Engineering in Action: Launch, Fling, Fly

Grades: K - 6
Time: 50 minutes

Rationale and Context:
Students will learn about the characteristics of butterflies and the ecology of one the most studied and locally threatened butterflies, the Monarch. Students will also use the Engineering Design Process (EDP) to define and construct a playful solution to a presented problem facing Monarch Butterflies. 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 and stream monitoring. 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:
Butterfly Ecology and Conservation
Vermont is home to close to 120 species of butterflies. These amazing animals are insects and like all insects they have an exoskeleton, 6 jointed legs and 3 body segments (head, thorax and abdomen). Butterflies undergo a remarkable transformation during their lifecycle called complete metamorphosis. During complete metamorphosis the young hatch from an egg looking very different from the adult form. There are four stages in the metamorphosis of a butterfly: egg, larva, pupa and adult.

The Monarch Butterfly is a species of special concern for us in Vermont. Vermont is situated in the migration route of the Eastern North American monarchs and provides them with resources critical to their survival. Each fall monarchs travel from their summer breeding grounds in Canada and New England to their overwintering locations 3000 miles south in central Mexico. Monarch populations are in sharp decline and loss of habitat in the summer breeding grounds and along their eastern migration route is contributing to that decline.

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

Standard	**K - 5**
LS1.A -1	All organisms have external and internal parts that serve various functions
LS1.C -1	All animals need food in order to live and grow
LS4.D-1	Animals live in a variety of habitats, and change in those habitats affects the organisms living there.
ETS1-1	Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
ETS1-2	Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of problem.
ETS1-3	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. We will define a problem facing the Lake Champlain Basin.
2. Students will use the EDP to collaboratively plan and build a solution, taking into account material/time constraints and criteria for success.
3. Through testing and group discussion, students will evaluate their designs.
4. Students will revise their solutions, considering how the structure of their original designs impacted their function.
5. 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.

Antenna	Criteria
Thorax	Constraints
Abdomen	Design
Proboscis	Engineering
Metamorphosis	Engineering Design Process
Migration	Fair Test
Technology	

Focusing Question(s):

What are the defining structures of a butterfly?
What are the stages and sequence of butterfly metamorphosis?
What can we do to help insure the growth of threatened butterfly populations?
How can we use the Engineering Design Process to solve problems in everyday life?
How do groups of people work together to solve problems?