# Fairfield Public Schools
# Science Curriculum

## Draft Units

### Authentic Science Research

# Authentic Science Research: Description

**Standards for this course are taken from the *Next Generation Science Standards* and are of three types:**

**Disciplinary Core Ideas (DCIs)**: Shown as content objectives, these standards define what students should know about the most essential ideas in the major science disciplines.  The focus is on a limited number of core ideas in science and engineering both within and across the disciplines to avoid the shallow coverage of a large number of topics and to allow more time for teachers and students to explore each idea in greater depth. Reduction of the sheer sum of details to be mastered is intended to give time for students to engage in scientific investigations and argumentation and to achieve depth of understanding of the core ideas presented.

**Science and Engineering Practices (SEP)**: These standards enable students to apply the content in the DCI’s and the skills of practicing scientists and engineers to explain phenomena and solve real world problems.  Engaging in the practices of science helps students understand how scientific knowledge develops; such direct involvement gives them an appreciation of the wide range of approaches that are used to investigate, model, and explain the world. Engaging in the practices of engineering likewise helps students understand the work of engineers, as well as the links between engineering and science.

**Crosscutting Concepts:** These standards provide students with connections and intellectual tools that are related across the differing areas of disciplinary content and can enrich their application of practices and their understanding of core ideas.  These broad concepts tie together the influence of engineering, technology, and science on society and the natural world.

http://www.nextgenscience.org/next-generation-science-standards

# CROSS CUTTING CONCEPTS

**Patterns**: Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.

**Cause and effect**: Mechanism and explanation. Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.

**Scale, proportion, and quantity**. In considering phenomena, it is critical to recognize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system's structure or performance.

**Systems and system models**. Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering.

**Energy and matter**: Flows, cycles, and conservation. Tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems' possibilities and limitations.

**Structure and function**. The way in which an object or living thing is shaped and its substructure determine many of its properties and functions.

**Stability and change**. For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.

# Authentic Science

| Course Essential Questions |
| --- |
| • How do scientists conduct research?<br>• How do scientists present their findings to others? |

DRAFT

# Course: Course-at-a Glance

| Unit | Title | | Unit Essential Questions |
|---|---|---|---|
| 1 | Asking Questions and Defining Problems | Analyze complex real-world problems by specifying criteria and constraints for successful solutions | What is a real-world problem?<br>How is the scientific method used?<br>What are the ways to define criteria for analysis?<br>How are solutions evaluated? |
| 2 | Identifying a real-world problem, becoming an expert and reaching out to the scientific community | Design and evaluate a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. | What am I interested in?<br>How do I identify resources related to my topic?<br>How do I decide on steps to implement problem solving? |
| 3 | Conducting research and presenting findings | Use mathematical models and/or computer simulations to predict the effects of a design solution on systems and/or the interactions between systems. | How do scientists conduct their research and analyze their findings?<br>How do scientists communicate their findings? |

DRAFT

# Unit 1 - Asking questions and defining problems

## Overview

In the first unit students will be introduced to the scientific method, data analysis and basic laboratory technique.

## Unit Content Objectives

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

## Unit Essential Questions

- What is a real-world problem?
- How is the scientific method used?
- What are the ways to define criteria for analysis?
- How are solutions evaluated?

## Crosscutting Concepts

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

## NGSS Unit Standards

**DISCIPLINARY CORE IDEAS (DCI):** Defining and Delineating Engineering Problems

**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. (HS-ETS1-1)
- 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. (HS-ETS1-1)

**SCIENCE AND ENGINEERING PRACTICES (SEP):**

**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. (HS-ETS1-1)

**Corresponding CT Core Standards:**

**ELA/Literacy – RST.11-12.7, RST.11-12.8, RST.11-12.9**

**Mathematics – MP.2, MP.4**

# Unit 2 - Identifying a real-world problem, becoming an expert and reaching out to the scientific community

## Overview

In this unit, students will identify a real-world problem that they are personally interested in. They will read all the available research on the topic, Students will design a research hypothesis and experimental design. They will reach out to scientists conducting research in this field with the goal to become personally involved in this research.

## Unit Content Objectives

- **Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. (HS-ETS1-2)**
- **Construction explanations and designing solutions in 9-12 builds on K-8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles and theories. (HS-ETS1-3)**

## Unit Essential Questions

- What am I interested in?
- How do I identify resources related to my topic?
- How do I decide on steps to implement problem solving?

## Crosscutting Concepts

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

## NGSS Unit Standards

## DISCIPLINARY CORE IDEAS (DCI): Optimizing the Design Solution, Developing Possible Solutions

**ETS1.B: Developing Possible Solutions**

- When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. (HS-ETS1-3)

**ETS1.C: Optimizing the Design Solution**

- **Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. (HS-ETS1-2)**

## SCIENCE AND ENGINEERING PRACTICES (SEP):

**Constructing Explanations and Designing Solutions**

Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles and theories.

- Design a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-ETS1-2)
- Evaluate a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-ETS1-3)

## Corresponding CT Core Standards:
## ELA/Literacy – RST.11-12.7, RST.11-12.8, RST.11-12.9

## Mathematics – MP.2, MP.4

# Unit 3 - Conducting research and presenting findings

## Overview

Students will conduct research on their topic. They will analyze results. Students will enter local, state and national science competitions and seek publication of their completed research.

## Unit Content Objectives

- **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. (HS-ETS1-4)**

## Unit Essential Questions

- How do scientists conduct their research and analyze their findings?
- How do scientists communicate their findings?

## Crosscutting Concepts

**Systems and System Models**

## NGSS Unit Standards

### DISCIPLINARY CORE IDEAS (DCI): Developing Possible Solution

**ETS1.B: Developing Possible Solutions**

- **Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs. (HS-ETS1-4)**

### SCIENCE AND ENGINEERING PRACTICES (SEP):

**Using Mathematics and Computational Thinking**
**Mathematical and computational thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.**

- **Use mathematical models and/or computer simulations to predict the effects of a design solution on systems and/or the interactions between systems. (HS-ETS1-4)**

### Corresponding CT Core Standards:

**ELA/Literacy – RST.11-12.7, RST.11-12.8, RST.11-12.9**

**Mathematics – MP.2, MP.4**