STEM WORKS THINKit

Community Need

GIS & DRONE

Our community needs

Tech Tool Ideas: Career Connections:

01 DEFINE THE PROBLEM

Define the Problem

Our engineering & design goal is to...

Our community is...

Three Criteria! We are successful if...

Three Constraints! Our solution is limited by...

02 GATHER PERTINENT INFO

Gather Pertinent Info

1.

2.

3.

4.

03 GENERATE IDEAS!

04 REFLECT & SELECT!

05 DESIGN SOLUTION!

06 TEST & OPTIMIZE!

07 SHARE & REFLECT!

STEM works THINKit

GIS & DRONE · **PROTOTYPE**

Community Need

There are many beautiful places to go hiking and swimming but sometimes people get hurt and cannot hike back. Drones can be used to find people and carry emergency supplies before a helicopter can arrive. Creating emergency drop kits with a message to the injured person will help calm and treat them.

Tech Tool Ideas:
ArcGIS Story Maps
Drone Technology
Recyclables

Career Connections:
Emergency Medical Technician
Geospatial Analyst
Drone Pilot
Packaging Engineer

01 DEFINE THE PROBLEM — Define the Problem

Our engineering & design goal is to...

Our community is...

Three Criteria! We are successful if...

Three Constraints! Our solution is limited by...

02 GATHER PERTINENT INFO — Gather Pertinent Info

1. What might the emergency drone supply kit need to contain?

2. How might emergency staff communicate with the injured or lost hiker (without cell service)?

3. How might the safety kit be attached, detached, and/or reattached?

4. How might you train and communicate with the hiking community or medical staff to properly use the safety drone?

5. How do balanced and unbalanced forces allow a drone to fly and maneuver? How might this impact the weight or shape of your kit?

Unit Extension Ideas

Connect to the NGSS Standards!

Explore possible materials used for packaging an emergency kit. Does it need to: stay dry, survive a fall, easily seen, reopen/close? Decide on the intended purpose and test materials based on properties such as: strength, flexibility, absorbance, durability, texture, absorbency, weight, etc.

2nd

- ❑ **PE:** Matter and Its Interactions: 2-PS1-2. Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.
- ❑ **SEP:** Analyzing and Interpreting Data
- ❑ **DCI:** PS1.A: Structure and Properties of Matter
- ❑ **CCC:** Cause and Effect

Model and/or test the implication of forces on first aid kit design. For a drone to lift off, the upward force on the drone, provided by the movement of air by the propellers, needs to be greater than the downward force of gravity. If a first air kit is added, the gravitational force increases, and more upward force is needed to fly.

5th

- ❑ **PE:** Motion and Stability: Forces and Interactions: 5-PS2-1. Support an argument that the gravitational force exerted by Earth on objects is directed down.
- ❑ **SEP:** Engaging in Argument from Evidence
- ❑ **DCI:** PS2.B: Types of Interactions
- ❑ **CCC:** Cause and Effect

Model effects of balanced and unbalanced forces on drone flight (up, down, forward, backward, etc.). Explore the effects of mass on forces and changes in motion. How does the addition of an emergency kit or wind impact the model of forces involved in flight?

6-8

- ❑ **PE:** Motion and Stability: Forces and Interactions: MS-PS2-2. Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.
- ❑ **SEP:** Planning and Carrying Out Investigations
- ❑ **DCI:** PS2.A: Forces and Motion
- ❑ **CCC:** Stability and Change

Solution design should prioritize criteria and consider tradeoffs/constraints such as weight, durability, cost, safety, reliability, aesthetics; as well as any regulations, social, cultural, or environmental impacts.

9-12

- ❑ **PE:** Engineering Design: HS-ETS1-3.Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.
- ❑ **SEP:** Constructing Explanations and Designing Solutions
- ❑ **DCI: EDP:** ETS1.B: Developing Possible Solutions
- ❑ **CCC:** (Project Design Specific)

STEM WORKS THINKit

Community Need

Drone technology is excellent for creative photography. For the upcoming school open house, students want a photo booth featuring three photos from unique perspectives. The booth needs to be easy to operate, so students with little experience can run the booth.

Tech Tool Ideas:
Drone Technology
Drone Camera

Career Connections:
Photographer, Event Planner
Drone Pilot
Programmer

01 DEFINE THE PROBLEM

Define the Problem

Our engineering & design goal is to...

Our community is...

Three Criteria! We are successful if...

Three Constraints! Our solution is limited by...

02 GATHER PERTINENT INFO

Gather Pertinent Info

1. How will you keep the experience safe?

2. To save time, how might you automate parts of the photo booth experience?

3. Drone batteries die quickly, how will you make sure the station is open for as long as it can be?

4. On a low cost budget, how might you share the photos with families?

5. What is your plan or system for training other people to help run the booth?

Unit Extension Ideas

Connect to the NGSS Standards!

Design a safety and training manual that communicates in diagrams and a series of sequential directions on how to run the photo booth. The manual might include one or more of the following: how to code and fly the drone, set up the booth, take photos, and share images.

K-2
- ☐ **PE:** Engineering Design K-2-ETS1-2. Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.
- ☐ **SEP:** Asking Questions and Defining Problems
- ☐ **DCI: EDP:** ETS1.A: Defining and Delimiting Engineering Problems
- ☐ **CCC:** Structure and Function

After the design process, students reflect on how their experience relates to the following statements. (1) Team communication is an important part of the process and can lead to more design solutions. (2) Researching the problem prior to creating a solution helps to broaden and inform solution ideas. (3) Testing to see how it performs under a range of likely conditions helps improvement. (4) Criteria help you design a solution and constraints limit your possibilities.

3-5
- ☐ **PE:** Engineering Design: 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.
- ☐ **SEP:** Constructing Explanations and Designing Solutions
- ☐ **DCI: EDP:** ETS1.B: Developing Possible Solutions
- ☐ **CCC:** (Project Dependent)

Students compare and evaluate each other's processes using constructive critique on how it meets criteria and constraints. Affirm parts of the process that work and gives advise on how to improve what's confusing. Students explain how they would (or wouldn't) utilize feedback and then redesign to improve their solution.

6-8
- ☐ **PE:** Engineering Design: MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
- ☐ **SEP:** Engaging in Argument from Evidence
- ☐ **DCI: EDP:** ETS1.B: Developing Possible Solutions
- ☐ **CCC:** (Project Dependent)

As a team, using at least three criteria for design, focus and systematically approach a solution by making a plan for content. Make decisions about the priority of certain criteria over others (identify trade-offs).

9-12
- ☐ **PE:** Engineering Design: HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
- ☐ **SEP:** Constructing Explanations and Designing Solutions
- ☐ **DCI: EDP:** ETS1.C: Optimizing the Design Solution
- ☐ **CCC:** (Project Dependent)

STEM WORKS THINKit

CODING   **GIS & DRONE**

Community Need

Our community needs a new automated transit route for both tourists and families to get where they need to go on a trolley or bus. It needs to be reliable and safe.

Tech Tool Ideas:
Ozobot, Sphero, littleBits, ArcGIS Story Maps, Drone Technology

Career Connections:
Programmer
Transit Operator
Community Planner
Drone Pilot

01 DEFINE THE PROBLEM

Define the Problem

Our engineering & design goal is to...

Our community is...

Three Criteria! We are successful if...

Three Constraints! Our solution is limited by...

02 GATHER PERTINENT INFO

Gather Pertinent Info

1. How might code direct an autonomous vehicle?

2. What city are you in?

3. Where might people want to stop?

4. How can you make it safe for people to get on and off the trolley?

5. What are the purpose of medians in the road?

6. Can you communicate where and when to expect the trolley (predict a schedule of stops)?

7. How can you use measurement to scale the time in your prototype to represent real time for a real transportation schedule?

01 DEFINE THE PROBLEM
02 GATHER PERTINENT INFO
03 GENERATE MULTIPLE SOLUTIONS
04 REFLECT, ANALYZE, AND SELECT A SOLUTION
05 DESIGN CULTURALLY RESPONSIVE SOLUTIONS
06 TEST AND OPTIMIZE
07 SHARE AND REFLECT

Unit Extension Ideas

Connect to the NGSS Standards!

Compare the safety or efficiency of the shape of different routes.

K-2
- ☐ **PE:** Engineering Design: K-2-ETS1-2: Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.
- ☐ **SEP:** Asking Questions and Defining Problems, Developing and Using Models, Analyzing and Interpreting Data
- ☐ **DCI: EDP:** ETS1.B: Developing Possible Solutions
- ☐ **CCC:** Structure and Function

Optimize the pattern of visual code that deliver autonomous vehicle transport on different routes.

4th
- ☐ **PE:** Waves and Their Applications in Technologies for Information Transfer: 4-PS4-3.Generate and compare multiple solutions that use patterns to transfer information.
- ☐ **SEP:** Asking Constructing Explanations & Designing Solutions
- ☐ **DCI:** PS4.C: Information Technologies & Instrumentation. **EDP:** ETS1.C: Optimizing the Design Solutions
- ☐ **CCC:** Patterns

Given the same speed of a vehicle, explore safety implications of an impact when parked versus moving on a designated route. Draw conclusions about the placement of a route and/or the a road median's size and location.

6-8
- ☐ **PE:** Motion and Stability: Forces and Interactions: MS-PS2-1. Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.
- ☐ **SEP:** Constructing Explanations & Designing Solutions
- ☐ **DCI:** PS2.A: Forces and Motion
- ☐ **CCC:** Systems and System Models

Observe and compare vehicles (objects) of different mass during collision and mathematically make predictions about the effects of a full versus an empty bus on safety. Alter the velocity of the moving object over a set distance. Measure/graph mass vs. distance moved upon impact. Have students infer relationships between net forces, mass, and acceleration (change in velocity over time) to make solutions for traffic or road safety.

9-12
- ☐ **PE:** Motions and Stability: Forces and Interactions: HS-PS2-1: Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.
- ☐ **SEP:** Analyzing & Interpreting Data
- ☐ **DCI:** PS2.A: Forces and Motion
- ☐ **CCC:** Cause & Effects

STEM WORKS THINKit

Community Need

Your relative just graduated and is going off to college. Your family is having a party to celebrate! Everyone wants a unique digital scrapbook where childhood memories can be geotagged, and new memories can be added!

Tech Tool Ideas:
Aria Creator (VR)
ArcGIS Story Maps
Google Maps

Career Connections:
Storyteller, Journalist
Geospatial Map Technician
Social Media Marketer

VIRTUAL REALITY

GIS

01 DEFINE THE PROBLEM
Define the Problem

Our engineering & design goal is to...

Our community is...

Three Criteria! We are successful if...

Three Constraints! Our solution is limited by...

02 GATHER PERTINENT INFO
Gather Pertinent Info

1. How can technology be used to geotag memories to share a life story?

2. How should the information (visuals and quotes) be organized?

3. How can a story be told without posting personal information (internet privacy)?

4. What events or milestones might a family want highlighted?

5. How will the content be shared with family?

Unit Extension Ideas

Connect to the NGSS Standards!

Brainstorm list of materials you might use to design a physical memory book. Diagram how each item may impact the environment. How does choosing to create a digital portfolio, (that can be viewed anywhere) reduce your families impact on the land, water, and living things?

K

- ❑ **PE:** Earth and Human Activity: K-ESS3-3. Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.
- ❑ **SEP:** Obtaining, Evaluating, and Communicating Information
- ❑ **DCI:** ESS3.C: Human Impacts on Earth Systems, **EDP:** ETS1.B: Developing Possible Solutions
- ❑ **CCC:** Cause and Effect

There are many hereditary traits that are passed from parents to children. Students can explore ideas such as eye, hair, and skin color. To dive deeper, have students look through family photos to see if they can find dominant traits that family members share like attached earlobes, tongue rolling, cleft chin, dimples, freckles, windows peak hairline shape, and more!

3rd

- ❑ **PE:** Heredity: Inheritance and Variation of Traits: 3-LS3-1. Analyze and interpret data to provide evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms.
- ❑ **SEP:** Analyzing and Interpreting Data
- ❑ **DCI:** LS3.A: Inheritance of Traits, LS3.B: Variation of Traits
- ❑ **CCC:** Patterns

Compare and contrast various means of physical and digital memory book platforms such as: social media, virtual reality, ArcGIS Story Maps, videos, file folders on a computer, etc. Evaluation may include reliability, stability, sharing, copying, transferring, security, theft, etc. Using this information, decide which options may be recommended to criteria and constraints for a family.

6-8

- ❑ **PE:** Engineering Design MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
- ❑ **SEP:** Engaging in Argument from Evidence
- ❑ **DCI:** **EDP:** ETS1.B: Developing Possible Solutions
- ❑ **CCC:** (Project & design specific)

Evaluate advantages and disadvantages of a physical versus various digital means for a memory book: reliability, stability, sharing, copying, transferring, security, theft, etc. Comparisons may include: social media, virtual reality, ArcGIS Story Maps, videos, file folders on a computer, etc.

9-12

- ❑ **PE:** Waves and their Applications in Technologies for Information Transfer: HS-PS4-2. Evaluate questions about the advantages of using digital transmission and storage of information.
- ❑ **SEP:** Asking Questions and Defining Problems
- ❑ **DCI:** PS4.A: Wave Properties
- ❑ **CCC:** Stability and Change

THINKit

![STEM Works THINKit logo]

Community Need

VIRTUAL REALITY | GIS

Zoos and aquariums try to teach visitors about the animals and plants they keep. Posters or displays aren't often read and without traveling worldwide, it is hard to picture the environments these animal live in. Is there a new way for guests to learn about and experience the habitats of the flora and fauna?

Tech Tool Ideas:
Google Street View App
Aria Creator
ArcGIS Story Maps

Career Connections:
Biologist, Zoologist
360° Photographer
Virtual Reality Developer

01 DEFINE THE PROBLEM

Define the Problem

Our engineering & design goal is to...

Our community is...

Three Criteria! We are successful if...

Three Constraints! Our solution is limited by...

02 GATHER PERTINENT INFO

Gather Pertinent Info

1. How can virtual reality be used to teach guests about flora and fauna?

2. Which flora or fauna will you focus on?

3. If you use images that are not yours, are they properly cited?

4. How does the technology work: Google Street View & Google Cardboard, Aria Creator, or ArcGIS Story Maps?

5. How will you digitally share or advertise the experience so a visitor knows what to do?

01 DEFINE THE PROBLEM
02 GATHER PERTINENT INFO
03 GENERATE MULTIPLE SOLUTIONS
04 REFLECT, ANALYZE, AND SELECT A SOLUTION
05 DESIGN CULTURALLY RESPONSIVE SOLUTIONS
06 TEST AND OPTIMIZE
07 SHARE AND REFLECT

Unit Extension Ideas

Connect to the NGSS Standards!

Introduce the viewer to the idea that habitats are unique and different geographic regions may have a unique diversity of plants and animals living on land and in water.

2nd
- ❑ **PE:** Biological Evolution: Unity and Diversity: 2-LS4-1. Make observations of plants and animals to compare the diversity of life in different habitats.
- ❑ **SEP:** Planning and Carrying Out Investigations
- ❑ **DCI:** LS4.D: Biodiversity and Humans
- ❑ **CCC:** (Project Dependent)

Communicate how the zoo imitates a habitat, since an organism survival depends on how well adapted it is to a specific habitat. Or explain how environmental or human caused impacts are predicted to effect habitat and have current or future impacts on of species survival. How are zoos often involved in conservation efforts?

3rd
- ❑ **PE:** Biological Evolution: Unity and Diversity: 3-LS4-3. Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.
- ❑ **SEP:** Engaging in Argument from Evidence
- ❑ **DCI:** LS4.C: Adaptation
- ❑ **CCC:** Cause and Effect

Consider scientific, economic, and social implications of efforts trying to support conservation of biodiversity efforts to stabilize in ecosystems. Compare the complexity of the two different methods and communicate the proposed plan as well as success or shortcomings of each. Possible societal needs to consider: water availability/purification, nutrient cycling, soil erosion, food availability, medicine, etc.

6-8
- ❑ **PE:** Ecosystems: Interactions, Energy, and Dynamics: MS-LS2-5: Evaluate competing design solutions for maintaining biodiversity and ecosystem services.
- ❑ **SEP:** Engaging in Argument from Evidence
- ❑ **DCI:** LS2.C: Ecosystem Dynamics, Functioning, and Resilience, LS4.D: Biodiversity and Humans, **EDP**: ETS1.B: Developing Possible Solutions
- ❑ **CCC:** Stability and Change

The completeness of an ecosystem is used to measure its health; certain conditions are indicators of overall health and keystone species have a huge influence. Create an interactive simulation or game, where the participant can make a series of choices that would ultimately effect the health of an ecosystem. The goal would be to mitigate negative impact and increase biodiversity. Consider including choices that would also have economic and social implications.

9-12
- ❑ **PE:** Biological Evolution: Unity and Diversity: HS-LS4-6: Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.
- ❑ **SEP:** Using Mathematics and Computational Thinking
- ❑ **DCI:** LS4.C: Adaptation, LS4.D: Biodiversity and Humans, **EDP**: ETS1.B: Developing Possible Solutions
- ❑ **CCC:** Cause and Effect

STEM WORKS THINKit

Community Need

PROTOTYPE   GIS

Many homes are built close to drainage ditches that become rivers during storms. Soil erodes and disperses into ocean, sometimes covering coral reefs. A development is being built by a dry creek that becomes a river during storms. The community needs a design using natural and fabricated solutions to keep soil from eroding.

Tech Tool Ideas:

Low tech (Recyclables)

High tech (SketchUp, CoSpaces, ArcGIS)

Career Connections:

Environmental Engineer

Landscaper

Ecologist

01 DEFINE THE PROBLEM

Define the Problem

Our engineering & design goal is to...

Our community is...

Three Criteria! We are successful if...

Three Constraints! Our solution is limited by...

02 GATHER PERTINENT INFO

Gather Pertinent Info

1. What is a riparian zone?

2. How do the roots of plants create buffer zone?

3. What species of shrubs or trees prevent erosion? Can native species be used?

4. How high or often may the river flood?

5. What man-made building solutions help keep soil stable, or protect homes and people during flooding?

6. Can multiple solutions be used?

01 DEFINE THE PROBLEM
02 GATHER PERTINENT INFO
03 GENERATE MULTIPLE SOLUTIONS
04 REFLECT, ANALYZE, AND SELECT A SOLUTION
05 DESIGN CULTURALLY RESPONSIVE SOLUTIONS
06 TEST AND OPTIMIZE
07 SHARE AND REFLECT

Unit Extension Ideas

Connect to the NGSS Standards!

Students compare each other's solutions and suggest ways to improve designs. Then, use feedback to make improvements or combine all the best ideas into a new solution.

2nd
- ☐ **PE:** Earth's Systems: 2-ESS2-1: Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.
- ☐ **SEP:** Constructing Explanations and Designing Solutions
- ☐ **DCI:** ESS2.A: Earth Materials and Systems, EDP: ETS1.C: Optimizing the Design Solution
- ☐ **CCC:** Stability and Change

Identify, categorize and describe types of weathering: Hunt for signs of weathering on school campus (water, tree roots), observe before and after photos of local effects (hurricanes, seasonal changes in beaches), research/collect images of large scale erosion effects (mudslides, tsunamis) and effects over long periods of time (canyons, arches, glacial movement).

4th
- ☐ **PE:** Earth's Systems 4-ESS2-1. Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.
- ☐ **SEP:** Planning and Carrying Out Investigations
- ☐ **DCI:** ESS2.A: Earth Materials and Systems, ESS2.E: Biogeology
- ☐ **CCC:** Cause and Effect

Research coastal erosion in Hawaii and other areas. Create a timeline (or story map) of reporting about the topic. Using the information, project the timeline into the predicted future as well as the past. For the future, include erosion predictions and/or predicted effects. For the past, record when the 'factors of causation' were documented and may have begun.

6-8
- ☐ **PE:** Earth's Systems: MS-ESS2-2: Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.
- ☐ **SEP:** Constructing Explanations and Designing Solutions
- ☐ **DCI:** ESS2.A: Earth's Materials and Systems, ESS2.C: The Roles of Water in Earth's Surface Processes
- ☐ **CCC:** Scale Proportion and Quantity

Water has unique combination of physical and chemical properties central to the planet's dynamics. Each group creates an experiment that investigates one of the following: (1) water's exceptional capacity to absorb, store, and release large amounts of energy, (2) transmit sunlight, (3) expand upon freezing, (4) dissolve and transport materials, and (5) lower the viscosities and melting points of rocks. Each inquiry should include references to a real world example.

9-12
- ☐ **PE:** Earth's Systems: HS-ESS2-5: Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.
- ☐ **SEP:** Planning and Carrying Out Investigations
- ☐ **DCI:** ESS2.C: The Roles of Water in Earth's Surface Processes
- ☐ **CCC:** Structure and Function