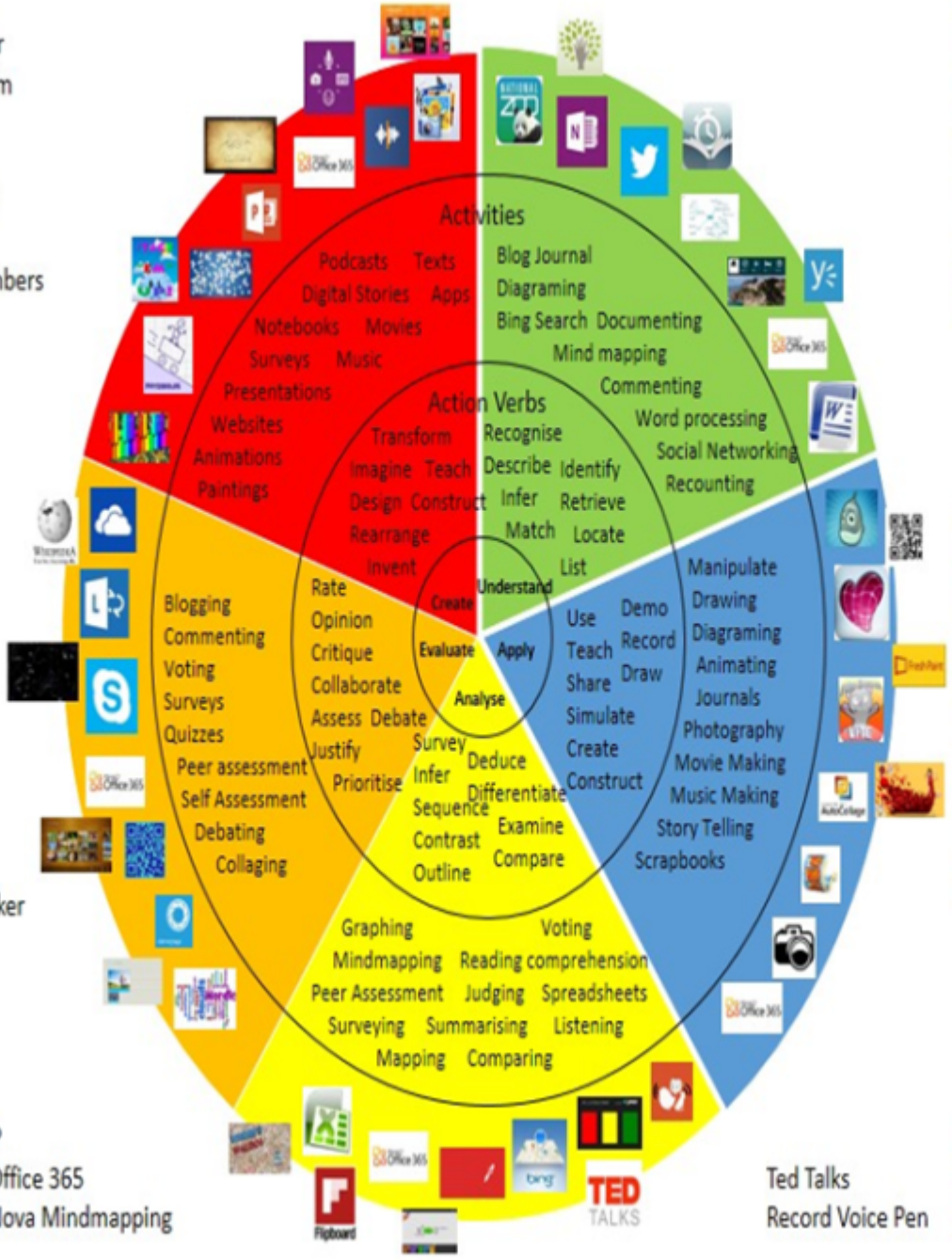
Technology Infusion

- Gizmos
- Near POD
- Google Classroom
- JamBoards

Win 8.1 Apps/Tools Pedagogy Wheel

Podcasts
Photostory 3
Kid Story Builder
Music Maker Jam
Paint A Story
Office 365
MS PowerPoint
Stack 'Em Up
NqSquared Numbers
Physamajig
Xylophone 8

Wikipedia
Skydrive
Lync
SkyMap
Skype
Office 365
Puzzle Touch
Easy QR
Memorylage
Life Moments
Word Cloud Maker



Where's Waldo?
MS Excel Office 365
Flipboard Nova Mindmapping

Ted Talks
Record Voice Pen

Originally taken from http://www.coetail.com/vzimmer/files/2013/02/iPadagogy-Wheel.001.jpg
And adapted for Windows 8.1 devices by Charlotte Beckhurst @CharBeckhurst

Alignment to 21st Century Skills & Technology

- English Language Arts;
- Mathematics;
- Science and Scientific Inquiry (Next Generation);
- Social Studies, including American History, World History, Geography, Government and Civics, and Economics;
- World languages;
- Technology;
- Visual and Performing Arts.

TECH.8.1.12.A.1	Create a personal digital portfolio which reflects personal and academic interests, achievements, and career aspirations by using a variety of digital tools and resources.
TECH.8.1.12.A.2	Produce and edit a multi-page digital document for a commercial or professional audience and present it to peers and/or professionals in that related area for review.
TECH.8.1.12.A.3	Collaborate in online courses, learning communities, social networks or virtual worlds to discuss a resolution to a problem or issue.
TECH.8.1.12.A.4	Construct a spreadsheet workbook with multiple worksheets, rename tabs to reflect the data on the worksheet, and use mathematical or logical functions, charts and data from all worksheets to convey the results.
TECH.8.1.12.A.5	Create a report from a relational database consisting of at least two tables and describe the process, and explain the report results.
TECH.8.1.12.B.CS2	Create original works as a means of personal or group expression.

21st Century Skills/Interdisciplinary Themes

- Communication and Collaboration
- Critical thinking and Problem Solving
- ICT (Information, Communications and Technology) Literacy
- Information Literacy
- Life and Career Skills
- Media Literacy

CAEP.9.2.12.C.1	Review career goals and determine steps necessary for attainment.
CAEP.9.2.12.C.2	Modify Personalized Student Learning Plans to support declared career goals.
CAEP.9.2.12.C.3	Identify transferable career skills and design alternate career plans.
CAEP.9.2.12.C.4	Analyze how economic conditions and societal changes influence employment trends and future education.

21st Century Skills

- Civic Literacy
- Environmental Literacy
- Financial, Economic, Business and Entrepreneurial Literacy
- Global Awareness
- Health Literacy

PFL.9.1.12.A.8	Analyze different forms of currency and how currency is used to exchange goods and services.
CAEP.9.2.12.C.5	Research career opportunities in the United States and abroad that require knowledge of world languages and diverse cultures.
CAEP.9.2.12.C.6	Investigate entrepreneurship opportunities as options for career planning and identify the knowledge, skills, abilities, and resources required for owning and managing a business.
CAEP.9.2.12.C.7	Examine the professional, legal, and ethical responsibilities for both employers and employees in the global workplace.
CAEP.9.2.12.C.8	Assess the impact of litigation and court decisions on employment laws and practices.
CAEP.9.2.12.C.9	Analyze the correlation between personal and financial behavior and employability.

Differentiation

- Small Group Instruction
- Study Guides
- Project Based Learning

Special Education Learning (IEP's & 504's)

- Quiz and Test Study Guides
- Graphic Organizers
- Powerpoints posted on google classroom

- printed copy of board work/notes provided
- additional time for skill mastery
- assistive technology
- behavior management plan
- Center-Based Instruction
- check work frequently for understanding

- computer or electronic device utilizes
- extended time on tests/ quizzes
- have student repeat directions to check for understanding
- highlighted text visual presentation
- modified assignment format
- modified test content
- modified test format
- modified test length
- multi-sensory presentation
- multiple test sessions
- preferential seating
- preview of content, concepts, and vocabulary
- Provide modifications as dictated in the student's IEP/504 plan
- reduced/shortened reading assignments
- Reduced/shortened written assignments
- secure attention before giving instruction/directions
- shortened assignments
- student working with an assigned partner
- teacher initiated weekly assignment sheet
- Use open book, study guides, test prototypes

English Language Learning (ELL)

- Peer to assist students
- Allow tests and quizzes to be taken in ESL room with extra time
- Students allowed to use electronic devices for translation
- Word Lists provided

- teaching key aspects of a topic. Eliminate nonessential information
- using videos, illustrations, pictures, and drawings to explain or clarif
- allowing products (projects, timelines, demonstrations, models, drawings, dioramas, poster boards, charts, graphs, slide shows, videos, etc.) to demonstrate student’s learning;
- allowing students to correct errors (looking for understanding)
- allowing the use of note cards or open-book during testing
- decreasing the amount of workpresented or required
- having peers take notes or providing a copy of the teacher’s notes

- modifying tests to reflect selected objectives
- providing study guides
- reducing or omitting lengthy outside reading assignments
- reducing the number of answer choices on a multiple choice test
- tutoring by peers
- using computer word processing spell check and grammar check features
- using true/false, matching, or fill in the blank tests in lieu of essay tests

At Risk

- Provide modified test
- Tutoring times offered
- Allow students to correct test for partial credit
- Extended time for assignments

- allowing students to correct errors (looking for understanding)
- teaching key aspects of a topic. Eliminate nonessential information
- allowing products (projects, timelines, demonstrations, models, drawings, dioramas, poster boards, charts, graphs, slide shows, videos, etc.) to demonstrate student's learning
- allowing students to select from given choices
- allowing the use of note cards or open-book during testing
- collaborating (general education teacher and specialist) to modify vocabulary, omit or modify items to reflect objectives for the student, eliminate sections of the test, and determine how the grade will be determined prior to giving the test.
- decreasing the amount of workpresented or required
- having peers take notes or providing a copy of the teacher's notes
- marking students' correct and acceptable work, not the mistakes
- modifying tests to reflect selected objectives
- providing study guides
- reducing or omitting lengthy outside reading assignments
- reducing the number of answer choices on a multiple choice test
- tutoring by peers
- using authentic assessments with real-life problem-solving
- using true/false, matching, or fill in the blank tests in lieu of essay tests
- using videos, illustrations, pictures, and drawings to explain or clarify

Talented and Gifted Learning (T&G)

- Provide enrichment articles and assignments
- Allow students to complete independent study assignments
- See addendum for Ted Talk
- See addendum for Independent Research Project

- Above grade level placement option for qualified students
- Advanced problem-solving
- Allow students to work at a faster pace
- Cluster grouping
- Complete activities aligned with above grade level text using Benchmark results
- Create a blog or social media page about their unit
- Create a plan to solve an issue presented in the class or in a text
- Debate issues with research to support arguments
- Flexible skill grouping within a class or across grade level for rigor
- Higher order, critical & creative thinking skills, and discovery
- Multi-disciplinary unit and/or project
- Teacher-selected instructional strategies that are focused to provide challenge, engagement, and growth opportunities
- Utilize exploratory connections to higher-grade concepts
- Utilize project-based learning for greater depth of knowledge

Sample Lesson

See Attached