Hempstead Union Free School District (HUFSD): 21stCentEd's Curriculum and STEM Unit Guide

Overview: Hempstead Union Free School District will use the 4 Shifts Protocol and STEM Unit Guide below to integrate STEM education for grades K-12. This guide will serve as a roadmap for Teachers and/or FaciliMentors, who will engage their students in high-level, inquiry-based STEM experiences. **This Unit Guide is a template that can be used as the instructional framework for 21stCentEd's STEM courses and district-level curriculum.** These STEM courses are grounded in the Next Generation Science Standards and provide the educator and learner with real-life, hands-on STEM experiences that will prepare all students for a global workforce, economy, and world.

Directions: Teachers and/or Facilimentors in grades K-12 will engage students in STEM education during each marking period for the 2022-2023 school year, using the engineering design process. In addition, instructors will use the template below to map out their **"STEM Units of Study"** that will enhance teaching and learning in the classroom and lead to higher student achievement.

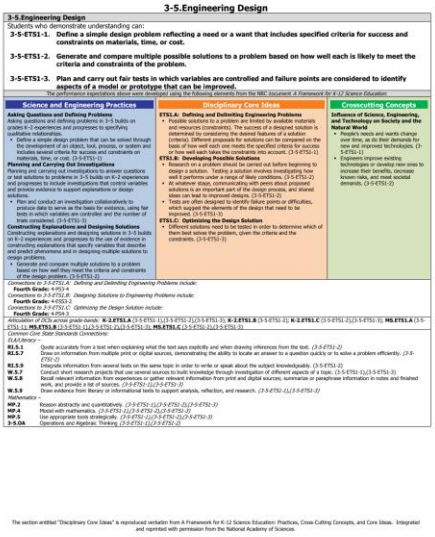
Shift 1: How will this unit of study foster deeper thinking & learning?

Unit Objective(s):	Unit Outcome(s):
Description: Unlike a goal, an objective is rooted in intention and planning. It's not something you hope to achieve, it's something you actively plan to achieve. **Objective 1:** **Objective 2:** **Objective 3:** **Resource 1:** Bloom's Taxonomy **Resource 2:** Depth of Knowledge	**Description:** Although outcome and objective are similar, the outcome is the finish line for an objective. **Outcome 1:** **Outcome 2:** **Outcome 3:** **Resource:** A Complete Definition of College & Career Readiness (see "Academic Performance" outcomes, top of page 3).

Engineering Design Standards (EDS):

K-2 EDS: (link)
3-5 EDS: (link)
MS EDS: (link)
HS EDS: (link)
Grade 5 & 8 Science Tests (link)

ELA Next Generation Standards: Cross-curricular (link)



3-5.Engineering Design

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Students who demonstrate understanding can:

3-5-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.

3-5-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 the problem.

3-5-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.

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Asking Questions and Defining Problems Asking questions and defining problems in 3-5 builds on grades K-2 experiences and progresses to specifying qualitative relationships. • Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost. (3-5-ETS1-1) **Planning and Carrying Out Investigations** Planning and carrying out investigations to answer questions or test solutions to problems in 3-5 builds on K-2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. • Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. (3-5-ETS1-3) **Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 3-5 builds on K-2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. • Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem. (3-5-ETS1-2)	**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)	**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)

Connections to 3-5-ETS1-A: Defining and Delimiting Engineering Problems include:
Fourth Grade: 4-PS3-4
Fifth Grade: 5-PS1-3
Fourth Grade: 4-ESS3-2

Connections to 3-5-ETS1-C: Optimizing the Design Solution include:
Fourth Grade: 4-PS4-3

Articulation of DCIs across grade-bands: **K-2.ETS1.A** (3-5-ETS1-1),(3-5-ETS1-2),(3-5-ETS1-3); **K-2.ETS1.B** (3-5-ETS1-2); **K-2.ETS1.C** (3-5-ETS1-2),(3-5-ETS1-3); **MS.ETS1.A** (3-5-ETS1-1); **MS.ETS1.B** (3-5-ETS1-1),(3-5-ETS1-2),(3-5-ETS1-3); **MS.ETS1.C** (3-5-ETS1-3),(3-5-ETS1-2)

Common Core State Standards Connections:
ELA/Literacy –
RI.5.1 Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. *(3-5-ETS1-2)*
RI.5.7 Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. *(3-5-ETS1-2)*
RI.5.9 Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (3-5-ETS1-2)
W.5.7 Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. (3-5-ETS1-1),(3-5-ETS1-3)
W.5.8 Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. *(3-5-ETS1-1),(3-5-ETS1-3)*
W.5.9 Draw evidence from literary or informational texts to support analysis, reflection, and research. *(3-5-ETS1-1),(3-5-ETS1-3)*
Mathematics –
MP.2 Reason abstractly and quantitatively. *(3-5-ETS1-1),(3-5-ETS1-2),(3-5-ETS1-3)*
MP.4 Model with mathematics. *(3-5-ETS1-1),(3-5-ETS1-2),(3-5-ETS1-3)*
MP.5 Use appropriate tools strategically. *(3-5-ETS1-1),(3-5-ETS1-2),(3-5-ETS1-3)*
3-5.OA Operations and Algebraic Thinking *(3-5-ETS1-1),(3-5-ETS1-2)*

The section entitled "Disciplinary Core Ideas" is reproduced verbatim from A Framework for K-12 Science Education: Practices, Cross-Cutting Concepts, and Core Ideas. Integrated and reprinted with permission from the National Academy of Sciences.

HUFSD Framework & NYSED Standards

Description: List your power standard(s) and interdisciplinary theme(s) here.

- **Power Standard(s):** Interdistrict, grade-level learning goals that are essential for students to master by the end of a specific unit of study, course, or grade level. These standards should be content-specific.
- **Transdisciplinary (K-5) & Global Context (6-8) Theme(s):** (link)
- **IB Themes & STEM Literacy:** (link)

Essential Questions

All students will keep considering…

Description: An open-ended question (written in student friendly language) designed to stimulate thought and provoke student inquiry into a topic. Essential Questions anchor knowledge in larger, more global "buckets" for students. They allow the teacher to connect academic content with broader, real-world application. EQs tap into student's natural curiosity so they engage with the content through inquiry, answering the following questions:

- Are the EQs authentic & age-appropriate for students?
- Do the EQs spark debate, research, or reflection?
- Do the EQs span broader than just this unit?
- Are the EQs connected to the standards?
- Are they formatted as a bulleted list of 2-5 Essential Questions with corresponding unit questions

added as sub-bullets if applicable?

Portrait of a 21st Century Graduate

Description: Captures the way this unit supports students in growing as scholars and global citizens. Only select the statements that are the primary focus of the unit. Teachers and/or FaciliMentors target key 21st Century skills and social-emotional learning competencies that are required for students to engage in and master during this unit of study.

Resource: The Four Keys to College & Career Readiness

Shift 2: How will students engage in authentic work?

F.I.D.S. Model: (link)

Description: Design Thinking-Infused Pedagogical approach to teaching & learning in the classroom that enhances educator effectiveness and increases student achievement.

FEEL

Description: Students identify what bothers them the most; They transform helplessness into empowerment. Use the following questions to engage students in the design thinking process:

- What are the key concepts or content being taught in this unit?
- What are possible topics/challenges students could discuss?
- What real life impact and relevance do these concepts have on the students and others? (also think about career connections)
- How could students explore these topics by gathering data or information? (also think about career connections)
- What data, information, and/or research might they do?

IMAGINE

Description: Students brainstorm ways to take the current situation to a

	preferred state for self and others. Use the following question to engage students in the design thinking process: • How might we...[students fill in the question based on the data gathered from the FEEL stage that guides them to a prototype]?
	DO **Description:** Students are empowered to do what it takes to bring about change with courage and determination. Use the following questions to engage students in the design thinking process: • How can students use this data, information, and/or research to create or innovate a prototype?
	SHARE **Description:** Students share their stories to inspire others to be the change. Use the following questions to engage students in the design thinking process: • Who is an authentic audience for the students to gain feedback on their innovation? (also think about career connections) • How can the students present their final plans/prototypes in an authentic manner? (also think about career connections)

Shift 3: How will this unit of study build student agency & personalization?

STEM Experiences & Activities / Instructional Protocols

Description: Teachers and/or FaciliMentors will develop lessons designed to engage students in STEM experiences. Each activity should build upon one another that guides the students through the four types of inquiry. In order to establish this type of instructional design that personalizes learning for each student, the instructor must implement instructional protocols that fosters cooperative learning, team work, peer feedback, and student agency. When implemented with fidelity, instructional protocols develop a learning environment in the classroom that teaches students how to engage in collaborative inquiry and group work that is needed in STEM activities and projects.

Resource: 5E Lesson Plan Template (optional)

Shift 4: How will this unit of study infuse instructional technology?

Technology Infusion

Description: Technology is more than the bells and whistles of new tablets or laptops in the classroom. The goal should be thinking about using the technology to effectively change or enhance instruction, so that you are doing something greater or more efficiently by using it (Resource link).

- Why do you want to use this technology here?
- Why hasn't the approach that you've been doing in the past worked?
- How do you hope technology will change it?
- Can technology make this idea more relevant to students?
- Can it push the lesson up a notch, or can it enhance things for students by allowing them to do something that they couldn't do without the technology? For example, does the technology allow students to collaborate beyond the classroom walls?
- Is the technology making possible a certain level of transparency for the teacher to assess where students are individually?
- Does the technology provide a platform for students to be creative without overbearing them with gadgets and apps?

Resource 1: What Does A 21st Century Classroom Look Like: Technology Integration (Edutopia, March 31, 2015).
Resource 2: Harnessing Technology for Deeper Learning