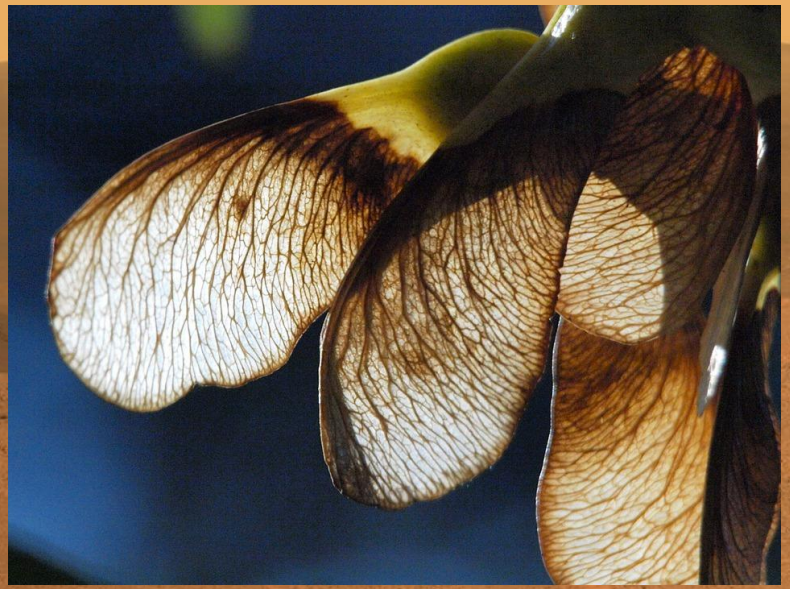

Using Nature as Inspiration to Design Martian Landers
Turn and Talk…
What do you notice in nature that defies gravity?

What do you notice and wonder? How does the structure help these animals glide?



Real World Problem:

Plans for colonizing Mars are already in place. The materials needed for survival are being sent to Mars await the arrival of the humans. This cargo must land safely.

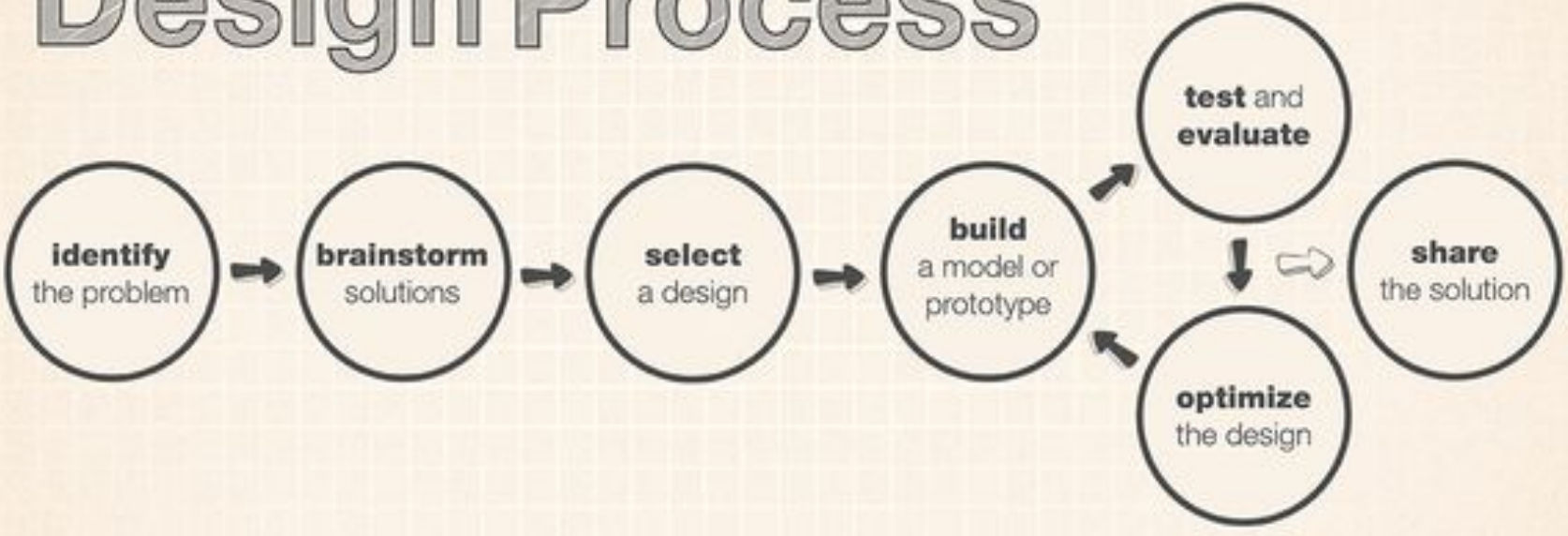
Your team has been challenged by NASA to use structures from plants and animals in nature as inspiration to create a Martian lander.

Real World Problem:

Your design must carry some cargo, “egg”stronauts, to the ground without injury. It must withstand wind, demonstrate air resistance, and resist gravitational pull. The most successful design will stay in the air for the longest time.

You will design, test, redesign and retest.

Engineering Design Process



Possible Materials List:

- Plastic shopping bags
- Aluminum foil
- Tissue paper
- String
- Cotton balls
- Copy paper
- Cardstock
- Rubber bands
- Toothpicks
- Pipe cleaners
- Feathers
- Measuring tape
- Stop watch (phone)
- Masking tape
- Dixie cups
- Binder clips
- Coffee filters
- Sponges
- Toilet paper
- Craft sticks
- Straws
- Napkins

Adding Constraints: You can limit students to **X** number of “things” or you can assign a “budget” similar to this:

Building Requirements: Your team will be given a $10 budget. Plan your design wisely! You are NOT allowed to go over budget, but you are not required to use all of your money. The prices for building supplies are as follows:

- pipe cleaners $0.80
- popsicle sticks $1.25
- plastic straws $0.75
- Index cards $1.10
- tissue paper $.75 per 5 centimeter square
- plastic cup $1.95
- String $0.10 per cm

  etc...

Kindergarten Data Sheet
Did it work?

Yes!

No!

Data (scaffolded structure) Only Test One Variable. Look for patterns in the data.

For grades 1-3, have groups test either the small or large canopy, each group tests only one line length. Then put data together as a class.

For grades 4-5, they can test one canopy size with varying line lengths or one line length with varying canopy sizes. Put data together with others.

	Small Canopy Diameter _____ cm			Large Canopy Diameter _____ cm			
Hang Time (seconds)							
Length of suspension lines	Trial 1	Trial 2	Trial 3	Trial 1	Trial 2	Trial 3	Length of suspension lines
15 cm							15 cm
25 cm							25 cm
35 cm							35 cm

Data: (5th grade and up)

1. Time from point of drop to point of landing. Test three times.
2. Improve. Draw and label what improvements were made to your design. Test your lander again three more times and average.

Design	Test 1	Test 2	Test 3	Average
Original				
Modified				

Explain:

- For Kindergarten ask if the design slowed down the payload.
- Grades 1-3: Look for a pattern in the data.
- Find the mean, median, mode and range of your data. Which central tendency best represents your data median or mean? Explain why. (5th grade and up) (4th usually focuses on one)
- What force is pulling the Lander down (5th grade and up)?
- What force acts against gravity to slow down the lander (5th grade and up)?

Evaluate:

Formative Assessment

Claim: (our design was/was not successful because)

Evidence: (What data did you collect?)

Reasoning: (Because…..)

Contacts, Credits, & Permissions

Carrie Akins **Central Middle School, Edmond, OK** **Twitter: @Cakins0101** **Email: cakins0101@gmail.com**	**Lisa Pitts** **Oakdale Middle School** **Twitter @lisa_rymac90** **Email: lisapitts1972@gmail.com**

NGSS Standards
K-2

K-PS2-2 Motion and Stability: Forces and Interactions
Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.

1-LS1-1 From Molecules to Organisms: Structures and Processes
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.*

*2-PS1-2 Matter and Its Interactions
Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.*

K-2-ETS1-1 Engineering Design
Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.

K-2-ETS1-2 Engineering Design
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.

NGSS Standards

3-5

3-PS2-1 Motion and Stability: Forces and Interactions

Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.

3-PS2-2 Motion and Stability: Forces and Interactions

Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.

3-LS3-1 Heredity: Inheritance and Variation of Traits

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.

4-PS3-1 Energy

Use evidence to construct an explanation relating the speed of an object to the energy of that object.

4-PS3-4 Energy

Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.*

4-LS1-1 From Molecules to Organisms: Structures and Processes

Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.

5-PS1-1 Matter and Its Interactions

Develop a model to describe that matter is made of particles too small to be seen.

5-PS1-3 Matter and Its Interactions

Make observations and measurements to identify materials based on their properties.

3-5-ETS1-3 Engineering Design

Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

NGSS Standards

6-8

MS-PS2-1 Motion and Stability: Forces and Interactions

Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.

MS-PS2-2 Motion and Stability: Forces and Interactions

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.

MS-PS2-4 Motion and Stability: Forces and Interactions

Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.

MS-PS2-5 Motion and Stability: Forces and Interactions

Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.

MS-PS3-1 Energy

Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.

MS-PS3-5 Energy

Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.

MS-LS1-4 From Molecules to Organisms: Structures and Processes

Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.

MS-ETS1-4 Engineering Design

Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.