CASTLE COMPLEX EDP PHASE 2 PROJECT (2018-2021)

UbD STEM UNIT PLAN TEMPLATE (adapted from ONR Engineering Success in STEM Project)

Teacher's Name: Adam Holbert Sheryl Mahiko	**School:** Benjamin Parker Elementary	**Grade Level:** 5
Content Area: Science and Engineering	**Course Name:**	**Period:**
Unit Title: Egg Drop	**Approximate Time Frame: 3-4 weeks**	

Essential Vocabulary:

- **gravitational potential**- is the potential energy a physical object with mass has in relation to another massive object due to gravity. It is potential energy associated with the gravitational field.
- **kinetic energy** - energy which a body possesses by virtue of being in motion.
- **transfer of energy** - the process of changing one form of energy to another

STAGE 1: DESIRED RESULTS

NGSS Standard(s)

Motion and Stability: Forces and Interactions
*5-PS2-1
Engineering Design
*3-5 ETS1-1
*3-5 ETS1-2
*3-5 ETS1-3
Earth and Human Activity
*5-ESS3

Performance Expectation(s)

Motion and Stability: Forces and Interactions

- Support an argument that the gravitational force exerted by Earth on objects is directed down.

Engineering Design

- Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
- Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
- 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.

Earth and Human Activity

- Obtain and combine information about ways individual communities use science ideas to protect Earth's resources and environment.

Dimension	Name and NGSS code/citation	Matching student task or question directly from the activity
Science and Engineering Practices (SEPs)	1. *Engaging in Argument from Evidence (**5-PS2-1**)* 2. *Asking Questions and Defining Problems (**3-5 ETS1-1**)* 3. *Planning and Carrying Out Investigations (**3-5 ETS1-2**)* 4. *Constructing Explanations and Designing Solutions (**3-5 ETS1-3**)* 5. *Obtaining, Evaluating, and Communicating Information (**5-ESS3-1**)*	**Engaging in Argument from Evidence:** ● Students will test the effects of gravity on different objects, make observations, discuss understanding and misconceptions about gravity. **Asking Questions and Defining Problems:** ● Students will identify the problem or need from the problem statement. ● Students will identify and ask questions about constraints and criteria. **Planning and Carrying Out Investigations:** ● Students will fill out a Pugh chart to determine the most important elements of their designs. ● Students will sketch and label designs for their egg catcher. ● Students will collaborate on evaluating and choosing the best design that meets the specified criteria. **Constructing Explanations and Designing Solutions:** ● Students will simulate, create a prototype, test design, collect data and make observations to inform redesign. **Obtaining, Evaluating, and Communicating Information:** ● Students will reflect on the EDP process and consider other applications for real-

		world and relevant problems.

Disciplinary Core Ideas (DCIs)	• **PS2.B: Types of Interactions**
	  ○ *The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center. (5-PS2-1)*
	• **ETS1.A: Defining and Delimiting Engineering Problems**
	  ○ *Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. (3-5-ETS1-1)*
	• **ETS1.B: Developing Possible Solutions**
	  ○ *Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. (3-5-ETS1-2) At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. (3-5-ETS1-2) Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. (3-5-ETS1-3)*
	• **ETS1.C: Optimizing the Design Solution**
	  ○ *Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. (3-5-ETS1-3)*
	• **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)*
		Student Should Understand:
		● Gravitational force exerted by Earth on objects is directed down.
		● How the effects of gravity on an object can be affected by air resistance and mass.
		● How to identify possible solutions based on constraints and required criteria.
		● How to manage time to enable students to conduct multiple tests for reliable and accurate data collection.
		● How to analyze data and make informed choices.
		● How to collaborate and communicate with peers and make decisions based on evidence and observations.
		● How mistakes can inform new decisions.
		● How the Engineering Design Process can be used to find solutions for real-world problems facing our environment.

Crosscutting Concepts (CCCs)	**Cause and Effect** • *Cause and effect relationships are routinely identified and used to explain change*. **Influence of Science, Engineering, and Technology on Society and the Natural World** • *People's needs and wants change over time, as do their demands for new and improved technologies. (3- 5-ETS1-1)* • *Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands. (3-5-ETS1-2)* **Systems and System Models** • *A system can be described in terms of its components and their interactions.* **Science Addresses Questions About the Natural and Material World.** • *Science findings are limited to questions that can be answered with empirical evidence.*	• Students will practice changing one variable at a time to help identify its effect on their designs. • Students will be able to analyze a problem statement to identify the wants and needs of a client. • Students will develop an understanding of how technology is constantly changing and new solutions are needed to evolve with it. • Students will develop an understanding of the impact invasive species have on native ecosystems.

Learning Goal (Student Learning Objectives): (Skills, content knowledge and understandings, values, etc.) *Students will be able to…*	• Students will be able to define a design problem; generate and evaluate multiple egg catcher designs that meet constraints and criteria; build an egg catcher in a timely manner; test their designs and consider improvements based on the trial results (3-5 ETS1-1) • Students will be able to explain which direction an object close to Earth's surface will fall & describe how gravity causes objects on Earth to fall directly downward (5-PS2-1) • Students will be able to help our community and environment by obtaining information about an existing problem in society, then considering solutions by applying the engineering design process (5-ESS3-1)
Essential Question(s):	How can we use the engineering process to protect Native bird species from extinction?

Enduring Understandings (Big Ideas): (Broad understandings that are not tied to place, time, specific people, etc.)	The Engineering Design Process can be applied to solve real-world problems such as protecting Native bird species from harm and extinction.
Other Standards/Benchmarks: Common Core Literacy Standards/Mathematical Standards C3 Framework for Social Studies Fine Arts Standards	

STAGE 2: ASSESSMENT EVIDENCE

Summative Assessment/ Performance Task	• Completed EDP notebook. • Building and testing a working prototype (Group).
Rubric(s) for Summative Assessment/Performance Task: (Attach documents)	GR5 Egg Drop EDP Unit Rubric
Formative Assessments:	• Small group questioning • Student workbook pages • Student questions
Engineering Notebook ***Need to get copy of Notebook*** (Attach notebook template documents by the steps of the EDP, including any final reflection and communication pages)	

STAGE 3: LEARNING PLAN:

The daily activities should address all aspects of the EDP, plus the communication/sharing process:**

Problem Statement (Scenario)
Ask: Need Identification, Problem Statement, Client(s), Specifications
Imagine: Research, Brainstorm Solutions
Plan: Pugh Chart, Gantt Chart, Materials, Equipment, Procedures
Create: Prototype/Model, Test
Improve: Reflect, Improve/Modify, Test

ASK (give a time frame for each activity)
Students are provided background knowledge prior to the lesson introduction. As a class, we watch the Falling 101 video to frame learning and build background knowledge. The teacher introduces the phenomenon by demonstrating two objects falling at the same rate and discussing observations. Students conduct their own experiment using classroom objects and making observations and writing results. The problem statement is introduced to students and background on the problem is provided to contextualize the task. The criteria and constraints are discussed and time is provided for students to ask questions. Further explanation for completing the Science Journal is provided (1-2 Days).
IMAGINE
Students will watch more videos:" What is an engineer?" and the" Wheelchair Video". Students will research and discuss the problems with invasive bird species and native birds. Students now pretend they are engineers and they will be trying to solve the real-world problem. Students will then brainstorm ideas for their designs and create sketches. Students will list materials and quantities for their designs (1 Day).
PLAN
Students fill out a Pugh Chart to help determine and justify their best design. After filling out the Pugh Chart, students will decide on a group design that best meets the constraints and criteria. Students will then create a detailed sketch of their selected design that includes multiple perspectives and labels. Students will then write out the step-by-step procedures required to create and test their design. After listing the steps in detail, students will update the materials and quantities list (1 Day).
CREATE
Once groups have decided which design they will use, they follow the plan and build the prototype. Test out their design and record the data in their notebooks (1-2 Days).
IMPROVE

Analyze the data, evaluate the results, identify variables to improve. Create a new sketch incorporating and labeling the improvements, update materials list, and write a justification for design changes. Test out your updated prototype and record data (1 Day).

COMMUNICATE**

Students independently fill out a final reflection in Science Journal. As a whole group, share reflections, takeaways, and questions. Summarize learning and key concepts (1 Day)

Materials, Equipment and Resources Needed to Implement Unit

Materials: plastic eggs, nuts, cotton balls, bubble wrap, paper bag, cardboard, duct tape, straws, felt/fabric, balloons, newspaper.

Equipment: Design testing area with labelled drop heights and ladder/chair for teacher to reach test drop height.