Innovation Collaborative Lesson/Unit Template

STEAM is most effective as a unit or group of related experiences, not a one-time lesson.

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Lesson/Unit Title *Design and Build a Kinetic Art Sculpture*

Grade Level(s) 7th or 8th grade

Duration 1.5 weeks

Big Idea/Unit Overview

Using the principles of balance and movement, students will apply their understanding of kinetic and potential energy, forces, and motion to design a piece of moving art. Students will synthesize their ideas of engineering and art to create beautiful sculptures that represent their identity and are powered by wind and/or gravity, magnetic or other forces. Through the engineering design process, students will design and refine their sculptures.

Objectives/Outcomes

Students will be able to:

- Describe how forces are used by artists to create moving art.
- Describe the types of forces and energy that make objects move.
- Use Elements of Art and the engineering design process to demonstrate force and motion.
- Explain the process they went through to create their sculpture, including challenges they overcame, how they selected the materials they used, and what causes their sculpture to move the way it does.

Through appropriate supports including word banks, graphic organizers, sentence frames, and write-arounds, students will be able to do the following, both orally and in writing:

- explain how artistic and scientific methods are similar
- describe the process they followed to design and create their kinetic sculpture
- describe the relevant forces at play in their sculpture; explain areas in which their sculpture demonstrates various types of energy explain what their artistic creation means to them

Essential Questions:

- What makes a mobile move the way it does?
- If we can't see force, how do we know it's real?
- Why does a ball roll through a marble run at varying speeds?
- What are some examples of moving art? Why does some art move?

Vocabulary for Both Arts and Science

- sculpture
- art
- balance
- movement
- motion
- magnet
- intent
- form
- structure
- work
- mobile
- force
- current
- repel
- attract
- pole
- net (as in net force)
- identity
- center of mass
- centripetal force
- convective current
- kinetic energy
- potential energy
- gravity
- kinetic

Process/Thinking Skills/Habits of Mind and how where they are used

- Disciplinary practices addressed
- Collaborative Creative/Innovative Thinking Skills used
- Arts Habits of Mind addressed
- Problem-solving skills used (see Collaborative Thinking Skills Rubric)
- Degree of content integration (see Collaborative Content Rubric)

NGSS practice standards (✓ = Incorporated in this lesson):

✓Asking questions and defining problems
✓Developing and using models
✓Planning and carrying out investigations
Analyzing and interpreting data
✓Using mathematics and computational thinking
✓Constructing explanations and designing solutions
Engaging in argument from evidence
✓Obtaining, evaluating, and communicating information

Thinking Skills (✓ = Incorporated in this lesson):

✓Observing and asking questions
✓Defining/clarifying a problem
Acquiring and evaluating necessary knowledge
✓Generating Ideas
✓Changing perspectives
✓Abstracting
✓Transforming
✓Synthesizing
✓Comparing/contrasting
✓Visually analyzing
✓Evaluating ideas or statements
✓Collaborating
Determining relevance to own lives
✓Persisting
✓Creating
✓Communicating

✓Developing the solution ✓Responding

Arts Habits of Mind (✓ = Incorporated in this lesson):

Cognitive
- Fluency
- ✓ Originality
- ✓ Imagination
- ✓ Elaboration
- ✓ Expression
- ✓ Creativity
- Resistance to closure

Social/emotional
- ✓ Cooperative learning

Personal
- ✓ Motivation
- ✓ Risk-taking
- ✓ Self-confidence
- ✓ Ownership of learning

Problem-Solving Skills (✓ = Incorporated in this lesson):

- ✓Asks questions
- ✓Defines problem
- ✓Acquires, analyzes and selects information
- ✓Generates and manages ideas
- ✓Develops and evaluates solution
- ✓Generates multiple solutions
- ✓Synthesizes in a manner that addresses and/or solves the problem

Degree of Content Integration:

- ✓Degree of integration: Transdisciplinary
- ✓STEM: Refining/Expert
- ✓Arts or Humanities: Refining/Expert

Materials

- PVC pipes
- marbles
- straws
- plastic cups and takeout containers
- string
- wood scraps of various sizes
- duct tape
- cardstock and cardboard
- foam board
- metal cans and other recyclables
- plastic jugs and other recyclables
- rubber bands
- wire and pipe cleaners
- wood glue
- ping pong balls
- hole punch
- sticks or dowels
- magnets
- metal objects
- other materials, including recyclables, as available

NOTE: Students will need access to the Art classroom, MakerSpace and/or the TechEd/Woodshop Classroom for equipment, materials, and tools

Resources (websites, videos, images, books, etc.)

Videos:
https://www.youtube.com/watch?v=ruiQR3CZE7k
https://www.youtube.com/watch?v=ZHF0hh8wsdY
https://www.youtube.com/watch?v=y-pc3sPXbfc
https://www.youtube.com/watch?v=rfn2f7SXKys
https://www.youtube.com/watch?v=lI6IKLGMxUc
https://www.youtube.com/watch?v=vkWCVemux2Y
https://www.youtube.com/watch?v=Mt0Y6xCjhYw

Learn from an artist: https://www.youtube.com/watch?v=PIbk4AKFMTc
Learn from another artist: https://www.youtube.com/watch?v=dehXioMIKg0
Learn about an artist: https://www.youtube.com/watch?v=Q5ktkR-xSoM
Learning about the engineering process of building a kinetic sculpture:
https://www.youtube.com/watch?v=nxdcj2tLQGE
Hear from a mechanical engineer: https://www.youtube.com/watch?v=9XM9MCtjo8M

Readings:
https://theculturetrip.com/south-america/venezuela/articles/venezuela-s-5-best-kinetic-and-op-artists-you-should-know/
https://www.artandobject.com/articles/moving-installations-poetic-kinetics
https://www.invaluable.com/blog/kinetic-art/ (includes each artist's nationality)
https://land8.com/the-art-and-science-of-wind-propelled-sculptures/

Required Reading (includes videos):
https://mymodernmet.com/kinetic-sculpture-art-history/

MA Sheltered English Immersion Smart Card

MA Curriculum Frameworks:
English Language Arts
Science and Technology Engineering
Arts

Universal Design for Learning:
https://udlguidelines.cast.org/

Other Resources:
https://www.teachengineering.org/lessons/view/cub_art_lesson01

https://www.albrightknox.org/learn-discover/educators/lesson-plans/kinetic-art-mobiles

Procedure (with modifications if needed):

Introduction

"In an effort to beautify our campus, our school principal has asked us to build a model to represent scientific learning that can be displayed during next month's curriculum night. To this end, you are going to create a moving sculpture to be displayed at our school. Your sculpture must, in some way, showcase the identity of your group. In order to build your sculpture, you will need to apply your knowledge of force, motion, and energy. You will have your choice of materials from what we have available in our MakerSpace, but the end result should be a work of art that is ***expressive*** *and* ***contains interesting movement*** *(caused by some force of your choosing). You will work as a team of 2-3 students to complete your designs. There will be an exhibition for you to showcase your work and explain your artistic and scientific processes. Members of the community will be invited to attend."*

Students will use their knowledge of energy, force, and motion to create a kinetic sculpture. Students will be expected to present their final product and explain the process they went through to design and build their piece (why they chose the materials, how they made sure it incorporated movement, what challenges they overcame, how they used art to solve a problem) and what their art piece represents to them.

Prior knowledge:
Students have previously learned about force, motion, and energy
Students have studied magnetic energy
Students have an understanding of gravity
Students have previous knowledge of the Elements of Art, art making, and art habits of mind

Demonstration:
Safety procedures for using tools and working in MakerSpace, art classroom, or woodshop
How to document their process using Engineering Design Process Template and Design Thinking Template

Inquiry and process

(Language Domains listed in parenthesis)

- Lesson launch: *(Speaking, Listening, Writing, Reading)*
  Have you ever seen a mobile? (Bring one in as an example for demonstration purposes). What keeps it balanced? What makes it move? What forces are involved?
  The Explanation Game: Use this video https://www.youtube.com/watch?v=lI6IKLGMxUc
  Prompts: "I notice that _____" "What made that happen?" or "Why is that?"
  Introduce kinetic art
  Explore more deeply using the choice board to learn more about kinetic art
  Review types of energy, force, and motion
    a. Chalk Talk to have students recall what they have learned
    b. Whole class discussion, including how art can be influenced by one's culture or environment
- Introduce the project and expectations; include review of assessment rubric *(Speaking, Listening, Writing)*

    a. Student groups begin to collaboratively design their sculpture
    b. Utilize the Engineering Design Process Template or Design Thinking Template
- Continue design process, begin building *(Speaking, Listening, Writing)*
    a. Discuss with students what it feels like to put forth effort and perseverance in order to get the best results
    b. Have students reflect and self assess their own effort and persistence
- Students continue working on projects *(Speaking, Listening)*
    a. Encourage collaboration and provide feedback as students enter data
    b. Provide an opportunity for students to reflect on their cooperative skills
    c. Provide feedback
- Students continue working on projects *(Speaking, Listening)*
    a. Encourage collaboration and provide feedback as students enter data
    b. Provide an opportunity for students to reflect on their cooperative skills
    c. Continue to provide feedback; remind students of available supports and additional challenges as needed
    d. Have students reflect on their own progress
- Students create a presentation which describes the student's process, design elements, and details of scientific elements. Presentation can take several forms, **student choice** (Newsletter with images, slide show presentation, video recording, live presentation, etc.) *(Listening, Speaking, Reading, Writing)*
- Students practice their presentations by presenting to peers in class *(Speaking, Listening)*
    a. Student audience listens and responds to presentations by commenting on what the art means to them, whether or not they had similar challenges, etc.
    b. Encourage peer feedback
- Student art showcase--parents and visitors from school, district, and community invited to attend *(Speaking, Listening)*

Closing

Prompts for presentation:

- Describe the process you went through to plan the design of your sculpture and to determine which materials to use in your art;
- Describe the relevant forces at play in the sculpture; explain areas in which the sculpture demonstrates various types of energy
- Explain the challenges you faced and how you overcame them, what changed in your design;
- Describe your artwork and what it means to you.
- In what ways are artistic and scientific methods similar? During this process, were you **an artist or a scientist or both**?

Assessment

- Formative

Ongoing, throughout the lesson:

Whole class, small group, and individual conversations

Observations from teachers and peers, resulting in feedback

Progress in engineering template and design thinking template

Student reflections and self assessments during design and building process

- Summative

  Final product, assessed against rubric
  Oral and written presentation
  Documentation in engineering template and design thinking template

- How are the Collaborative rubrics used?

  This project naturally creates opportunities for students to practice a vast majority of the collaborative thinking skills through an authentic, hands-on, problem-based task. In order to ensure this project is truly transdisciplinary, the teacher(s) must remain true to elevating both the scientific and artistic elements of the kinetic sculpture as well as the process of designing, creating, and building it. By frequently returning to the Collaborative rubrics, the teacher will find it is easier to remain true to the intent of this project.

Culminating Event (Optional)

Student art showcase--parents and visitors from school, district, and community invited to attend

Teacher Reflection

This lesson requires STEM teachers to have strong background knowledge and appreciation of visual arts in order to successfully and fully integrate the content areas. If not careful, a STEM teacher could focus primarily on the science of the kinetic sculpture without enough emphasis on the artist elements and presentation of the piece. Professional development or, at a minimum, collaboration with content-specific teachers with a strong background knowledge of science and/or visual arts will be critical.

Extensions

For students who are accelerated or interested in pursuing this further, consider having them include additional elements or challenges (eg. Can you make the kinetic art move at a specific speed? What music would you select to play while your kinetic art is on display and why does that music work best for your kinetic sculpture?)

You could have them research an artist and ask them to create a piece that is inspired by their work. Students could also be asked to figure out how their sculpture could be combined with another sculpture in the class - and how to use academic vocabulary to describe how that would affect the artistic and scientific impact of the project. Finally, students could be asked to reflect on how their process used the creative and innovative thinking skills.

Standards:

	Grade Level	Grade Level	Grade Level	Grade Level
NATIONAL CORE ARTS STANDARDS (NCAS): *Visual Arts* *Artistic Processes:* *Creating, Responding, Connecting*	Generate and conceptualize artistic ideas: VA:Cr1.1.6a Combine concepts collaboratively to generate innovative ideas for creating art. VA:Cr1.1.8a Document early states of the creative process visually and/or verbally in traditional or new media. VA:Cr1.2.7a Develop criteria to guide making a work of art or design to meet an identified goal VA:Cr2.1.8a Collaboratively shape an artistic investigation of an aspect of a present-day life using a contemporary practice of art and design	Organize and develop artistic ideas and work: VA:Cr2.1.7a Demonstrate persistence in developing skills with various materials, methods, and approaches in creating works of art or design. VA:Cr2.1.8a Demonstrate willingness to experiment, innovate, and take risks to pursue ideas, forms, and meanings that emerge in the process of art-making or designing. VA:Cr2.3.8a Select, organize, and design images and words to make visually clear and compelling presentations.	Refine and complete artistic work: VA:Cr3.1.8a Apply relevant criteria to examine, reflect on, and plan revisions for a work of art or design in progress.	Perceive and analyze artistic work VA:Re.7.1.8a Explain how a person's aesthetic choices are influenced by culture and environment and impact the visual image that one conveys to the other.
	Synthesize and relate knowledge and personal experiences to make art. VA:Cn10.1.8a			

	Make art collaboratively to reflect on and reinforce positive aspects of group identity.			
NEXTGEN SCIENCE STANDARDS (NGSS): *Crosscutting concepts:* *Scale, proportion, and quantity* *Cause and effect* *Systems and system models*	MS-PS2-1. Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.*	MS-PS2-5 Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.	MS-PS3-1. Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.	MS-PS3-2. Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.
	MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.	MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.	MS-ETS1-3. Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.	

ENGLISH LANGUAGE ARTS COMMON CORE STANDARDS (CCSS): *Language Domains:* *Listening, Speaking, Reading, Writing*	W.8.1 Write arguments to support claims with clear reasons and relevant evidence.	W.8.2 Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.	SL.8.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacherled) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly.	SL.8.4 Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation.
	SL.8.5 Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest.	L.8.6 Acquire and use accurately grade-appropriate general academic and domain-specific words and phrases; gather vocabulary knowledge when considering a word or phrase important to comprehension or expression.		
OTHER CONTENT STANDARDS: ● *Social-emotional learning* ● *Responsive Teaching for All Learners* *(list specifics)* *CASEL Competencies and their related Capacities*	CASEL Competency: Relationship Skills Capacities: Communicating effectively Practicing teamwork and	CASEL Competency: Social Awareness Capacities: Taking others' perspectives Recognizing strengths in others	CASEL Competency: Self Management Capacities: Managing one's emotions Exhibiting self-discipline and self-motivation	Competencies of Culturally Responsive Teaching Bring real-world issues into the classroom Reflect on one's cultural lens

Competencies of Culturally Responsive Teaching	collaborative problem-solving Resolving conflicts constructively Showing leadership in groups Seeking or offering support and help when needed	Showing concern for the feelings of others Recognizing situational demands and opportunities	Setting personal and collective goals Using planning and organizational skills Showing the courage to take initiative Demonstrating personal and collective agency	