STEM Curriculum Planning Guide

This instructional design guide serves as the template for the design and development of STEM units of instruction at the Dayton Regional STEM Center in Dayton, Ohio. The guide is anchored to the *STEM Education Quality Framework* also developed at the Dayton Regional STEM Center.

STEM Unit Title	**Currently Adrift**
Economic Cluster	Environmental Engineering
Targeted Grades	7th grade
STEM Disciplines	Science Technology Engineering Mathematics
Non-STEM Disciplines	English Language Arts Social Studies

Section I: STEM Unit Overview

Unit Overview

Student teams will investigate effects of temperature on water density. Using this knowledge, students will then design a current to carry a raft to a nearby island. Using the video data collected during the design challenge, they will apply ratios and proportions to create a map of the raft's movement. Teams will then research ocean currents as they apply to real world events in search of a missing flight recorder. Student teams will then create a written proposal to present their predictions of the box's location.

Essential Question

How do differences in water temperature move and circulate the water and drive the ocean conveyor belt?

Enduring Understanding

Changes in water density cause global ocean current patterns
There is evidence of a human impact on climate change
Ratios and proportions can be used to understand and solve real world problems
Thermal energy is transferred in the ocean through currents.

Engineering Design Challenge

The news has just reported an aircraft crashing into the ocean. As part of the search and recovery team you need to recover the flight data recorder. It can provide key evidence in determining the cause of the aircraft loss. The design challenge is to engineer a model simulation of ocean currents and then estimate the location of a flight data recorder of a downed-at-sea aircraft. The ocean model will simulate the drift of the flight recorder to an island based on ocean currents. Your team will have to manipulate currents to carry your flight recorder onto two different islands. Your team will have hot water (yellow-dyed water) and cold water (blue-dyed water) to represent the currents of the conveyor belt. Your team needs to decide where to position two syringes with tubes to deliver water which is taped onto a tub of water, to represent the ocean, hot and cold water will be pumped into the tub to create the ocean currents and move your flight recorder.

Time and Activity Overview

Day	Time Allotment	Actvities
1	50 minutes	Pre-test Unit Hook Video Introduction
2	50 minutes	Introduction of Engineering Design Challenge and Engineering design Process Water Density Inquiry
3	50 minutes	Brainstorming Design Plan Generation
4	50 minutes	Testing, Analysis, & Redesign Exit Slip
5	50 minutes	Testing, Analysis & Redesign
6	50 minutes	Mapping, Video Analysis & Conclusions
7	50 minutes	Real-World Connections Go with the flow and clown fish simulations Based on conclusions from simulation, predict location of black box from list of lost black box list
8	50 minutes	Research Plane Location; Prepare Presentations

9	50 minutes	Research Plane Location; Prepare Presentations
10	50 minutes	Presentations Post-Test

Academic Content Standards

Pre-requisite Knowledge & Skill

Math:
~Understand rate and ratios
~Graph ordered pairs on a coordinate plane
~Calculate the product of fractions and mixed numbers

English Language Art:
~Be able to demonstrate presentation skills
~Be able to collaborate with your team
~Utilize proper writing conventions and grammar
~Be able to use writing for different purposes

Science:
~ Understanding of the concept of density
~ Understand the relationship between temperature and the change of state
~Understand how to calculate speed and direction

Social Studies:
~Use map reading skills to determine location

Add Standard	**Mathematics**
Grade/Conceptual Category	7
Domain	RATIOS AND PROPORTIONAL RELATIONSHIPS 7.RP.A
Cluster	Analyze proportional relationships and use them to solve real-world and mathematical problems.
Standards	7.RP.A. 1. Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units. For example, if a person walks ½ mile in each ¼ hour, compute the unit rate as the complex fraction ½ / ¼ miles per hour, equivalently 2 miles per hour. 7.RP.A. 2. Recognize and represent proportional relationships between quantities. a. Decide whether two quantities are in a proportional relationship, e.g., by testing for equivalent ratios in a table or graphing on a coordinate plane and observing whether the graph is a straight line through the origin. b. Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships. c. Represent proportional relationships by equations. For example, if total cost t is proportional to the number n of items purchased at a constant price p, the relationship between the total cost and the number of items can be expressed as t = pn. d. Explain what a point (x, y) on the graph of a proportional relationship means in terms of the situation, with special attention to the points (0, 0) and (1, r) where r is the unit rate. 7.RP.A.3 Use proportional relationships to solve multi-step ratio and percent problems.

Add Standard	English Language Arts
Grade	7
Strand	Writing
Topic	Research to Build and Present Knowledge
Standard	W. 7. 7- Conduct short research projects to answer a question, drawing on several sources and generating additional related, focused questions for further research and investigation.

Add Standard	Social Studies
Grade	7
Theme	World Studies from 750 B.C. to 1600 A.D.: Ancient Greece to the First Global Age
Strand (pk-8 only)	Geography
Topic	Spatial Thinking and Skills
Content Standard	12. Maps and other geographic representations can be used to trace the development of human settlement over time.

Add Standard	Social Studies
Grade	6 (Reinforcement)
Theme	REGIONS AND PEOPLE OF THE EASTERN HEMISPHERE
Strand (pk-8 only)	Geography
Topic	Spatial Thinking and Skills
Content Standard	4. Latitude and longitude can be used to identify absolute location

Add Standard	Science
Grade	7
Theme	Earth & Space Science
Topic	Cycles and Patterns of the Earth and the Moon
Content Standard	Thermal-energy transfers in the ocean and the atmosphere contribute to the formation of the currents, which influence global climate patterns. The sun is the major source of energy for wind, air and ocean currents and the hydrologic cycle. As thermal energy transfers occur in the atmosphere and ocean, currents form. Large bodies of water can influence weather and climate. The jet stream is an example of an atmospheric current and the Gulf Stream is an example of an oceanic current. Ocean currents are influenced by factors other than thermal energy, such as water density, mineral content (such as salinity), ocean floor topography and Earth’s rotation. All of these factors delineate global climate patterns on Earth.

Add Standard	Science
Strand	
Course Content	
Content Elaboration	

Add Standard	Fine Arts
Enduring Understanding	
Progress Points	
Grade Level	
Content Statement	

Assessment Plan

What evidence will show that students have acquired the enduring understandings for this STEM unit?

Performance Task, Projects	Research Creating map with calculations Video Analysis Setting up a successful experiment?
Quizzes, Tests, Academic Prompts	Pre-Test Post-Test
Other Evidence (e.g. observations, work samples, student artifacts, etc.)	Presentation
Student Self- Assessment	Exit tickets Student self-assessment for presentation

Technology Integration

ADISC Technology Integration Model*

	Type of Integration	Application(s) in this STEM Unit
A	Technology tools and resources that support students and teachers in ***adjusting, adapting, or augmenting*** teaching and learning to meet the needs of individual learners or groups of learners.	Powerpoint, Google Slides Presentation, Prezi
D	Technology tools and resources that support students and teachers in ***dealing effectively with data***, including data management, manipulation, and display.	Calculator
I	Technology tools and resources that support students and teachers in conducting ***inquiry***, including the effective use of Internet research methods.	Internet Research
S	Technology tools and resources that support students and teachers in ***simulating*** real world phenomena including the modeling of physical, social, economic, and mathematical relationships.	Videos
C	Technology tools and resources that support students and teachers in ***communicating and collaborating*** including the effective use of multimedia tools and online collaboration.	Video Recorder
	**The ADISC Model was developed by James Rowley PhD, Executive Director of the Institute for Technology-Enhanced Learning at the University of Dayton*	

Career Connections

Career Description

Climatologist
Climatologists also fit under the umbrella of atmospheric scientists. The primary difference from a meteorologist is that climatologists study weather patterns and trends over a long period of time as opposed to making short-term predictions. The long-term studies by climatologists are used to develop assessments of historical climate conditions in various cities, states, regions, countries and continents. Climatologists also watch for any significant changes in climates over time, which may affect long-term future weather conditions in an area.

Conservation Administration
Organizations and educational institutions all need administrative support to run the offices, apply for grants, hire and manage staff, create budgets and keep careful records. Administrative careers in nature conservation include nonprofit directors and fundraisers who interact with the public to increase awareness and raise money for research and conservation projects. Secretaries, bookkeepers, accountants, public relations and marketing professionals all play necessary roles in the industry dedicated to environmental studies and conservation.

Conservation Fieldwork
Careers that take you in the field are attractive to many naturists. Park rangers, while not specifically called conservationists, are on the front lines of conservation daily. They oversee state parks and public lands to ensure its safety and provide educational services to that public. You could work for a nonprofit conservation organization and spend your days collecting samples for study or mapping outdoor environs. Fieldwork with wildlife takes you to natural habitats where you may study migration and reproduction activities of animals or count living populations on the verge of extinction.

Conservation Scientists
Scientists in nature conservation often work in the field. Fisheries biologists, for example, are responsible for advising public policy makers how to protect the nation’s rivers and streams. They evaluate and monitor fish habitats and create safe areas for various species to live and populate. Wildlife biologists are focused on maintaining wildlife habitats and regularly study and monitor forests and wooded lands, plants and nesting grounds. They provide the expertise to support wildlife populations in danger of extinction and also make recommendations to policy makers.

Environmental Scientist

Environmental scientists study nature to monitor and discover potential threats to natural resources and populations. Much of their research involves taking samples of air, water and other natural substances to identify harmful threats or changing conditions. Discussion and studies of global warming fall under the umbrella of environmental science. In essence, careers in this field of science emphasize study of the impact of climate changes and environmental conditions on people, animals and plant life.

Meteorologist

The American Meteorological Society describes a meteorologist as someone “with specialized education, using scientific principles to explain, understand, observe or forecast the earth’s atmospheric phenomena.” It’s important to the general public to understand how the weather affects our living environment, so meteorologists translate these phenomena into concepts the general public can understand. A minimum of a four-year degree in meteorology or other sciences like earth and physical sciences is required. Meteorologists work in government, media, research, education, aviation and instrumentation, and as private consultants.

Meteorology Researcher

If you want to combine an interest in research with meteorology, there are several options in government and private industry. Forensic meteorologists examine weather patterns at the time of an accident, such as an airplane crash. Researchers develop tools for monitoring and forecasting. Many researchers spend time in the field observing hurricanes, tornadoes and other weather phenomena. If you're serious about weather-related research, pursue a Ph.D. in meteorology or atmospheric science.

Section II: STEM Lesson Plan

Title of Lesson — **Day 1: Pre-Test and Introduction to Currents**

Time Required — 50 minutes

Materials

Appendix A:Pre-Test (1 per student)
Appendix B: Pre/Post Test Teacher Edition
Appendix C: Ocean Currents Article (1 per student)
Appendix D: Black Box Prediction Sheet (1 per student)

Computer with projection capability
Global Map Example: https://www.google.com/maps/d/u/0/viewer?mid=zuVUPD-N5sEk.k2vClsDw8gtQ&hl=en_US

Hook video:Underwater search begins for black box of missing Malaysia Airlines Flight 370
https://www.youtube.com/watch?v=6r4FnmbhMZo

Objectives

Students will gain background knowledge on ocean currents through predicting the location of the flight data recorder for missing flight Malaysia 370.

Instructional Process

1. Administer the pre-test. Provide approximately 10-20 minutes to complete this assessment.

2. Play a video to build the students' interest and anticipation about the upcoming engineering design challenge. The video can be found on https://www.youtube.com/watch?v=6r4FnmbhMZo.

3. Next, provide students the article on Malaysian flight 370 from NewsELA. As students read, they will interact with the text by making personal connections, marking new vocabulary words, and asking questions about the flight. https://newsela.com/articles/malaysia-wingflap/id/11527/

4. Students will look at a global map and mark where they believe the black box from Malaysian Flight 370 could be. After marking their prediction, students will have to provide evidence for their answer.

5. To sum up the lesson, each student from the class will be able to mark on a global map where they believe the black box to be.

Differentiation

Article can be given to students based on Lexile level. For students that struggle with reading, allow students to read with a partner or use a text to speech application such as Speak It!

Assessments

Pre-Test

Section II: STEM Lesson Plan

Title of Lesson

Day 2: Water Density Inquiry

Time Required

50 minutes

Materials

- Lesson PowerPoint slides
-Video of demo of design challenge: https://youtu.be/r0cuxwDvoAI
- projector to show slides (1 per class)
- Cold water (colored blue) in foam cup (1 per team)
- Hot water (colored yellow) in foam cup (1 per team)
- Room temperature water in clear plastic cup (colorless) (1 per team)
- droppers (2 per team)
- Additional hot water (colored yellow) (1 per class)
- Additional cold water (colored blue) (1 per class)
- 2 identical clear baby food jars (1 set per class)
- Water-resistant card (from a deck of cards or laminated index card) (1 per class)
- Paper towels

Appendix E: KWL Chart (1 per student)
Appendix F: Water Density Inquiry Handout Student Version (1 per student)
Appendix G: Water Density Inquiry Handout Teacher Version (1 per teacher)
Appendix H: Engineering Design Process Wheel (1 per team)
Appendix I: Engineering Design Process Wheel Cover (1 per team)
Appendix J: Student Handout for Engineering Design Challenge (1 per team)
Appendix K: Design Challenge Rubric

Teacher Preparation:
- Add ice to water to make very cold water. Half-fill one foam cup with cold water (no ice cubes) and another with hot water for each group.
- Add 2 drops of yellow food coloring to the hot water and 2 drops of blue food coloring to the cold water.
- Fill a clear plastic cup about ⅔ of the way with room-temperature water.
- Distribute the set of 3 cups to each group

Objectives

Student will explore the Engineering Design Process through discovering the Design Challenge.
Students will engage in a water density inquiry, to understand the impact of temperature on water density.

Instructional Process

1. Warm Up: Have you ever heard of the Engineering Design Process? If so, what have you heard? If not, think about and list the steps you would follow to solve a problem.

2. Distribute the Student Handout for Engineering Design Challenge, Mapping Handout for Engineering Design Challenge, Design Challenge Rubric. Read through the design challenge and rubric.

Show design challenge and read aloud.

"The news has just reported an aircraft crashing into the ocean. As part of the search and recovery team, you need to recover the flight data recorder. It can provide key evidence in determining the cause of the aircraft loss. The design challenge is to engineer a model simulation of ocean currents and then estimate the location of a flight data recorder of a downed-at-sea aircraft. The ocean model will simulate the drift of a flight data recorder to an island based on ocean currents. Your team will have to manipulate currents to carry your flight data recorder

onto two different islands. Your team will have hot water (yellow-dyed water) and cold water (blue-dyed water) to represent the conveyor belt. Using two syringes with tubes taped onto a tub of water, which represents the ocean, hot and cold water will be pumped into the tub to create the ocean currents."
Recollect the the rubrics to distribute on Day 3.

3. Each team of students will have an Engineering Design Process wheel (teacher will put together for students with metal brad prior to instruction-laminating will allow them to be used again) to use to follow the process and explain that everyone has completed step one. Allow for questions about the design process. Ask students what step is next. Once "Research" has been identified, explain that in order to research effectively, students will need to identify specific topics to investigate.

4. Student teams work together to identify background knowledge they have that could inform the design challenge. Students write this information in the "know" box. Students also write questions that they would like to answer in order to excel at the design challenge. These questions go in the "Wonder" section. Students will record information that they learn in the "Learned" section of their chart.

5. Hand out activity sheet.
Teacher demonstration. Tell students that you are going to try to place one jar filled with hot colored water upside down over another jar with cold colored water.
Discussion Question: Do you think the hot and cold water will mix or stay separate?
Procedure:
A. Hot water on top
i. Completely fill a baby food jar with hot tap water and add 2 drops of yellow food coloring.
ii. Completely fill another baby food jar with very cold water and add 2 drops of blue food coloring. Stir the water in both jars so that the coloring is well-mixed in both. Place the cold water jar on a paper towel.
iii. Hold a water-resistant card over the top of the hot water jar.
iv. While holding the card against the jar opening, carefully turn the jar upside down.
v. With the card still in place, position the jar of hot water directly over the jar of cold water so that the tops line up exactly.
vi. Slowly and carefully remove the card so that the hot water jar sits directly on top of the cold water jar.

Discussion Questions:
- Why do you think the hot water stayed on top of the cold water?
- What might happen if you placed the cold blue water on top of the hot yellow water and then removed the card?

B. Cold water on top
i. Use the same procedure as above, but place the jar of cold water, upside down over the jar of hot water.
Discussion Question: Why do you think the hot and cold water mixed when the cold water was placed on top?

6. Group lab inquiry activity: Is there a density difference between hot and cold water?
'
Discussion Questions:
- What did you notice when you placed the cold blue water in room-temperature water?
- Is cold water more, less, or the same density as room-temperature water?
- What did you notice when you placed the hot yellow water in room-temperature water?
- Is hot water more, less, or the same density as room-temperature water?

7. Students clean up and connect what they discovered in the lab to the Design Challenge in the Learned section of their KWL chart.

Differentiation

For students struggling with grasping the relationship between temperature and water density, consider showing videos.

Extension for students who have mastered the relationship between temperature and water density- review your prediction of where the black box may be, based on what you learned during this lab. Has your prediction changed?

Assessments

Water Density Inquiry Handout. "Learned" section of KWL chart

Section II: STEM Lesson Plan

Title of Lesson — **Day 3: Plan and Prepare to Sail**

Time Required — 50 minutes

Materials

For each team:
one clear, rectangular, plastic tub about 11 inches by 15 inches,
two 30 mL syringes,
two plastic tubing about 2-3 feet long that connects to the syringes,
duct tape to tape tubes to the tub,
two different food coloring one each for the hot and cold water,
two sheets of quarter-inch ruled graph paper with the x- and y-axis drawn in the middle of the paper,
one clear bottle cap that will act as the “black box”,
one toothpick and some modeling clay (this will used to mark the position of the “nearby” island),
video recorder (unless students are using their smart phones to videotape the trials),
Coordinate Plane printable (based on the size of your container)

Appendix K: Design Challenge Rubric (1 per team)
Appendix L: Coordinate Plane Graph Paper Information (Approximately 5 sheets of graph paper per team, choose size based on size of tub)
Appendix M: First Trial Exit Ticket (1 per team)
Appendix N: List of Possible Locations (1 per teacher)

Objectives

Students will be given materials to brainstorm their ideas as a team as to where to place their materials to carry the flight recorder to the designated area.

Instructional Process

1 Review the Engineering Design Process and explain that this process will be used during the Engineering Design Challenge.

2 .Have all the materials accessible for each team for the design challenge (see materials above) in the tub to used during planning.

3, Explain key points of the Engineering Design Challenge:
a. Each tub will have one inch of room temperature water placed in it.
b. A sheet of graph paper will be placed under the tub so that origin is directly below the center of the plastic tub.
c. Use a clear plastic water bottle cap to represent the black box and the modeling clay will hold the toothpick to represent the “nearby” island.
d. Teams will be given different locations for a “nearby” island so each team’s challenge will be a little different.
e. Teams will place the bottle cap at the center of the tub (the origin on the graph paper) to start the trial.
f. Teams will record every trial on a smartphone or other video recording device as evidence of the trial as well as to be used in the map activity of Day 6.
g. Teams will have to decide where to place the two tubes in the tub so that both tubes are under the water level in the tub and then tape the tubes using duct tape to the tub.
h. Both syringes will be filled, one with yellow-dyed hot water and one with blue-dyed ice cold water.
i. Teams will start videotaping from a position directly above the tub, and then release the hot and cold water from each syringe to see what effect these water currents have on their black box.
j. Each team will be given a different location for their “nearby” island. For example, an island is 9 miles East and 6 miles South of the current black box location.

k. Teams will have to work together and complete the mathematical process to locate the position of their island on the coordinate plane.

l. Teams will place the toothpick in the modeling clay at the correct location. The island locations will be checked and must be mathematically proven as to where the island would be placed (ask for the math as their evidence).

4. For 3-5 minutes teams will individually brainstorm where they would place the two tubes in the tub so the current created will carry the black box to the island.

5. For 5-10 minutes teams will share what they thinks is the best location for the two tubes, and then decide where they think is the best placement of the tubes for the first trial tomorrow.

6. Teams will add this first location of both tubes as well as the location of their island on a graph paper.

7. Teams will complete an exit ticket that explains where and why they placed the tubes.

Differentiation

For students who have difficulty with written expressions, have the team give the teacher a verbal report of where they are planning to place each tub and explain their reasoning for this location.

Assessments

First Trial exit ticket

Section II: STEM Lesson Plan

Title of Lesson

Day 4 & 5: Engineering Design Challenge

Time Required

100 minutes

Materials

For each team:
one clear, rectangular, plastic tub about 11 inches by 15 inches,
two 30 mL syringes,
two plastic tubing about 2-3 feet long that connects to the syringes,
duct tape to tape tubes to the tub,
two different food coloring one each for the hot and cold water,
two sheets of quarter-inch ruled graph paper with the x- and y-axis drawn in the middle of the paper,
one clear bottle cap that will act as the “black box”,
one toothpick and some modeling clay (this will used to mark the position of the “nearby” island),
video recorder (unless students are using their smart phones to videotape the trials)
Engineering Design Wheel
Manila Folder (1 per team)

Appendix J: Student Handout For Engineering Design Challenge (1 per team)
Appendix L: Coordinate plane Graph Paper Information (Approximately 10 sheets of graph paper per team, choose size based on size of tub)
Appendix O: Mapping Handout for Engineering Design Challenge (1 per team)

Objectives

Students will test, analyze, and redesign their models. Concurrently, they will be gathering data via recording their trials.

Instructional Process

1. Post the Engineering Design Process on the SmartBoard or projector.

2, Hand each team “Student Handout for the Engineering Design Challenge” and a manilla folder. Explain the key points of the Engineering Design Challenge and keep all paperwork in the folder. Store the folder in the classroom.

3. Teams work to get their black box to carried to their nearby island using the location of the tubes that the team decided on from Day 3.

4. Teams will have the entire period to create a current to carry their black box to the island. For each trial, the teams need to complete all the steps on the “Student Handout for the Engineering Design Challenge”.

5. If a team gets their black box to their nearby island, provide another island location for the team so that they can continue to test.

6. Walk around the room monitoring each teams progress and answering student questions.

7. For Day 2, regardless if the team got their black box to their island, give each team a new island location. Teams should use previous trials to guide their next trial.

Differentiation

For teams who get their black box to the island, the teacher will have another island location for the team.

Assessments

"Student Handout for the Engineering Design Challenge" There should be a graph paper for each trial. The team will be assessed on how they answer the questions on this handout

Section II: STEM Lesson Plan

Title of Lesson — **Day 6:Map It**

Time Required — 50 minutes

Materials

Smart Phone or video camera that was used to video each trial of Days 4 and 5, the graph paper used by the team during all the trials, “Mapping Handout for the Engineering Design Challenge”, calculators (if teacher approved)

Appendix K: Design Challenge Rubric (1 per team)
Appendix O: Mapping Handout for Engineering Design Challenge (1 per team)

Objectives

Students will map, analyze their videos, and provide conclusions. *See Mapping Day 6 document*

Instructional Process

1. Distribute the “Mapping Handout for the Engineering Design Challenge” to each team and explain the key components.

2. Show the provided video of the example of the teacher demonstrating finding the points from the recording during the engineering design challenge, plotting the points and calculating the distance.

3. Teams work to map their two most successful trials to their two nearby islands.

4. Circulate around the room to help clarify any student questions and provide assistance to each team.

5. Teams complete and turn in both trials by the end of the class period.

Differentiation

For students who struggle with math, the teacher could provide an example of the math used to “map” a black box to an island. The students could see how to solve a similar problem and apply that example to their problem. For students who excel in math, the students could use the Pythagorean theorem to find how far the black box was from the starting location (an 8th grade math standard).

Assessments

“Mapping Handout for the Engineering Design Challenge” handout

Section II: STEM Lesson Plan

Title of Lesson — **Days 7 & 8: The Deep Dive**

Time Required — 100 minutes

Materials

Computers with internet access

Appendix P: The Great Ocean Conveyor Belt Simulation Experience (1 per student)
Appendix Q: 3.2.1. Exit Ticket (1 per student)
Appendix R : The Investigative Process Go Team NTSB Career Descriptions (1 per team)
Appendix S: Let's Dive In Career Research Note-Taking guide (1 per student)
Appendix T: PSA Career Poster Assignment (1 per team)
Appendix U: PSA Career Poster Checklist (1 per team)
Appendix V: PSA Career Poster Rubric (1 per team)
Appendix W: Poster Sample (1 per team)

Clown Fish simulator link : Columbia.edu website link
http://ocp.ldeo.columbia.edu/climatekidscorner/nemo_page.shtm
NASA simulator link: http://spaceplace.nasa.gov/ocean-currents/en/

Objectives

Students will engage in simulations to make connections between their results and ocean currents.

Instructional Process

1. Students will be investigating online simulations. The first one is called Ocean Currents, that uses a Clown Fish as a guide and the other a NASA Space Place simulation called The Great Ocean Conveyor Belt. Both of the links to these online simulations are on the student hand-out Appendix P.

2. The teacher will direct students to access Ocean Currents first followed by The Great Ocean Conveyor Belt at NASA Space Place.

3. The teacher will hand out Appendix Q which is a student guide for both online simulations. The teacher will also pass out the exit ticket Appendix R that students will complete following both simulations.

4. The teacher will then direct students to follow along as the teacher explains the process or demonstrates both of the simulations

5. Teacher will ask students to form a prediction before they begin about the length of time it will take to get the Clown fish home. Students will then guide a Clown fish along the Gulf Stream during this simulation and they will be following arrow indicators to end up in the Coral Sea.

6. Next, students will engage in a NASA simulation of The Great Ocean Conveyor Belt. Students will read the text, view a video presentation and then play the game.

7. Students will then complete a 3.2.1. Exit ticket to reflect on the both simulations. They will discuss in the Exit ticket what they understood, any remaining questions and interesting details regarding the online simulations. This could lead to a teacher-led class discussion or peer to peer discussion.

8. Following the completion of the simulations and the exit ticket student teams will be given will be given the

following documents Appendix R- The Investigative Process Team NTSB Career Descriptions, Appendix T- PSA Career Poster Assignment, Appendix U- PSA Career Poster Checklist, Appendix V- PSA Career Poster Rubric and Appendix W- a completed poster example. The teacher will also hand out to each student Appendix S- Let’s Dive In Career Research Note-taking guide.

9. The teacher should spend some time going over each of the student career research documents clarifying expectations and answering any task specific questions that student teams have and making sure all students are aware of their individual responsibilities to perform research and share their new knowledge with their team.

10. Depending on length of class period these tasks have been given two days to be completed, the teacher can adjust time as necessary depending on the individual and team needs.

Differentiation

Students who struggle with research and higher level content reading they can be paired with a peer during research and creation of their career poster. Students who are accelerated could research local jobs that might be available in their chosen career field and look at what college requirements and what colleges specialize in these career goals.

Assessments

PSA Poster by rubric
3.2.1. Exit Ticket

Section II: STEM Lesson Plan

Title of Lesson

Days 9 & 10: Pinpoint the Flight Recorder

Time Required

100 minutes

Materials

computers with internet access (multiple for each team),
iMovie/Movie Maker video editing software (possible)

Appendix X: Plane Down:Missing Flight Recorder Handout (1 per team0
Appendix Y: List of Unrecoverable Flight Recorders (1 per team)
Appendix Z : Presentation Rubric (1 per team)

Objectives

Student teams will be tasked with completing a presentation to highlight their work on the Engineering Design Challenge, as well as their work on analyzing and predicting the location of an unrecovered flight recorder.

Instructional Process

1. Teacher will pass out Plane Down: Missing Flight Recorder handout to each student.

2. Student teams will have ten minutes to look over presentation requirements, determine next steps, and ask clarifying questions of the teacher.

3. Student teams will then begin working on preparing their presentations for Day 11.

4. Teacher will need to assist students in the use of incorporating the video clip into their presentations, as well as ensuring that all student teams are working effectively and efficiently.

Differentiation

The extent of the presentation can be differentiated for varying student needs. For students with a higher level of readiness, the requirement of NOAA ocean currents/ data can be incorporated. For lower level of readiness, student teams can be given information on the currents in the area, in order to determine the flight recorder's location.

Assessments

Students will be assessed on Day 11 with the Presentation Rubric.

Section II: STEM Lesson Plan

Title of Lesson — **Days 11 & 12: Present and Reflect**

Time Required — 100 minutes

Materials

Computer with speakers and projector

Appendix Z : Presentation Rubric (1 per team)
Appendix AA: Self/Peer/Team Reflection (1 per student)
Appendix A; Pre/Post Test Student Version (1 per student)
Appendix B: Pre/Post Test Teacher Edition (1 per teacher)

Objectives

Student teams will present data from the Unit in the form of a presentation. Students will then take the Post-Test and complete the Self/Peer/Team Reflection.

Instructional Process

1. Student teams will give their 5-7 minute presentations, while teacher assesses the presentations.

2. Students will then complete the Self/Peer/Team Reflections.

3. Students will then complete the Unit Post-Test.

Differentiation

Post-Test can be modified based on learner's level of readiness and to reflect other modifications/extensions in the unit.

Assessments

Self/Peer/Team Reflection, Post-Test, Presentation Rubric

Section III: Unit Resources

Materials and Resource Master List

30 mL syringes (2 per team)
Black and red pen (1 per team)
Blue food coloring (enough for density activity and for engineering design activity)
Clear bottle cap that will act as the "black box" (1 per team)
Clear plastic cup (1 per team)
Clear, rectangular, plastic tub about 11 inches by 15 inches (1 per team)
Computer with Internet access and video editing software (ideally 1 per student)
Coordinate Plane printable (based on the size of your container) (1 per team)
Droppers, small (2 per team)
Duct tape to tape tubes to the tub (1 per team)
Foam cup (2 per team)
Hot plate or hot pot to make hot water (enough to fill cups for density activity and to fill plastic tubs for engineering design activity)
Ice and cold water (enough to fill cups for density activity and to fill plastic tubs for engineering design activity)
Identical clear baby food jars (2 for teacher)
Manila folder (1 per team)
Paper towels
Plastic tubing about 2-3 feet long that connects to the syringes (2 per team)
Quarter-inch ruled graph paper with the x- and y-axis drawn in the middle of the paper (2 sheets per team)
Toothpick and some modeling clay (1 per team)
Video recorder (unless students are using their smart phones to videotape the trials)
Water-resistant card (from a deck of cards or laminated index card) (1 for teacher)
Yellow food coloring(enough for density activity and for engineering design activity)

Key Vocabulary

complex fraction - a fraction with fraction in its numerator and/or denominator

coordinate plane - a two dimensional plane that is numbered using a horizontal axis (x-axis) and a vertical axis (y-axis)

density- a measure of how much mass is contained in a given unit volume (density = mass/volume). (http://www.windows2universe.org/glossary/density_defn.html)

downwelling- the piling up and sinking of surface waters as they move toward the coast. (http://oceanmotion.org/html/background/upwelling-and-downwelling.htm)

global conveyor belt- a constantly moving system of deep-ocean circulation driven by temperature and salinity (http://oceanservice.noaa.gov/facts/conveyor.html)

ocean currents- a horizontal movement of seawater in the ocean. (http://www.eoearth.org/view/article/154990/)

ordered pair - is a pair of numbers used to locate a point on a coordinate plane

proportion - a statement that two ratios are equal

rate - ratio between to unlike quantities (ex: miles per hour, price per pound)

ratio - comparison between two like quantities

salinity- the amount of dissolved salts that are present in water. (http://www.britannica.com)

syringe - an instrument that can release or withdraw a fluid

unit rate - a rate that compares how many of the first quantity compares to one unit of the second quantity

upwelling- Upwelling is a process in which deep, cold water rises toward the surface. (http://oceanservice.noaa.gov/facts/upwelling.html)

water circulation- the mixing of layers found in a body of water.

water column- a conceptual column of water from the surface of a sea, river or lake to the bottom sediments- any particulate matter that can be transported by fluid flow and which eventually is deposited as a layer of solid particles on the bed or bottom of a body of water or other liquid. (https://www.sciencedaily.com/terms/sediment.htm)

Technical Brief

The ocean covers 71 percent of the planet and holds 97 percent of its water, making the ocean a key factor in the storage and transfer of heat energy across the globe. The movement of this heat through local and global ocean currents affects the regulation of local weather conditions and temperature extremes, stabilization of global climate patterns, cycling of gases, and delivery of nutrients and larva to marine ecosystems.
Ocean currents are located at the ocean surface and in deep water below 300 meters (984 feet). They can move water horizontally and vertically and occur on both local and global scales. The ocean has an interconnected current, or circulation, system powered by wind, tides, the Earth's rotation (Coriolis effect), the sun (solar energy), and water density differences. The topography and shape of ocean basins and nearby landmasses also influence ocean currents. These forces and physical characteristics affect the size, shape, speed, and direction of ocean currents.
Surface ocean currents can occur on local and global scales and are typically wind-driven, resulting in both horizontal and vertical water movement. Horizontal surface currents that are local and typically short term include rip currents, longshore currents, and tidal currents. In upwelling currents, vertical water movement and mixing brings cold, nutrient-rich water toward the surface while pushing warmer, less dense water downward, where it condenses and sinks. This creates a cycle of upwelling and downwelling. Prevailing winds, ocean surface currents, and the associated mixing influence the physical, chemical, and biological characteristics of the ocean, as well as global climate.

Deep ocean currents are density-driven and differ from surface currents in scale, speed, and energy. Water density is affected by the temperature, salinity (saltiness), and depth of the water. The colder and saltier the ocean water, the denser it is. The greater the density differences between different layers in the water column, the greater the mixing and circulation. Density differences in ocean water contribute to a global-scale circulation system, also called the global conveyor belt.

The global conveyor belt includes both surface and deep ocean currents that circulate the globe in a 1,000-year cycle. The global conveyor belt's circulation is the result of two simultaneous processes: warm surface currents carrying less dense water away from the Equator toward the poles, and cold deep ocean currents carrying denser water away from the poles toward the Equator. The ocean's global circulation system plays a key role in distributing heat energy, regulating weather and climate, and cycling vital nutrients and gases.

Safety and Disposal

Before beginning the activities in this unit, discuss equipment and safety guidelines with students.
Students must avoid drinking water from science equipment at all times.
Students must immediately clean up water spills in the lab area.
Students should wear goggles and aprons when heating water and using food coloring dye.
Students must use oven mitts or gloves to handle hot water samples.
When working with electrical devices, students must have dry hands.
Water with food color may be dumped down the drain.
Once activities are complete, materials may be discarded or cleaned and stored in the lab.

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