



4-H STEM Toolkit

Introduction and Guide for the Facilitator

4-H

University of Maine Cooperative Extension conducts the state's most successful out-of-school youth educational program through 4-H. 4-H is a positive youth development organization that empowers young people to reach their full potential. 4-H is the largest youth development organization in the United States (4h.org/about). 4-H is delivered by Cooperative Extension—a network of more than 100 land grant universities across the country that provides young people with research-based experiential learning programs. 4-H welcomes young people of all beliefs and backgrounds, giving them a place to express who they are and to explore how they can improve their lives and communities. Through 4-H programs, youth take on critical societal issues, such as addressing community health inequities, engaging in civil discourse and advocating for equity and inclusion for all.

4-H programs are developed using research-based practices. The 4-H Thriving Model is our underlying theory of change. Our programs provide youth a place to belong, to matter and to explore their personal interests and sparks. High quality learning settings provide spaces to grow relationships with youth that express care, challenge growth, and share power.

For more information on the 4-H Thriving Model, please visit helping-youth-thrive.extension.org.

4-H STEM Toolkits

In Maine, we developed 4-H STEM Toolkits to provide experiential learning opportunities for youth by providing materials needed to successfully complete science-based activities. Elements of the 4-H Thriving Model are built into the activities—for example, youth voice and reflection built into each lesson ensures that there are opportunities for youth to feel like they belong. They can study the process of science, engineering, and technology while working as a team to ensure the success of their project with the help of a caring facilitator.

4-H STEM Toolkits include:

- Lesson plans for 4-H Science activities
- Materials to support lesson plans including notation of which materials are not included
- 4-H Life Skills wheel, Thriving Model graphic and definitions
- University of Maine Cooperative Extension staff as resources
- General media release form for youth and adults
- Evaluation forms
- Toolkit return checklist to be filled out before returning the toolkit

If you are not in Maine or do not have access to the full kit, you can use the lesson plans in this document and gather your own materials to facilitate the activities. Images for printed materials are available in the appendix.

5E Instructional Model

University of Maine Cooperative Extension 4-H Science Toolkits use the 5E Instructional Model (Bybee, 2015, etc.), a model that is learner-centered and inquiry-based, and allows practitioners to effectively teach science concepts. The five E's: engagement, exploration, explanation, elaboration and evaluation, are sequential activities where learners experience scientific phenomena before formal instruction on that phenomena is provided. In conjunction with the 4-H Experiential Learning Model (Kolb, 1974, etc.), the format of these curricula allow us to develop effective STEM programs that also align with informal learning best practices.

4-H Sustainable Fishing Toolkit

This series of activities engages youth in hands-on experiences created to help them learn by doing. Youth will learn about cutting edge research in fisheries while engaging in activities that foster youth finding their sparks, belonging, and developing positive relationships. This developmental context – the setting and focus of 4-H programs – aligns with the **4-H Thriving Model**/Positive Youth Development Framework.

Integration of the 4-H Thriving Model in These Activities

Sparks

Through this kit, youth are exploring topics related to sustainable fishing, but other interests and passions may be explored through these activities such as using scientific tools (ex. pocket microscope), local and regional impacts of climate change, environmental science and engineering design.

Belonging

The adult facilitator is responsible for creating an environment where youth feel safe, trusted, and nurtured. Opportunity for youth to safely explore a new topic appears throughout all the activities. As well, the youth are working in groups/teams for most activities, with time to reflect on working in groups and challenges that occur.

Engagement

Each activity is hands-on. Youth participate by exploring. Activities build upon each other, and include different types of experiences (games, challenges, exploration). These activities should challenge the youth and stimulate discussion between them.

Included with each activity are suggested reflection questions. Some questions relate to science learning, others to the 4-H thriving model integration (how did it feel to work in a group?). To view a visual aid of the 4-H thriving model, visit helping-youth-thrive.extension.org/home/

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NGSS Matching for Sustainable Fishing

The materials/lessons/activities in this kit are just one step toward reaching the performance expectations below.

Activity	What is the Objective of this Activity	Disciplinary Core Ideas	Science and Engineering Practices	Crosscutting Concepts
1: Getting to know aquatic animals	Introduce youth to a few fish and other aquatic animal species that live in the state of Maine, learn some facts about them and generally where they are found (broadly, as in freshwater, saltwater, and intertidal zone).		Constructing explanations: Using evidence to support an explanation (3-LS3-2) and using evidence to construct an explanation (3-LS4-2), and 3-LS4-3. Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.	Patterns
2: Species range	Engage youth in a challenging activity that encourages them to reason with evidence to understand that species have a certain range in which they can live and survive. The factors they focus on are abiotic.	LS2.C: Ecosystem dynamics, functioning and resilience When the environment changes in ways that affect a place's physical characteristics, temperatures, or availability of resources, some organisms survive and reproduce, others move to new locations, yet others move into the transformed environment, and some die (3-LS4-4). LS4.D: Biodiversity and humans Populations live in a variety of habitats, and change in those habitats affect the organisms living there (3-LS4-4).	Analyzing and interpreting data: Analyze and interpret data to make sense of phenomena using logical reasoning (3-LS4-1) Engaging in argument from evidence: 3-LS2-1, 3-LS4-3, 3-LS4-4	
3: Finding fish	Introduce youth to one way fish are found, sonar technology. Youth drop one drop of water into a tray of water and make observations and share them with their group. Youth develop questions and choose one question to investigate	PS4.A: Wave properties Waves, which are regular patterns of motion, can be made in water by disturbing the surface. When waves move across the surface of deep water, the water goes up and down in place; there is no net motion in the direction of the wave except when the water meets a beach (4-PS4-1).	Developing and using models: Develop a model using an analogy, example or abstract representation to describe a scientific principle (4-PS4-1) Planning and carrying out investigations: Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test to design a solution (3-PS2-2), (4-PS3-3)	Patterns Cause and effect

Activity	What is the Objective of this Activity	Disciplinary Core Ideas	Science and Engineering Practices	Crosscutting Concepts
4: Battle for fish	Exploring the idea that finding (or catching) one fish can mean they are more. AND that bycatch is a negative outcome of fishing.	LS4.D: Biodiversity and humans Populations live in a variety of habitats, and change in those habitats affects the organisms living there (3-LS4-4)	Developing and using models	Cause and effect Science affects everyday life (3-ESS3-1) Practice using coordinate grids (Math Common Core)
5: Sustainable fishing	Understanding the difference between sustainable fishing and unsustainable fishing and the impacts both can have.	ESS3.C: Human impacts on earth systems Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments (5-ESS3-1)		Systems and system modeling Representing and interpreting data (Math Common Core)
6: Crime scene scientists	Explore what kind of evidence animals can leave behind, on both macro and micro scales.		Scientific Investigation use a variety of methods: Science investigations use a variety of methods, tools and techniques (3-PS2-1)	Scale, proportion and quantity
7: DNA	Build on the phenomenon that we inherit traits from our parents, just like fish and other animals inherit traits too.	LS3.B: Variation of traits Different organisms vary in how they look and function because they have different inherited information (3-LS3-1)	Planning and carrying out investigations: Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test to design a solution (3-PS2-2)	
8: eDNA	Introduce youth to the idea that with eDNA we can detect which species are present or absent in an ecosystem based on the DNA that is collected from the environment and matched to a species list.	LS2.C: Ecosystem dynamics, functioning and resilience When the environment changes in ways that affect a place's physical characteristics, temperatures, or availability of resources, some organisms survive and reproduce, others move to new locations, yet others move into the transformed environment, and some die (3-LS4-4).	Analyzing and interpreting data: Analyze and interpret data to make sense of phenomena using logical reasoning (3-LS4-1) Planning and carrying out investigations: Plan and conduct an investigation collaboratively to produce data to serve as the basis of evidence, using fair tests in which variables are controlled and the number of trials considered (3-5-ETS1-3).	Patterns Representing and interpreting data (Math Common Core)