Engineering in Action: Spring Leapers

Grades: K - 5
Time: 45 minutes

Rationale and Context:
The program begins with a brief review of the characteristics of amphibians and a review of a frogs life cycle. We will also explore the the sounds frogs make, why they vocalize and how their vocalizations relate to the annual spring migrations of frogs and salamanders. Students will use the Engineering Design Process (EDP) to define and construct a playful solution to a presented problem facing frogs and other amphibians in Vermont and around the world. The EDP is a series of steps that engineers employ to develop solutions to a given problem. It is a cyclical process that can be applied to any problem requiring a technological solution. Many of the environmental challenges facing the Lake Champlain Basin benefit from engineered technologies, such as management of invasive species, stream monitoring and wildlife conservation efforts. Students will come to see that the EDP can be used to solve problems in a diversity of contexts and themselves as possessing the ability to design and improve technologies.

Teacher Background Information:
Vermont is home to 11 species of salamanders, 9 species of frogs and 2 species of toads. Out of these 22 species of amphibians 2 are considered endangered, the Fowler's Toad and the Boreal Chorus Frog. The Boreal Chorus Frog may be lost to Vermont. It was last heard in 1999.

Several factors threaten our native amphibians including habitat loss, illegal collection and killing, pollution, disease and road mortality. To learn more about Vermont amphibians, conservation efforts and citizen science projects visit The Vermont Reptile and Amphibian Atlas here, https://www.vtherpatlas.org/

The Engineering Design Process
Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands. The Engineering Design Process (EDP) is a set of steps engineers follow to solve problems. Steps include: Define, Plan, Build, Evaluate, and Revise. The process is designed to be cyclical with students repeating the steps as many times as necessary to refine their ideas. Fundamental to this process is the ability of students to solve problems creatively and work together. Typically solutions involve designing a product that meets certain criteria and possible solutions to a problem are limited by available materials and resources (constraints). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success. Different solutions need to be tested in order to determine which of them best solves the problem.

Vermont Standard(s): Next Generation Science Standards

Disciplinary Core Ideas	**K - 5**
LS1.A - Structure and Function	All organisms have external and internal parts that serve various functions
LS1.B: Growth and Development of Organisms	Adult animals can have young. Reproduction is essential to the continued existence of every kind of organism. Animals have unique and diverse life cycles.
LS1.D: Information Processing	Animals have body parts that capture and convey different kind of information needed for growth and survival. Animals use their perceptions and memories to guide their actions.
LS4.D: Biodiversity and Humans	There are many different kinds of animals. Animals live in a variety of habitats, and change in those habitats affects the organisms living there.
ETS1.A: Defining and Delimiting Engineering Problems	Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
ETS1-B: Developing Possible Solutions	Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of problem.
ETS1 - C: Optimizing the Design Solution	Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.
Science and Engineering Practices	Define a simple problem. Generate and compare solutions to a problem. Engage in the design cycle to construct a solution that meets a specific design goal. Plan and carry out fair tests in which variables are controlled. Communicate information and design ideas with others.
Cross Cutting Concepts	Systems and Models Structure and Function Cause and Effect: Mechanism and explanation

P21 21st Century Skills

Skills	**K - 5**
Think Creatively	Elaborate, refine, analyze and evaluate their own ideas in order to improve and maximize creative efforts.
Work Creatively with Others	Be open and responsive to new and diverse perspectives; incorporate group input and feedback into the work. View failure as an opportunity to learn; understand that creativity and innovation is a long-term, cyclical process of small successes and frequent mistakes.

Learning/Behavioral Objective(s):

1. Students will discuss the characteristics of an amphibian, review the unique life cycle of frogs and learn about the annual amphibian migration.
2. Students will investigate a problem facing the Lake Champlain Basin.
3. Students will use the EDP to collaboratively plan and build a solution, taking into account available material/time constraints and criteria for success.
4. Through testing and group discussion, students will evaluate their designs.
5. Students will revise their solutions, considering how the structure of their original designs impacted their function.
6. Together we will reflect on the EDP and its application in everyday life.

Vocabulary: Students will gain an understanding of certain vocabulary words through active participation and explanation.

Amphibian	Metamorphosis	Hibernation	Migration
Vernal Pool	Habitat	Citizen Science	Fair Test
Engineering Design Process		Tympanic Membrane	

Focusing Question(s):

What are the characteristics of amphibians?
What are the stages of a frog's life cycle?
Can you identify a frog by its sound?
What are the annual migration patterns of amphibians?
What can we do to help amphibians survive?
How can we use the Engineering Design Process to solve problems in everyday life?
How do groups of people work together to solve problems?