STEM works THINKit

CODING

Community Need

Our community needs

Tech Tool Ideas:

Career Connections:

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...

Gather Pertinent Info

1.

2.

3.

4.

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CODING PROTOTYPE

Community Need

Cats and dogs often play by pretending to stalk prey. Many pets live in small ohanas and don't have much space. How can these pets get more exercise to stay healthy and fit?

Tech Tool Ideas:

Ozobot, littleBits, Sphero, Microduino, Arduino, Micro:bit

Career Connections:

Programmer
Toy Designer
Inventor

Define the Problem

Our engineering & design goal is to...

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Three Constraints! Our solution is limited by...

Gather Pertinent Info

1. What kind of pet is the design for?
2. What kind of prey might the pet chase?
3. If you are using programming, how can you write a program to that mimics the movement of prey?
4. How can you decorate the tool to entice the pet to play?
5. Are your materials safe for a pet?
6. How will you market your design with the community?

Unit Extension Ideas

Connect to the NGSS Standards!

Design and explain how the solution helps a specific animal as it: sees, hears, grasps an object, and/or helps it feed or find water. Discuss the concept of biomimicry, how humans find solutions by mimicking nature and natural processes.

1st

- ❑ **PE:** From Molecules to Organisms: Structures and Processes: 1-LS1-1. Use materials to design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs.
- ❑ **SEP:** Constructing Explanations and Designing Solutions
- ❑ **DCI:** LS1.A: Structure and Function, LS1.D: Information Processing
- ❑ **CCC:** Cause and Effect

Explain how the solution will help a specific animal survive well in its environment. Explain why it may not meet the needs of other animals.

3rd

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

Expand the issue of feral populations of animals in Hawaii. Explore issues of resource availability, population control (growth and reproduction), and carrying capacity. Use mathematics to explore possible effects feral populations, if left unchecked, on native species and ecosystems.

6-8

- ❑ **PE:** Ecosystems: Interactions, Energy and Dynamics: MS-LS2-1: Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
- ❑ **SEP:** Analyzing & Interpreting Data
- ❑ **DCI:** LS2.A: Interdependent Relationships in Ecosystems
- ❑ **CCC:** Cause & Effect

Use mathematics to diagram historical, current, and future prediction of the population size of introduced species (biocontrol or accidental introduction) in Hawaii versus native species populations. Identify how introduced species have had a historical impact on native species through predation, competition, and disease. Explore how these factors contribute to the fundamental tension on the abundance (number of individuals) of species, or carrying capacity, in any ecosystem.

9-12

- ❑ **PE:** Ecosystems: Interactions, Energy and Dynamics: HS-LS2-1: Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.
- ❑ **SEP:** Using Mathematics and Computational Thinking
- ❑ **DCI:** LS2.A: Interdependent Relationships in Ecosystems
- ❑ **CCC:** Scale, Proportion, and Quantity

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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

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...

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?

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

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CODING

CIRCUITS & HARDWARE

Community Need

The county fair is coming up and your school is designing and building a parade float. Any animatronics that light up, move or make sounds are especially fun!

Tech Tool Ideas:

Ozobot, Sphero, littleBits, Micro:bit, Makey Makey, Snap Circuits, Arduino

Career Connections:

Machinist
Programmer
Set Designer
Electrical Engineer
Electrician

Define the Problem

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Gather Pertinent Info

1. How can you use the tech tools to design movement, sounds, or lights?

2. What materials will make the movement of your animatronics seem more lifelike?

3. Will your animatronics be autonomous or will it be controlled by people riding on the float?

4. How can you use code to control movement?

5. Does your float have a theme or message that you want your community to understand?

Unit Extension Ideas

Connect to the NGSS Standards!

Students design a float with access to the same materials. Discuss the variance in final designs. Encourage students to disassemble their work and recycle their materials to improve/build an alternative solution.

2nd

- ❑ **PE:** Matter and its Interactions: 2-PS1-3: Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object.
- ❑ **SEP:** Constructing Explanations and Designing Solutions
- ❑ **DCI:** PS1.A: Structures and Properties of Matter
- ❑ **CCC:** Energy and Matter

Discuss the path of each float design. Can their motion be predicted? Have students explain how they use observation and measurement (distance, direction, or time) to predict the future motion/path of their float. Explain how technology was used to make it predictable or explain why the motion may not be predictable.

3rd

- ❑ **PE:** Motion and Stability: Forces and Interactions: 3-PS2-2: Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.
- ❑ **SEP:** Planning and Carrying Out Investigations
- ❑ **DCI:** PS2.A: Forces and Motion
- ❑ **CCC:** Patterns

Research and discuss electromagnetic trains. Have students use magnets to either make a vehicle move or make an animatronic device that simulates movement using magnets, electrically charged objects, and/or gravity.

6-8

- ❑ **PE:** Motion and Stability: Forces and Interactions: 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.
- ❑ **SEP:** Planning and Carrying Out Investigations
- ❑ **DCI:** PS2.B: Types of Interactions
- ❑ **CCC:** Cause & Effect

Parade floats travel at a slow speed but people often ride them. If an accident were to occur, design a solution to minimize the risk (impact) during a collision. (This idea may also be extended to solutions that minimize the collision risk of animals riding in truck beds). Be sure to include a method that could be used to systematically collect data that would measure the devices ability to protect against damage!

9-12

- ❑ **PE:** Motion and Stability: Forces and Interactions: HS-PS2-3: Apply science and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.
- ❑ **SEP:** Constructing Explanations and Designing Solutions.
- ❑ **DCI:** PS2.A: Forces and Motion, **EDP:** ETS1.A: Defining and Delimitating an Engineering Problem, ETS1.C: Optimizing the Design Solution
- ❑ **CCC:** Cause and Effect

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CIRCUITS & HARDWARE

CODING

Community Need

Pets can easily get lost and some have even been hit by cars! Some pets overheat or are not warm enough. Pet owners would like a way to see or protect their pet outside so they can be healthy, safe, or easily found.

Tech Tool Ideas:

Conductive Connections
Snap Circuits
Micro:bit
Arduino

Career Connections:

Programmer
Electrician
Electrical Engineer
Machinist

Define the Problem

Our engineering & design goal is to...

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Gather Pertinent Info

1. Is the invention stationary or wearable?
2. How might your device fit on a pet or be secured to a wall, post, or the ground?
3. Will the device use sound, light, or another kind of energy? If so, what is needed to make a circuit or what is needed for thermal energy transfer?
4. If it is raining, or if a pet needs a bath, does the device need to be waterproof?
5. Can the pet owner easily detach the device?
6. How is your design safe for a pet?
7. How will you market your device to your community?

Unit Extension Ideas

Connect to the NGSS Standards!

Decide on some physical criteria for success and collect data on the physical properties of each design. Students might rate performance by durability, strength, flexibility, hardness, texture, absorbency, etc. Analyze the data to decide on designs best suited for your solution.

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

Challenge students to create a solution that uses heat, light, or sound energy.

4th

- ❑ **PE:** Energy: 4-PS3-4. Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.
- ❑ **SEP:** Constructing Explanations and Designing Solutions
- ❑ **DCI:** PS3.B Conservation of Energy and Energy Transfer, PS3.D Energy in chemical Processes and Everyday Life, **EDP**: ETS1.A: Defining Engineering Problems
- ❑ **CCC:** Energy and Matter

Challenge students to create a solution that uses thermal energy transfer to either heat or cool a pet. Have students think about the pet shipping industry, keeping pets warm in cold areas and cool in warm areas.

6-8

- ❑ **PE:** Energy: MS-PS3-3: Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.
- ❑ **SEP:** Constructing Explanations and Designing Solutions
- ❑ **DCI:** PS3.A: Definitions of Energy, PS3.B Conservation of Energy and Energy Transfer, **EDP**: ETS1.A: Defining Engineering Problems, ETS1.B: Developing Possible Solutions
- ❑ **CCC:** Energy and Matter

Challenge students to design a solution for an individual's specific pet, using input from the owner for criteria and constraints. The solution must keep the pet safe and incorporate energy transfer. Students should measure success using quantitative and qualitative evaluation.

9-12

- ❑ **PE:** Energy: HS-PS3-3: Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.
- ❑ **SEP:** Constructing Explanations and Designing Solutions
- ❑ **DCI:** PS3.A: Definitions of Energy, PS3.D Energy in Chemical Processes, **EDP**: ETS1.A: Defining and Delimitating an Engineering Problem
- ❑ **CCC:** Energy and Matter

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DIGITAL MEDIA

CODING

Community Need

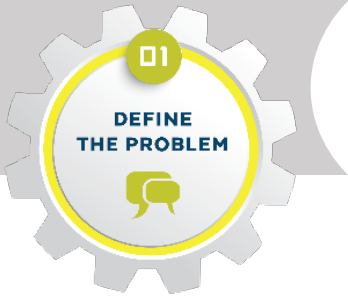
Students often miss school when they are sick and the doctor's office sometimes has a long wait. To help, a local doctor's office wants to have an educational game that people in the wait room can play. This game should be fun and also teach the community about ways to be healthy and get better.

Tech Tool Ideas:

Bloxels
Makey Makey

Career Connections:

Script Writer, Toy Maker
Video Game Designer



Define the Problem

Our engineering & design goal is to...

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Gather Pertinent Info

1. How can games be used as educational learning tools?

2. Can you write dialogue to listen to or read in the game?

3. What health topic(s) will you teach?

4. How will you have the player interact with the information?

5. How can the doctor's office let parents or kids know about the game?

Unit Extension Ideas

Connect to the NGSS Standards!

After research (texts/media), students develop a game that teaches ways kids and parents can communicate to have what they need to stay healthy. How do people let others know what they need? Caregivers may respond by cooking, comforting, healing, and teaching other safe behaviors.

1st

- ❑ **PE:** Molecules to Organisms: Structures and Processes: 1-LS1-2: Read texts and use media to determine patterns in behavior of parents and offspring that help offspring survive.
- ❑ **SEP:** Obtaining, Evaluating, and Communicating Information
- ❑ **DCI:** LS1.B: Growth and Development of Organisms
- ❑ **CCC:** Patterns

Using specific examples, students explain how their game helps family groups to be healthier through making positive choices that may include topics: healthy food, protection from weather, safety in the environment, or coping with stress or difficult situations.

3rd

- ❑ **PE:** Ecosystems: Interactions, Energy, and Dynamics: 3-LS2-1. Construct an argument that some animals form groups that help members survive.
- ❑ **SEP:** SEP: Engaging in Argument from Evidence
- ❑ **DCI:** LS2.D: Social Interactions and Group Behavior
- ❑ **CCC:** Cause and Effect

Create a game about genetics, where the goal is to 'build organisms' by collecting genes. Through creative design of playing cards, game boards, or even clay models, a player creates organisms with characteristic traits from: (1) traits from normal genes on their chromosomes or (2) traits impacted by gene mutation, resulting in new features with harmful, beneficial, or neutral effects on the structure and function of the organism.

6-8

- ❑ **PE:** MS-LS3-1: Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism.
- ❑ **SEP:** Developing and Using Models
- ❑ **DCI:** LS3.A: Inheritance of Traits, LS3.B: Variation of Traits
- ❑ **CCC:** Structure and Function

Design reading material or an interactive model for families about genetics and heredity. Make it interactive, perhaps by including 'Q&A' or 'I spy a characteristic trait' or a genetic 'choose your own adventure' book. Include interesting characteristics or traits that children get from parents (example: eye color, blood type, ear lobes, etc.). Consider including scientific ideas about similarities and differences in DNA of different living things, known and unknown function of segments of genetic code, interaction of nature versus nurture, and even genetic modification!

9-12

- ❑ **PE:** HS-LS3-1: Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.
- ❑ **SEP:** Asking Questions and Defining Problems
- ❑ **DCI:** LS1.A: Structure and Function, LS3.A: Inheritance of Traits
- ❑ **CCC:** Cause and Effect