Activity Guide Week 3 - Explore, Design, Create Grades: 6-8

Hello Parent/Guardian,

We hope you are doing well. Here is a guide full of fun activities for your child to try out this week at home! This educational guide is meant to be engaging and fun for your child. Complete the tic-tac-toe board with them on the front sheet, or challenge them to complete each of the activity squares. Included you will find: stories to read; letter, and sound activities; science and art activities; and some great math graphing practice. This week's theme is parts and pieces. We hope you enjoy your activity guide for week 3.

Kent ISD

In partnership with

Kent District Library

Grand Rapids Public Library

Literacy Center of West Michigan

Grades 6-8
Week 3: PARTS AND PIECES

STEM: Invent something cool! Use cardboard and tape (or any supplies you can find!) to create your new invention. Answer questions about your toy created in a maker's journal entry.	**READ:** **Choose 1:** - A real book about a machine - A fiction book about a machine - One of the stories in this packet	**VOCABULARY:** Review the list of words and definitions related to the design process, then draw a picture next to each vocab word. The picture must describe the word.
WRITE: -Find a piece of technology in your house. This could be your toaster, electric toothbrush, remote controller, etc! Sketch out the piece of technology and label each part. Then explain in a paragraph why each part you labeled is important and its purpose. How would you improve it's design?	**FREE SPACE**	**WEEKLY CHALLENGE:** Attempt the paper folding challenge!
MATH: Take a look at the world's unsolved problems! You will need help from a parent/guardian/older sibling for this activity!	**SCIENCE:** How could you invent something that would make life easier for people? What would you invent and why? Design your invention, describing how it would work.	**LANGUAGE:** Find a piece of technology in your house. Hide it from someone. Tell them about it using only 5 describing words. Tell what each part does. See if the other person can guess your toy!

Designing the First Flying Machine

by ReadWorks

Inventor Wilbur Wright's 1904 notes on flight

Orville and Wilbur Wright lived in the early 1900s. Many people believe they invented the airplane. But they did not. Other people had flown and crashed flying machines before. In fact, the brothers weren't even inventors to begin with. Instead, they started their careers printing newspapers and making bikes. They used the design ideas and science rules they had learned printing and making bikes to create their best innovation. An innovation is a new thing no one has made before. Their innovation was a system of controlling how a flying plane moves and keeping it from crashing. People all around the world admired and recognized them as inventors because of this innovation.

The Wright brothers were born in the north central area of the United States. The two often played together as boys. Their favorite toy was a helicopter their dad had given them. The toy had blades that twirled. The boys built a new helicopter toy when that one broke.

The boys kept trying to fix and improve different objects. Even though they were really smart, neither

of them graduated from high school. Orville dropped out to start a printing business. Wilbur helped him publish a newspaper. A few years later, bicycles became very popular in America. So the brothers decided to open a shop where they fixed and sold bicycles.

If the brothers had kept on building bikes and printing newspapers, they might have become very successful. But we might have forgotten them by now. However, they used the money they made from their businesses to support their interest in flying.

By the early 1900s, many people had been trying to invent an airplane that worked. Some airplanes were powered by steam. Others had wings like birds. A German inventor was getting a lot of attention for his flying machine called a glider. His machine did not have a motor. But it was able to fly through the air when it was carried by the wind. He had built the machine based on the way storks fly. A stork is a type of bird. Unfortunately, this German inventor crashed to his death in a glider. This made inventors realize they had to improve this design or risk dying in an accident.

Back then, there was no Internet to look up designs. So the Wright brothers had to write letters to a museum asking for more information about early flight inventors. They carefully read and studied everything they could find. They carefully looked over the designs and plans of different inventors. And like many inventors before them, they watched a lot of birds. Inventors studied the way birds fly to help design a flying machine that they think would work.

The brothers noticed one big difference between birds and early gliders. Birds were able to smoothly turn right or left as the winds changed by moving the angles of their wings. Birds could lean into turns while staying stable and upright, just like a person riding a bike. But a glider pilot did not have as much control while turning as a bird did. This was why glider pilots could end up crashing.

The Wright brothers loved trying different ways to fly, but they certainly didn't want to die in the process. They knew pilots needed to have more control over the way airplanes move. So they focused on figuring out how to create this control. The brothers combined what they learned from studying different flying machines and the design ideas they had learned from making bicycles. They knew they first had to figure out how to control the movement of flying machines as well as birds could control their bodies. This would help them find the right parts to add onto wings and motors to create a viable, or working, flying machine. This plan was very different from the way other inventors went about finding the right solution. Other inventors were studying trains or ships. So some spent most of their time building stronger motors, hoping this could help planes fly more easily. Others spent their time building steering parts similar to what ships have to help guide planes more easily. As it turned out, the Wright brothers had the right plan.

The brothers decided to begin testing their experiments with gliders. They needed to find a place that was windy enough so the gliders could fly. They checked weather information and asked other inventors for advice. They decided a breezy town in North Carolina would be the best place to test the gliders. For a few years, they stayed in this town and tested different designs. They tested these designs by making a kind of glider that could fly without pilots. That way, no one could get hurt if a test went wrong.

They kept comparing different innovations with the way birds fly. This helped them change each small part of their design. Some of their innovations had giant wings. Others had no tails. Many were still crashing. But the brothers tried not to become upset. During one winter, they returned home to the state of Ohio. There they tried different ways of testing that didn't cost as much money. On some

days, they rode bicycles that had wings down the streets. On others, they'd create tiny airplane models to test in the wind.

Over time, the brothers discovered many mistakes in the designs of the inventors that had come before them. They fixed these mistakes by using their own calculations. The brothers knew that the movement of an airplane had to be controlled in three ways. That's because a plane can point up or down. It can move from side to side. It can also roll upside-down. So they knew their final design had to let a pilot control these movements of a plane. This would help keep the plane from crashing. The design they came up with gives pilots this control. It is still used today.

The Wright brothers' design had different parts. They created one innovation that lets the pilot bend the wings and help to turn the plane like a bird might do with its wings. They created another innovation that helps the pilot turn the plane towards the sky or toward the ground. They also figured out a way to keep the plane from flipping over.

By 1902, the Wright brothers piloted hundreds of flights on gliders. They could control the movement of these gliders really well using their design. They finally felt confident enough in their design. They were ready to add motors to the gliders. Once they had the right motor for the airplane, they were ready to test it out. When they flew this plane with the motor, they made history. This was the first flight ever in an airplane with a motor. Today, the brothers are also remembered for creating an innovation that helps pilots control a plane's movements. Because of them, people can fly planes more safely.

Name: _____ **Date:** _____

1. Who is credited as the inventor(s) of the airplane?

A. Otto Lillienthal

B. Orville and Wilbur Wright

C. Alphonse Pénaud

D. Charlie Taylor

2. What does the author describe in the passage?

A. Orville and Wilbur Wright's childhood in Indiana

B. how French inventor Alphonse Pénaud designed the helicopter

C. how the first airplane was invented

D. flight patterns of migratory birds

3. Otto Lillienthal's gliding airplane design was not a success. What evidence from the text supports this statement?

A. "By this time, many people had been trying to invent an airplane that worked. Some airplanes were steam-powered; others had flapping wings, like birds."

B. "The German inventor Otto Lillienthal, also known as "The Gilder King," was appearing in all the papers, showing off his gliding machine, which he'd built based on his studies of storks."

C. "Though his gliders had no motors, instead coasting purely on air, they could keep a pilot hanging in the air under the right conditions."

D. "When Lillienthal made headlines again by plunging to his death in August of 1896 during a gliding accident, inventors knew they had to improve upon his designs, or else."

4. Which of the following helped Orville and Wilbur to finally create a successful plane?

A. directly working with the German inventor Otto Lillienthal

B. their experience building experimental aircraft during their childhood

C. the research and designs of other inventors which Orville and Wilbur improved upon

D. the formal education in Physics that Orville and Wilbur had both received

5. What is this passage mostly about?

A. the creation of the first motorized airplane

B. the Wright Brothers' bicycle business

C. Otto Lillienthal's gliders

D. the first transcontinental flight

6. Read the following sentences: "If the brothers had kept on building bikes and printing poetry, they might have done very well for themselves, and we might have forgotten them by now. But instead, they used the proceeds from their business **ventures** to fund further tinkering in a new kind of interest: flying."

As used in the passage, what does "**ventures**" most nearly mean?

A. distractions

B. inventions

C. designs

D. projects

7. Choose the answer that best completes the sentence below.

_____ many of Orville and Wilbur's first airplane models crashed, they persevered and were eventually successful.

A. Even though

B. As a result

C. Initially

D. Above all

8. What difference did the Wright Brothers notice between birds and early gliders?

_____

_____

_____

9. Describe the gliding machine Otto Lillienthal had invented.

10. How was Orville and Wilbur's approach to building a successful airplane different from that of other inventors who were working on airplanes? Use information from the text to support your answer.

Coast Beast

by Stephen Battersby

The beach is where Theo Jansen's wild things are.

On a windy stretch of beach on the coast of Holland, a skeletal creature crawls across the sand. It stands as high as a person and seems to have as many legs as a centipede. A close-up look reveals primitive senses and the beginnings of a brain. The creature stops, then starts again, relying on the inconstant wind for its mobility.

What is this thing? It's a *strandbeest,* a creation of Dutch inventor Theo Jansen. It exists between the dunes and the sea in a twilight zone linking art and science. "I am trying to remake nature," says Jansen.

Loek van der Klis/www.kliski.com

The plastic mechanical skeletons pictured on these pages are just a few of the many strandbeests that kinetic sculptor Theo Jansen has built in the Netherlands since 1990.

Plastic Bones

Jansen graduated from college with a degree in physics in the 1970s. He then turned to painting and other art projects. Jansen never abandoned his scientific inclinations, though. In 1990, he conceived the idea of leggy, wind-driven machines that could walk along the beach, helping build dunes that would defend the Netherlands against any rise in the North Sea.

For his raw material, Jansen chose a type of stiff, yellow plastic tubing that is easily cut and fitted together. When heated with a hot-air gun, two tubes can be joined and bent to form a simple joint that's a little like a human knee.

Loek van der Klis/www.kliski.com

The bones of every strandbeest are made from stiff plastic tubing that's easily fitted together.

The central spine of a strandbeest is a plastic *crankshaft* (rotating rod) that's linked to all its many legs. Each leg has 11 plastic "bones" that form a *mechanical linkage*-an assembly of rigid rods and joints that transmits mechanical forces and movement from one place to another. As the crankshaft rotates, it moves a leg joint, which transmits motion via the other joints to the foot.

A leg's motion depends on the lengths of all 11 bones. To develop a leg with a smooth step, Jansen used a *genetic algorithm,* a computer program that mimics *natural selection.* Natural selection is a process that drives evolution, favoring the fittest forms of living things. From an initial population of legs, each one of which flailed clumsily, a more elegant leg evolved. Its foot lifts and moves forward swiftly, then sets down and pushes backward, horizontally and steadily.

Loek van der Klis/www.kliski.com

With the computer-generated leg as a blueprint, Jansen painstakingly pieced together his first strandbeest, which means "beach animal" in Dutch. He named it *Animaris Currens Vulgaris,* took it to a beach, and set it free. It collapsed.

Back in his studio, Jansen slowly learned how to design a more robust structure. He also added simple sails so that it could be pushed forward by the wind.

Energy Conversion

Over the years, Jansen has experimented with different strandbeests. Some move forward, and some move sideways. Some can even store energy using simple air pumps. Each pump is a narrow tube that slides up and down like a piston inside a larger tube. Sails drive the pumps, and with every up-and-down movement, each pump squirts air into a plastic bottle. As the air is compressed in the bottle, it gains *potential energy* (stored energy). When enough air is stored, valves open, releasing the air into a second set of pumps, forcing the pistons in them to move. Those pumps act like muscles, moving the beasts' legs. The compressed air's potential energy is turned into *kinetic energy,* the energy of movement.

Loek van der Klis/www.kliski.com

Sails mounted on a strandbeest pump pistons that enable it to move and sense things it should avoid, such as water and sand dunes.

Even after 21 years of tinkering, the strandbeests remain delicate. They can blow over in storms and get stuck if they wander into the sea. "I have to nurse these animals," says Jansen. "Every few minutes, I have to save them from dying."

Jansen is now trying to make the beasts more independent by giving them senses. He has added another system of air pumps that suck on a long plastic tube hanging from one side of the beast. If the strandbeest veers into the sea, the tube starts to inhale water. The weight of that water changes the air pressure, prompting the beast to change direction.

Jansen has even tried giving one of his beasts a brain-as any mad scientist should. A piston with a hole in one side can switch a flow of air on and off, imitating the on and off positions of a computer's electric switches. "With this basic device, you can make networks comparable to electronics," says Jansen. He has built a network of hissing valves and pistons that can count a strandbeest's steps so, in theory, the beast knows how far it has walked.

3-D Printing

Jansen claims to be creating new forms of life. He originally hoped that the beasts would be able to reproduce, perhaps by feeding on plastic and making offspring inside themselves. That idea proved to be too ambitious. "Then I found that behind my back, these animals were using people to multiply," he says. Enthusiasts in Japan and the United States are making their own beach creatures, some

using the modern technology of three-dimensional printing. "A year ago, two students put a small beast on a table. It comes in one piece out of a printer and walks away," says Jansen. "It's a real miracle."

Strandbeest by Theo Jansen, powered by Shapeways

youcubed

Paper Folding

Work with a partner. Take turns being the skeptic or the convincer. When you are the convincer your job is to be convincing! Give reasons for all of your statements. Skeptics must be skeptical! Don't be easily convinced. Require reasons and justifications that make sense to you.

For each of the problems below one person should make the shape and then be convincing. Your partner is the skeptic. When you move to the next question switch roles.

Start with a square sheet of paper and make folds to construct a new shape. Explain how you know the shape you constructed has the specified area.

- [ ] 1. Construct a square with exactly ¼ the area of the original square. Convince yourself and then your partner that it is a square and has ¼ of the area.

- [ ] 2. Construct a triangle with exactly ¼ the area of the original square. Convince yourself and then your partner that it has ¼ of the area.

- [ ] 3. Construct another triangle, also with ¼ the area, that is not congruent to the first one you constructed. Convince yourself and then your partner that it has ¼ of the area.

- [ ] 4. Construct a square with exactly ½ the area of the original square. Convince yourself and then your partner that it is a square and has ½ of the area.

- [ ] 5. Construct another square, also with ½ the area, that is oriented differently from the one you constructed in #4. Convince yourself and then your partner that it has ½ of the area.

Adapted from: *Fostering Geometric Thinking: A Guide for Teachers, Grades 5-10,* by Mark Driscoll, 2007, p. 90, http://heinemann.com/products/E01148.aspx

Maker's Journal Questions

STEM: Invention Follow up

Sketch out your Invention:

Name of your invention: _____
What materials did you use?

_____

_____

_____

_____

What made you decide to create this invention?

_____

_____

_____

_____

What might you change about your invention's design?

_____

_____

_____

_____

VOCABULARY:

Vocabulary Word	Definition	Picture
Artifact	a man-made object	
Dimension	a construct distinguishing objects or individuals	
Invention	the act of making something new	
Innovation	the act of starting something for the first time	
Brainstorm	try to solve a problem by thinking intensely about it	
Engineering	applying scientific knowledge to practical problems	

Prototype	a standard or typical example	
Data	a collection of facts from which conclusions may be drawn	
Design	the act of working out the form of something	
Sketch	preliminary drawing for later elaboration	
Consumer	a person who uses goods or services	
Designer	someone who creates plans to be used in making something	
Model	a representation of something, often on a smaller scale	

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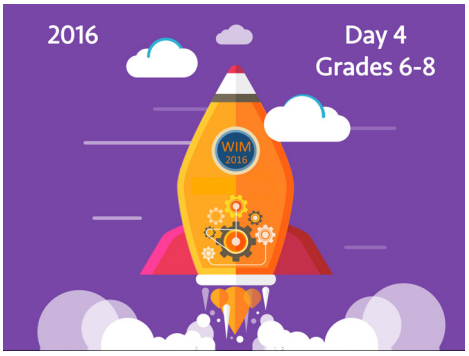

Oh Hail the Elephant!

Introduction:

This lesson focuses on one of the world's unsolved problems in mathematics, which we have found students get very excited about. It involves Hailstone sequences and invites students to make their own conjectures and learn something about the history of mathematics.

Agenda for the day:

Activity	Time	Description/Prompt	Materials
Mindset Video	5 min	Play the mindset video, *Speed is not important* https://www.youcubed.org/wim2-day-4/	Mindset Video day 4, *Speed is not important*
Hailstone Sequences	5 min	Introduce the activity • Discuss with students the word conjecture. A conjecture is a proposition that is consistant with known data, but hasn't been proven, yet! In science we use hypothesis. In maths we use conjecture • Don't tell students the conjecture. See what they can discover!	Student handout (optional) page 3. This handout is prepared for students to read the task on their own, if you would like them to read some of the interesting details of this event - or you could tell them about it instead.
Exploration	20 min	Ask students to expolore the expression and generate their own data. What do they notice? What questions do they have?	Paper and pencil Student handout (optional) page 3
Class Discussion	10 min	Collect observations and student thinking	
Closing	5 min	Remind students that math is not about speed, and what is important in math is to think deeply, and to make connections.	

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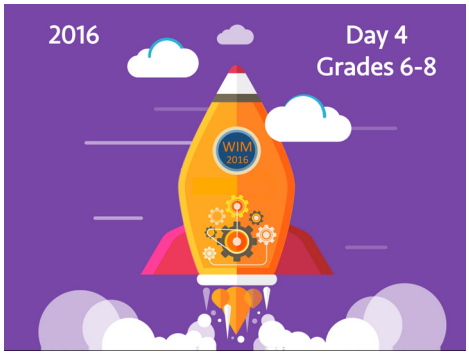

This problem introduces students to one of the world's unsolved problems in mathematics, which is, in itself very cool. It involves a sequence of numbers called a Hailstone sequence. It is called this because the numbers go up and down again. For example:

20 – 10 – 5 – 16 – 8 – 4 – 2 – 1

Hailstone Sequences follow these rules:

If a number is even, divide it by 2
If a number is odd, multiply it by 3 and add 1.

You may like to tell or remind students that hailstones go up and down too – they start in a cloud as drops of rainwater, then they are pushed higher in the atmosphere by wind where they freeze, sometimes several times, before eventually falling back to Earth. The number sequences are called hailstone sequences because they go up and down like this.

In mathematics people make conjectures – it is an idea that you think might be true but you do not know for sure. Conjectures are very important in mathematics, and it is really good to ask students to make conjectures in mathematics. In our youcubed summer school the students really enjoyed making conjectures which we put on the board.

To introduce the activity tell students about hailstones and ask them to make conjectures about the hailstone sequence, by starting at different numbers and seeing what happens.

In 1937 a mathematician called Lothar Collatz proposed that for any number you pick, if you follow the procedure enough times you will eventually get to 1. This then became known as The Collatz Conjecture. Since then lots of mathematicians have been trying to prove or disprove it. So far every number that has been tried has reached 1, and powerful computers have checked enormous numbers of numbers, but no one knows if there is a big number out there that might break the rule. So this is classified as an unsolved problem in mathematics.

This is Collatz' conjecture, but three are many other conjectures that students may have come up with.

In our youcubed summer camp the students were really excited to learn about problems in mathematics that are unsolved, or that took many hundreds of years to solve, such as Fermat's Theorem.

More information on Hailstone sequences and the Collatz conjecture can be found at:
http://mathworld.wolfram.com/HailstoneNumber.html
http://mathworld.wolfram.com/CollatzProblem.html
https://pmm.nasa.gov/education/content/how-does-hail-form
https://en.wikipedia.org/wiki/Collatz_conjecture

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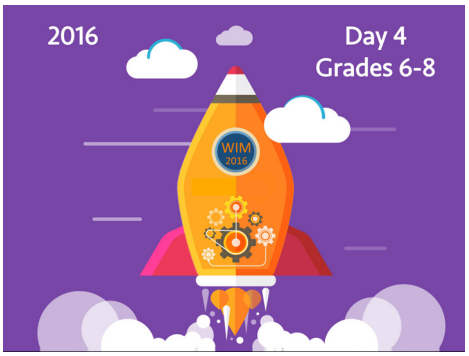


Oh Hail the Elephant!

The problem you will work on today is one of the world's unsolved problems in mathematics, which is, in itself very cool. It involves a sequence of numbers called a Hailstone sequence. The sequence is called this because the numbers go up and down again, like this:

20 – 10 – 5 – 16 – 8 – 4 – 2 – 1

Hailstones do this – they start in a cloud as drops of rainwater, then they are pushed higher in the atmosphere by wind where they freeze, sometimes several times, before eventually falling back to Earth. The number sequences are called hailstone sequences because they go up and down like hailstones.

In mathematics people make conjectures - it is an idea that you think might be true but you do not know for sure. Conjectures are very important in mathematics, and making conjectures is something you can be doing as a math student.

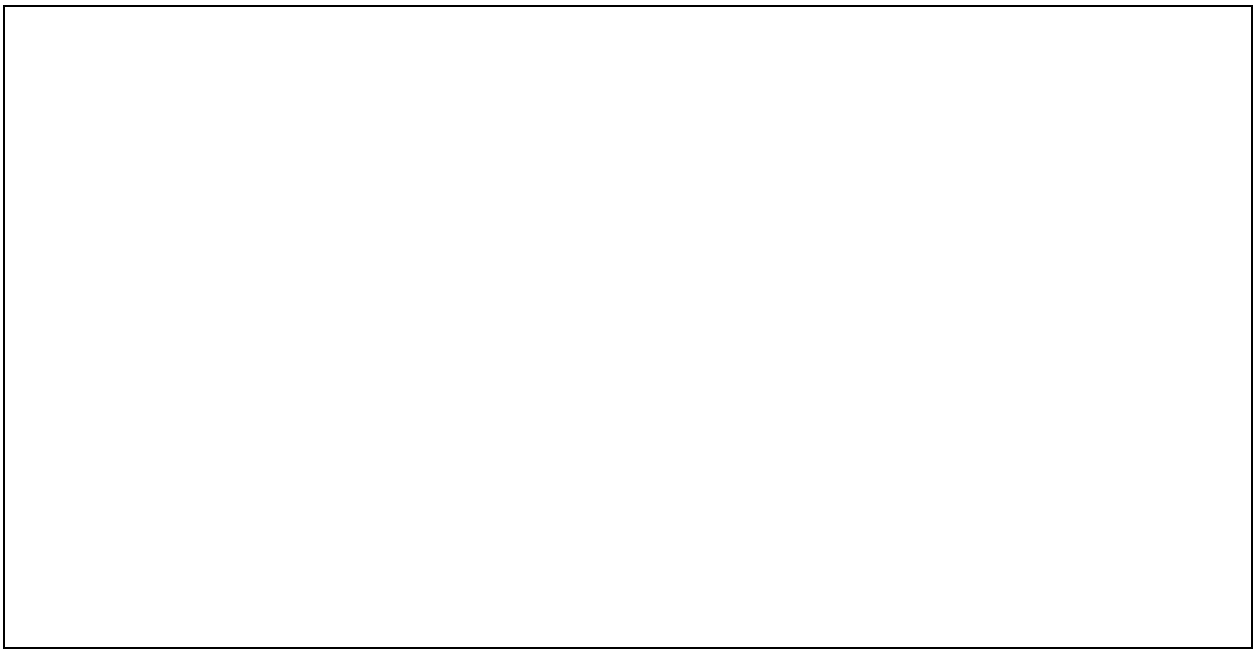
Try working with some hailstone strings of numbers that have different starting numbers and make conjectures about what you find out.

A hailstone strong follows these rules:

If a number is even, divide it by 2
If a number is odd, multiply it by 3 and add 1.

WRITE:

Directions: Sketch out the piece of technology you found in your house and label each part.



Explain why each part you labeled is important. What is its purpose?

_____

_____

_____

_____

How would you improve its design?

_____

_____

_____

_____

_____

_____

_____

_____

Credits

Math: https://www.youcubed.org/

Vocabulary: https://www.vocabulary.com/lists/1497667

Stories: https://www.readworks.org/

STEM: @CarlyandAdam on TeacherspayTeachers

WEEKLY CHALLENGE: https://www.youcubed.org/

Science: https://creativecommons.org/licenses/by/4.0/