At-a-Glance: Greenhouse

Life Science – Ecosystems (Grades 4-6)

Description

Saint Paul, Minnesota has a long tradition of selling goods at the farmers market, the city's first public market. While dairy products, flour, cakes and candies are sold year-round, fresh produce is only available during the summer season. Many families of students in schools in Minnesota grow and sell fresh produce at the market. However, the growing season for produce (tomatoes) in Minnesota is very limited due to the climate. To extend the growing season for tomatoes, students design and construct a model greenhouse that will maintain an optimal temperature closest to 24°C and maintain a temperature between 18°C and 35°C.

Engineering Design Challenge: Design and construct a model greenhouse that will maintain an optimal temperature closest to 24°C and maintain a temperature between 18°C and 35°C			
Lesson 1	**Lesson 2**	**Lesson 3**	**Lesson 4**
Intro to the Engineering Design Challenge (2 class periods)	Testing Materials (1 class period)	Design and Cost Analysis of Greenhouse (3 class periods)	Construct and Test Greenhouse (2-3 class periods)
Lesson 5	**Lesson 6**	**Lesson 7**	**Lesson 8**
Plant Parts (1 class period)	Redesign and Cost Analysis of Greenhouse (1 class period)	Build and Test Redesign (2 class periods)	Communication (1 class period)

Lesson Summaries

- **Lesson 1:** This session begins with a discussion about the St. Paul Farmers Market and what goods may be sold at the Farmers Market. Pictures of the market will be shared with students. Students are asked if they know why only certain produce is sold during certain parts of the year. Students are given the problem: How can we extend the growing season for tomatoes? Students begin by examining some plants and brainstorming their needs for survival.

- **Lesson 2:** Students review plant needs and how to extend the growing season. Students test materials, record data and make claims based on their data. They examine how to use evidence to extend the growing season for tomatoes in Minnesota.

- **Lesson 3:** Using a provided set of materials, students design and conduct cost analysis. Students sketch their design, propose a list of materials, and are given the scoring rubric and the list of material costs. Drawings must be made to scale. Plans are submitted to the teacher before approval to build.

- **Lesson 4:** Students construct greenhouses based on their plan. They test their designs to examine how they maintain the optimal temperature in a 10-minute period while they are exposed to light and then continue to monitor 10 minutes after light source is off. Students graph the data and examine how well it meets the needs of the challenge. Students share designs and data.

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- **Lesson 5:** Students examine, then sketch and label the parts of a tomato plant. Students plant tomato seeds and place them in their greenhouse. Students record observations of their plants for the rest of the unit. During growth and development students measure and record their plants' height, measure the temperature inside their greenhouse, and count and record the number of leaves.

- **Lesson 6:** Students use the knowledge gained during lessons 4 and 5 to work on their redesign, analyzing the effectiveness of their previous greenhouse. Students develop a new design that will be more effective based on the challenge. Students also examine how to increase their point total. All redesigns must be approved by the teacher.

- **Lesson 7:** Students use their redesign to gather materials and construct an improved model. The improved designs are tested to observe how they maintain the optimal temperature in a 10-minute period while they are exposed to light and then continue to monitor after 10 minutes after light source is off. Students graph the data and examine how well it meets the needs of the challenge. Students share designs and data.

- **Lesson 8:** Student teams communicate with client describing the challenge, a claim on why their design is successful, evidence to support the claim, an explanation for why their design should be selected, and address any weaknesses in their design. Student teams write a report for the client and present it to the class.

Throughout the unit, each student documents their work and the engineering design process in an Engineering Notebook. Students record all observations, collected data, and plans. The Engineering Notebook includes answering specific questions related to that day's activities. Students also use their notebooks as a reference – a place to maintain the information they are learning through design. Additionally, students reflect on their work throughout the design process, important for modeling what real-life engineers do. Notebooks are used to assess student learning and their design process.

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