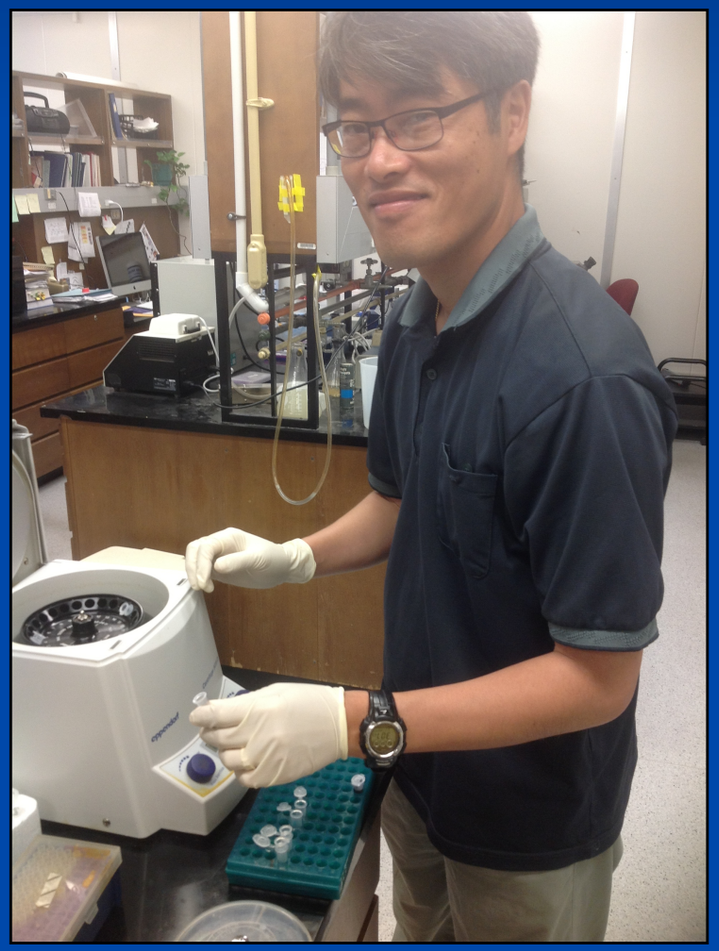
To Boldly Go . . . *and Return*

By Brendan Carroll
Teacher - Franklin Elementary

RET Summer 2013

RET Participant: Brendan Carroll

Location: Dr. Joel Rothman's Lab
UCSB Department of Molecular Cellular and Developmental Biology



Mentor:

Dr. Pan Young Jeong

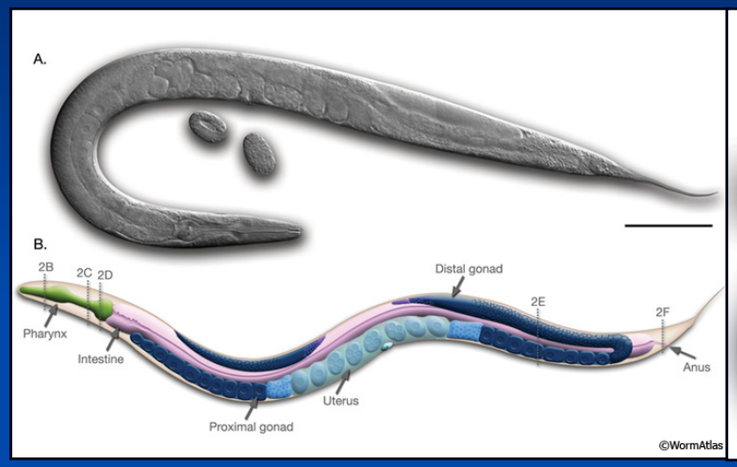
C. elegans

Dr. Joel Rothman

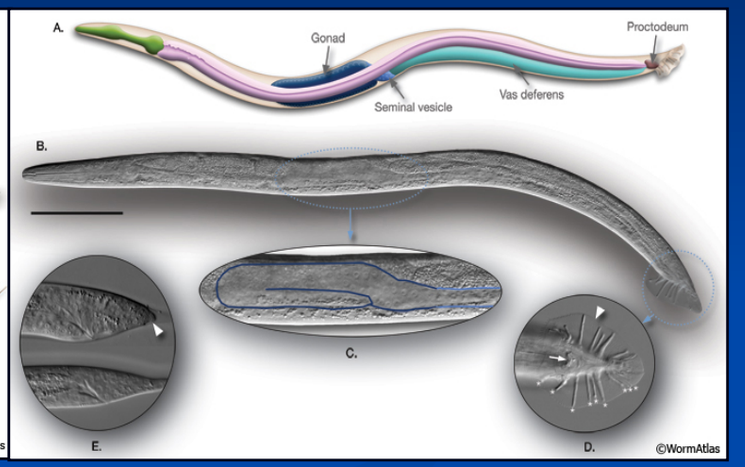
C. elegans:
A Model Organism for Research

Ideal subject for genetics research;

- Life span 2-3 weeks
- Adults 1mm
- Transparent
- RNAi (introduced via inoculated bacteria)
- Genome completely mapped
- Hermaphroditic



hermaphrodite



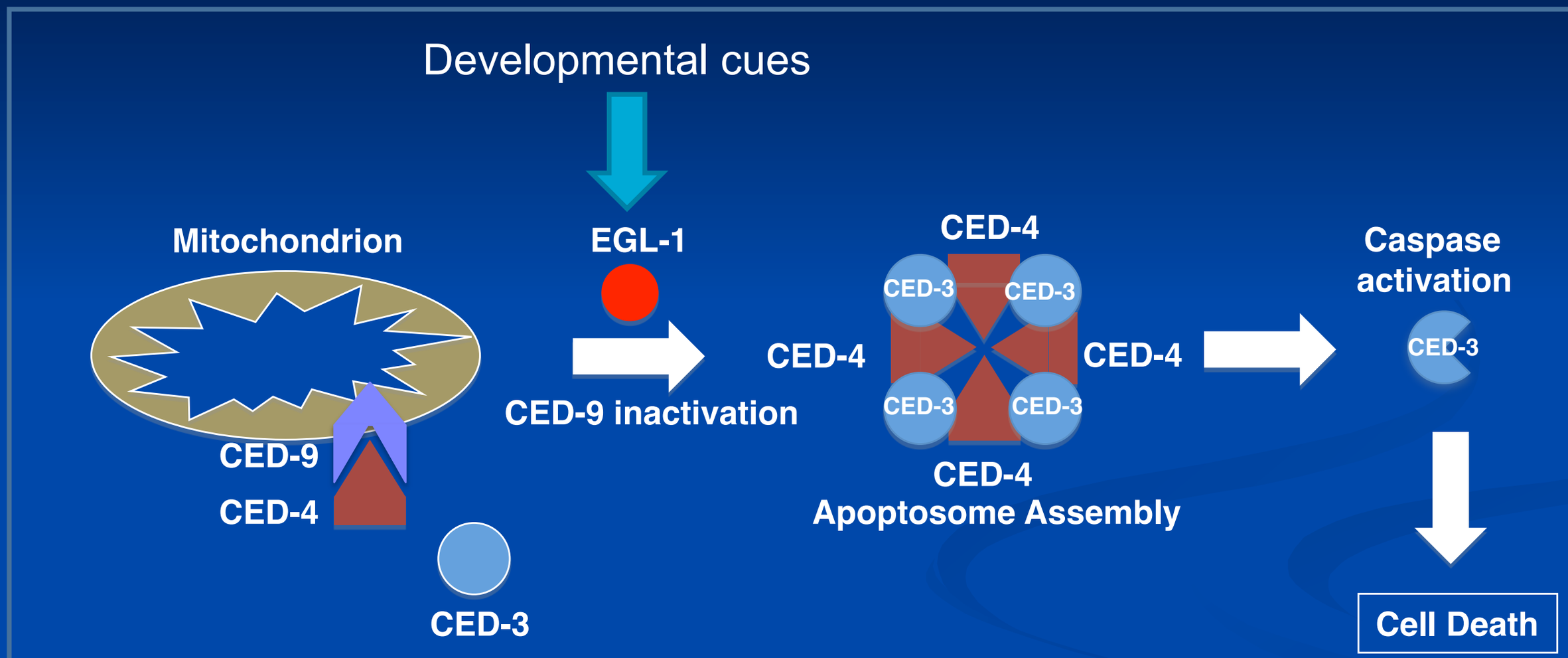
male

INTERESTING FACTS:

- Survives -80° C for 10 years
- Survived 2003 space shuttle Challenger disaster
- Descendants of the Challenger survivors traveled to space on the Endeavour in 2011

PCD model in *C. elegans*

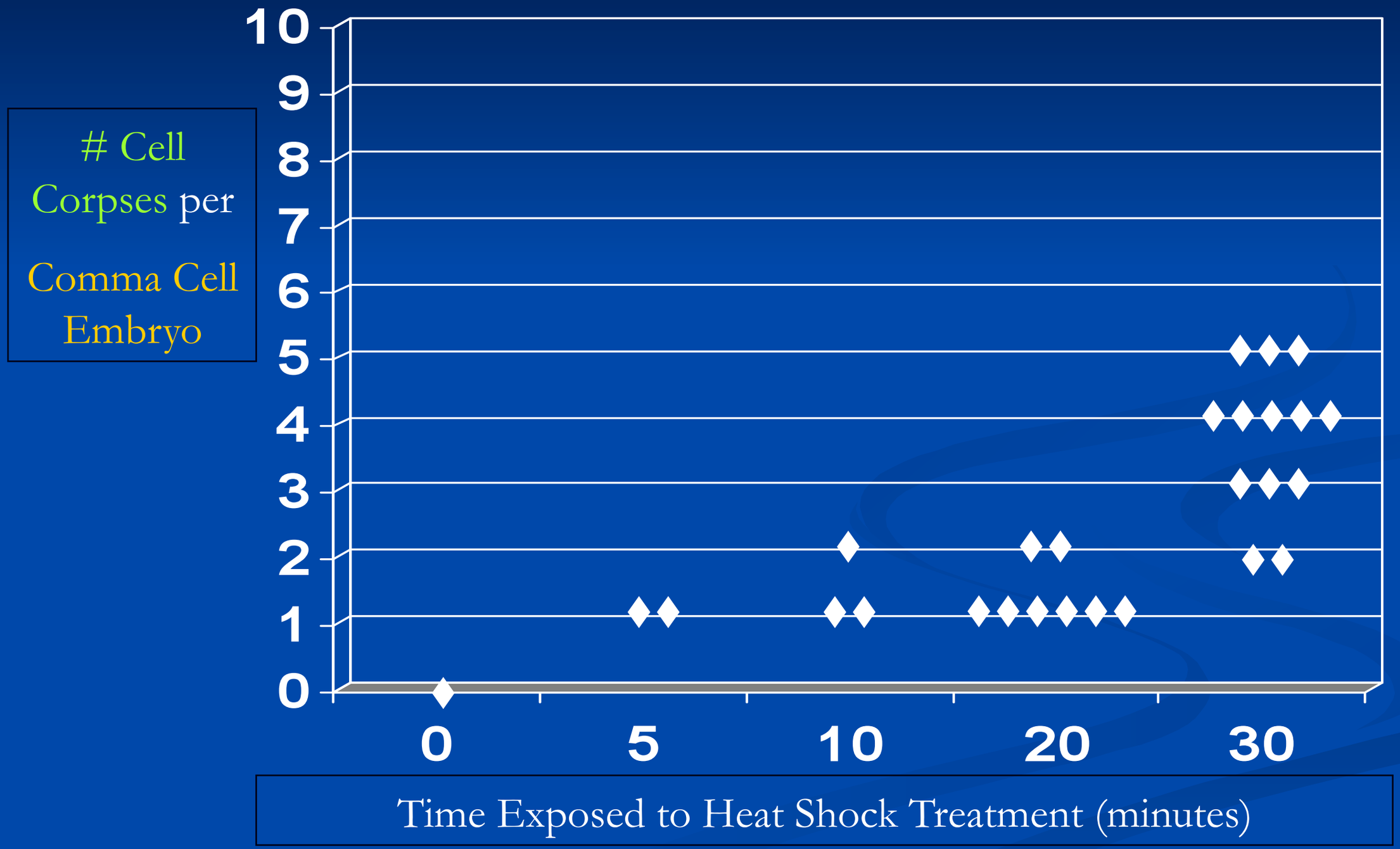
Pathway to Apoptosis (programmed cell death) discovered in *C elegans*



- Cancer
- Genetic birth disorders
- Parkinson's disease

Diagram by Dr.Pan Young Jeong

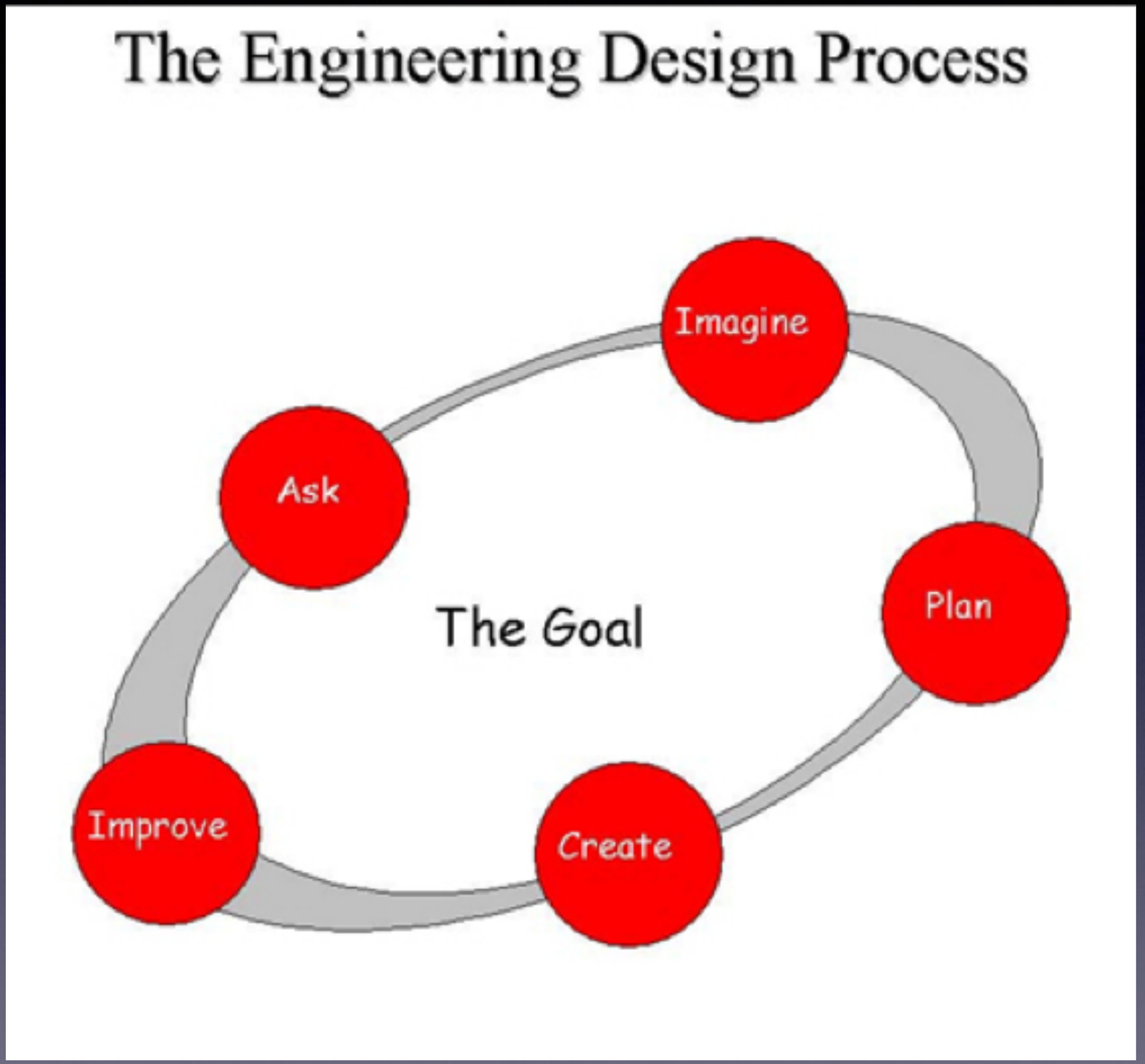
Cell Corpse Observations Post-Heat Shock Treatment



Total Embryos Observed: (10) (8) (9) (16) (13)

Unit Focus: Engineering

Designed for
Elementary Students
Kindergarten - Fourth Grade



Flowchart from Engineering is Elementary

K-2 NGSS
Engineering Design Standards

- 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.

- 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.

- Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.

NGSS Grade Level Standards

Kindergarten

- Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.

- 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.

First Grade

- 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.

Second Grade

- Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties

- Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.

- 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.

NGSS Grade Level Standards

3rd Grade

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

4th Grade

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

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

Engineering Project Rubric

Engineering Design Process	1	2	3	4
Identifying the problem	Vague of understanding problem	Can describe one element of problem	Clearly articulates problem	Clearly articulates problem and foresees relevant issues that might also arise
Identify the engineering criteria (goals) and design constraints	Only identifies one goal or one design constraint	Identifies just the goals or just the constraints	Identifies all the goals and constraints	Identifies all goals and constraints and suggests new goals / considerations in resolving the problem
Imagine possible solutions	Unable to think of a solution or copies someone else's idea	Thinks of one solution	Thinks of more than one solution	Thinks of more than one solution and articulates the benefits or trade-offs of each solution, including those of others
Make a plan for a possible solution	Draws a solution	Uses a labeled diagram	Uses a labeled diagram and can explain their plan	Uses a labeled diagram, can clearly explain plan and rationale for their design choices.
Test ideas and improve design based on results	Narrowly focuses on one solution and makes no adjustments based on results	Tests ideas, but makes improvements based on subjective opinion rather than data	Tests ideas and makes appropriate improvements based on results	Tests ideas and is able to narrow variables in order to more precisely identify areas for design improvement

Engineering Notebook

Engineer(s)	DATE

Project Title

Engineering Goal

Design Constraints (Limitations)

Draw your Best Ideas for Solving this Engineering Challenge
Label the parts of your invention and the materials being used.

How will you test your ideas?

Draw the Solutions that worked Best at meeting the Engineering Goal for this project

What did you discover after testing your ideas?
What did you change to make it work better?

Vehicle Designs

- Launch
- Re-Entry
- Emergency Rescue

Launch Vehicles

Antacid Rockets

Compare effects of . . .

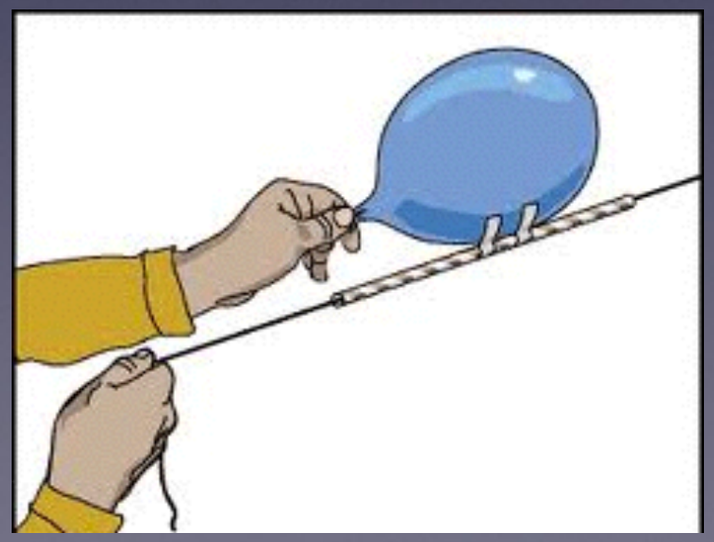
Varying amounts of Water

Rocket Balloons

Compare effects of . . .

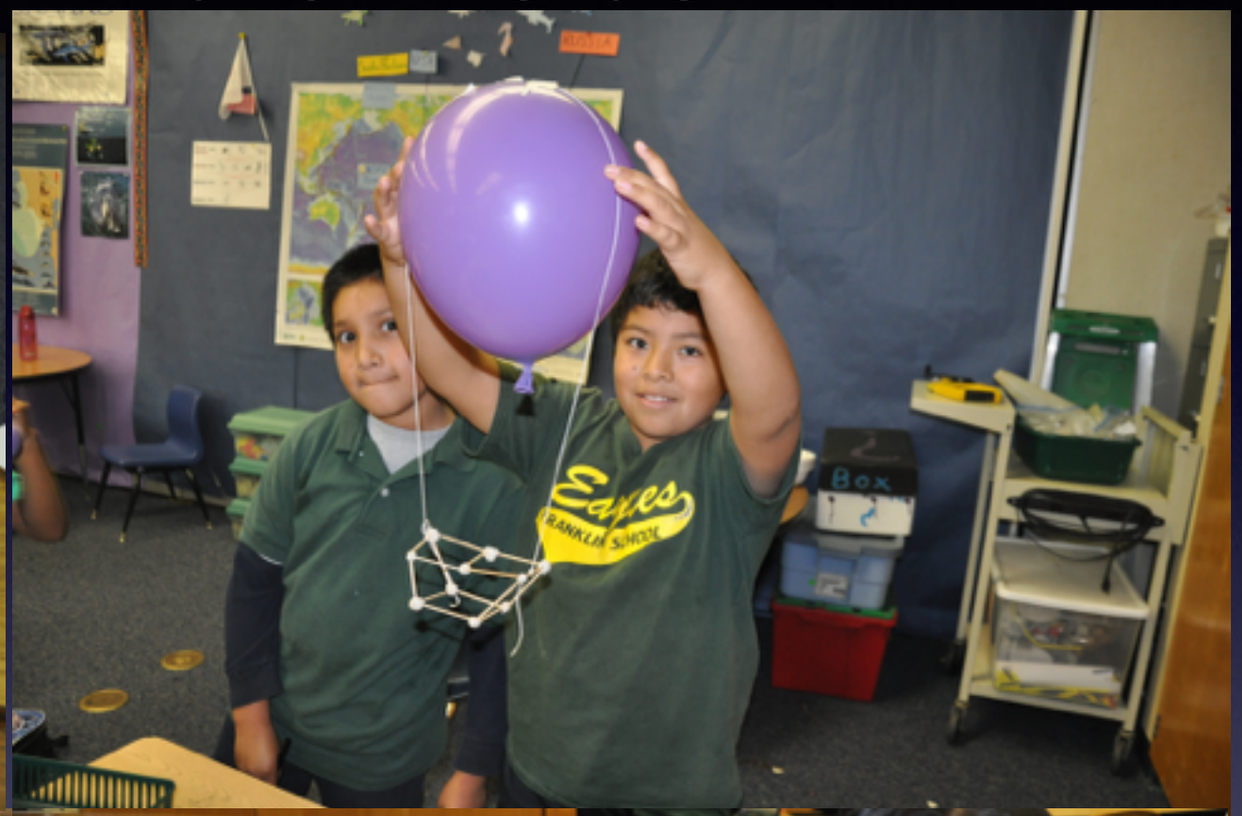
Fishing Line vs. Cotton String

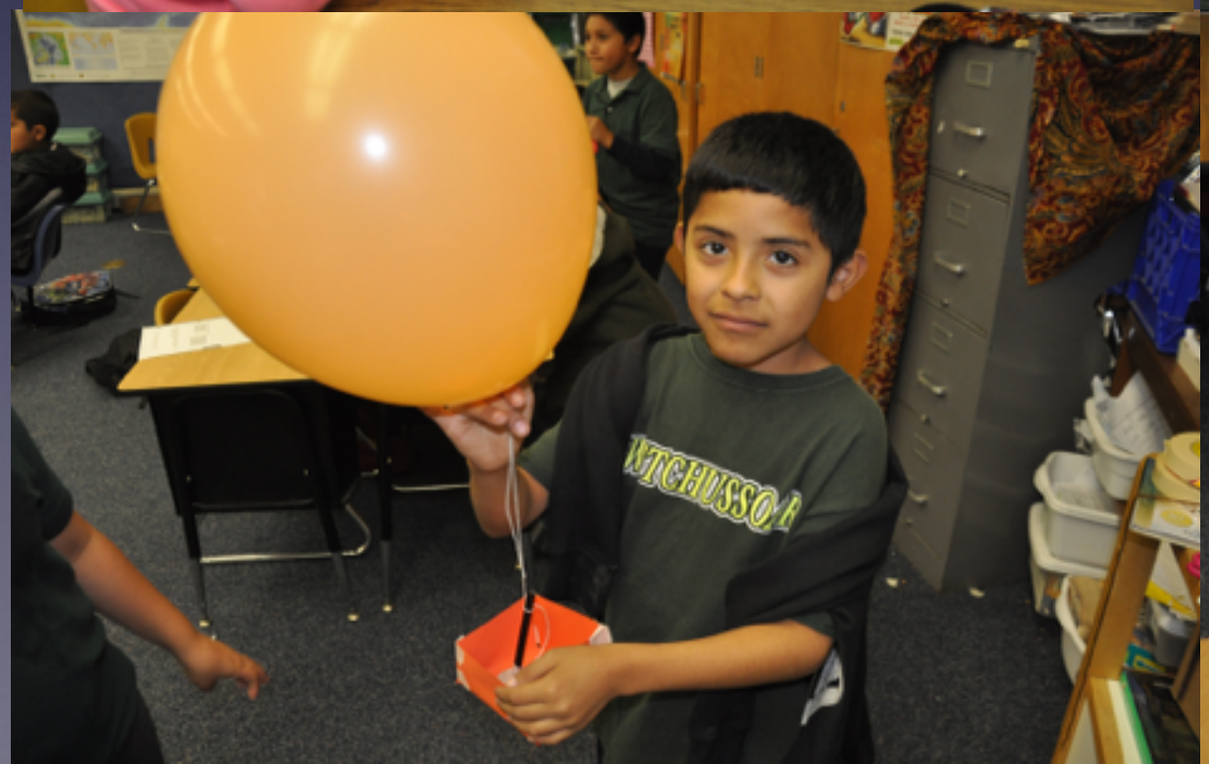
Fins and Stabilizers



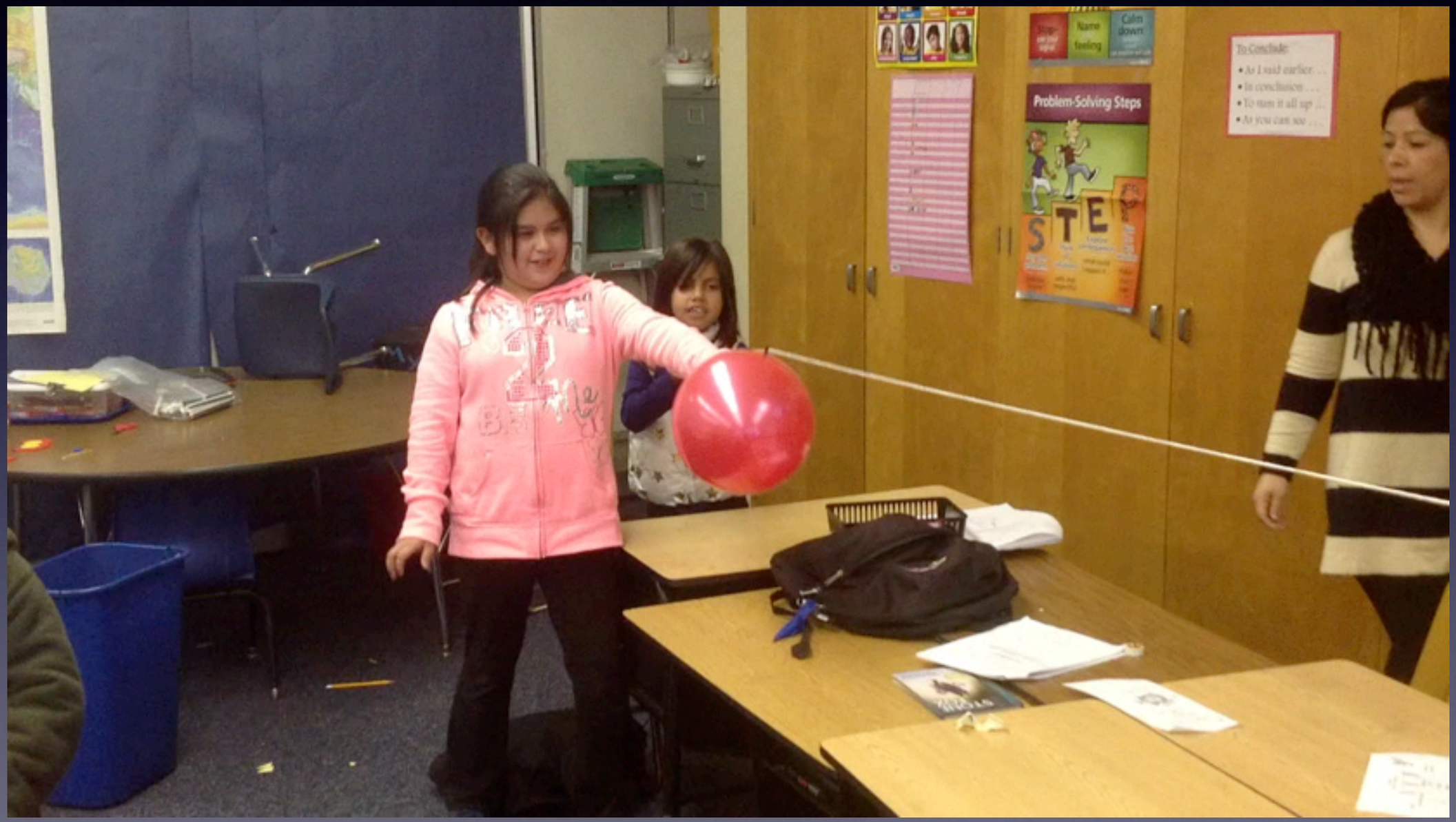
Antacid Rockets

Balloon Rockets





Rocket Balloons

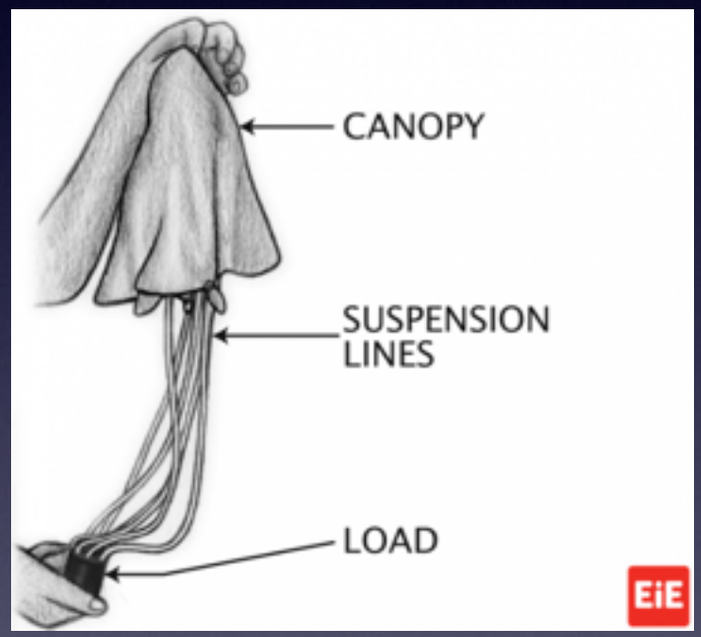


Re-Entry Vehicles

Wind Tube

Open-ended

Flight Experimentation



Parachute

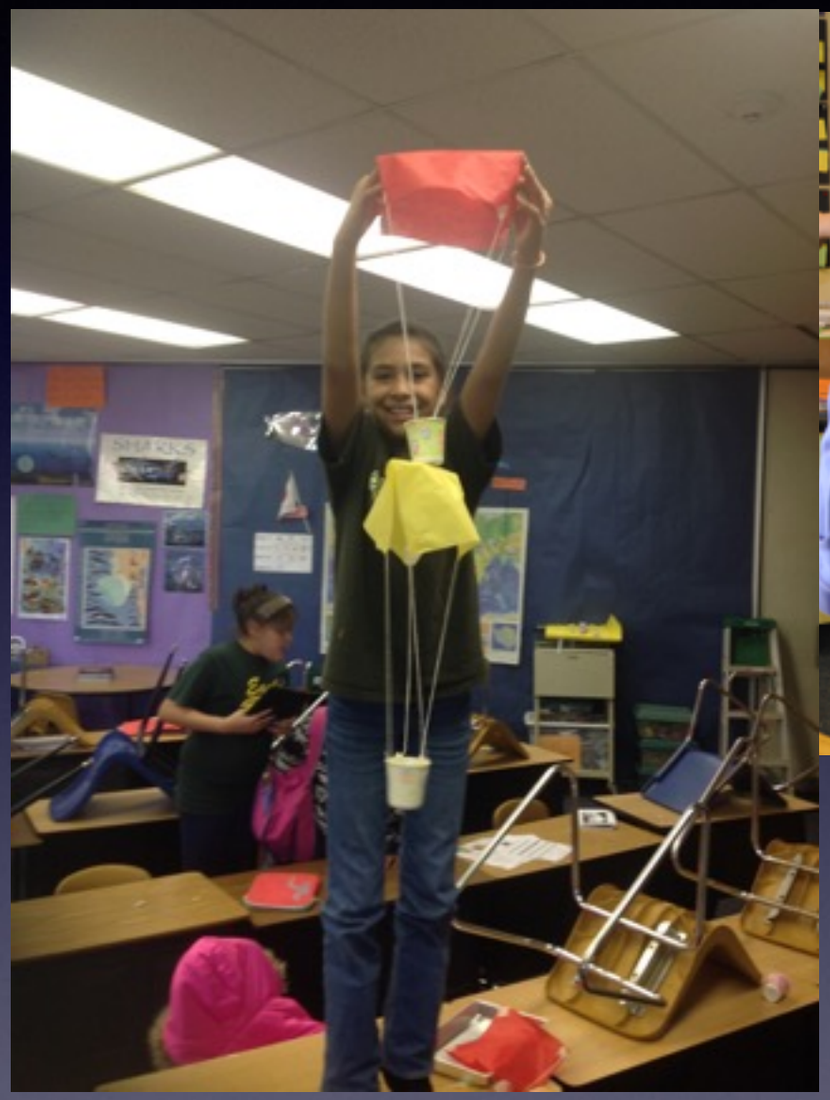
Parachute Designs

Canopy Materials

Gliders

Paper Airplane Designs

Parachutes



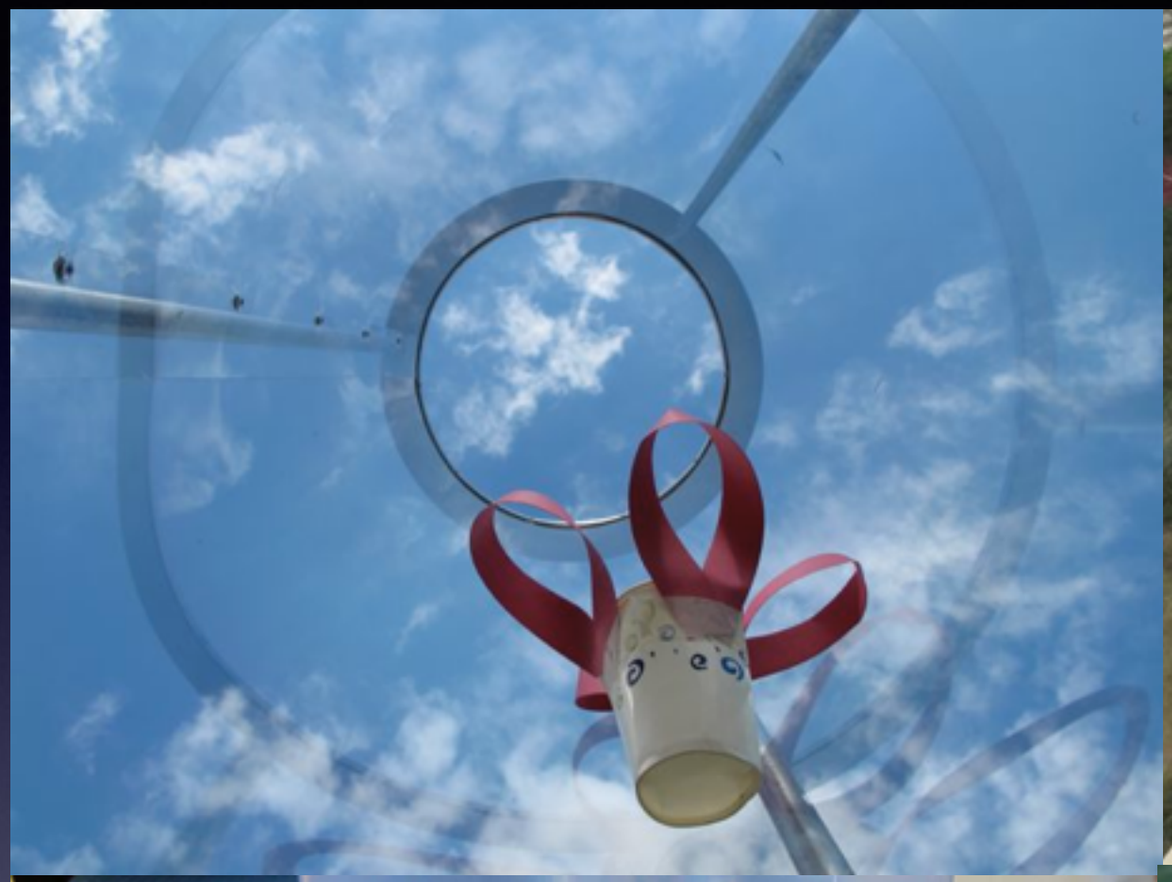
Wind Tube

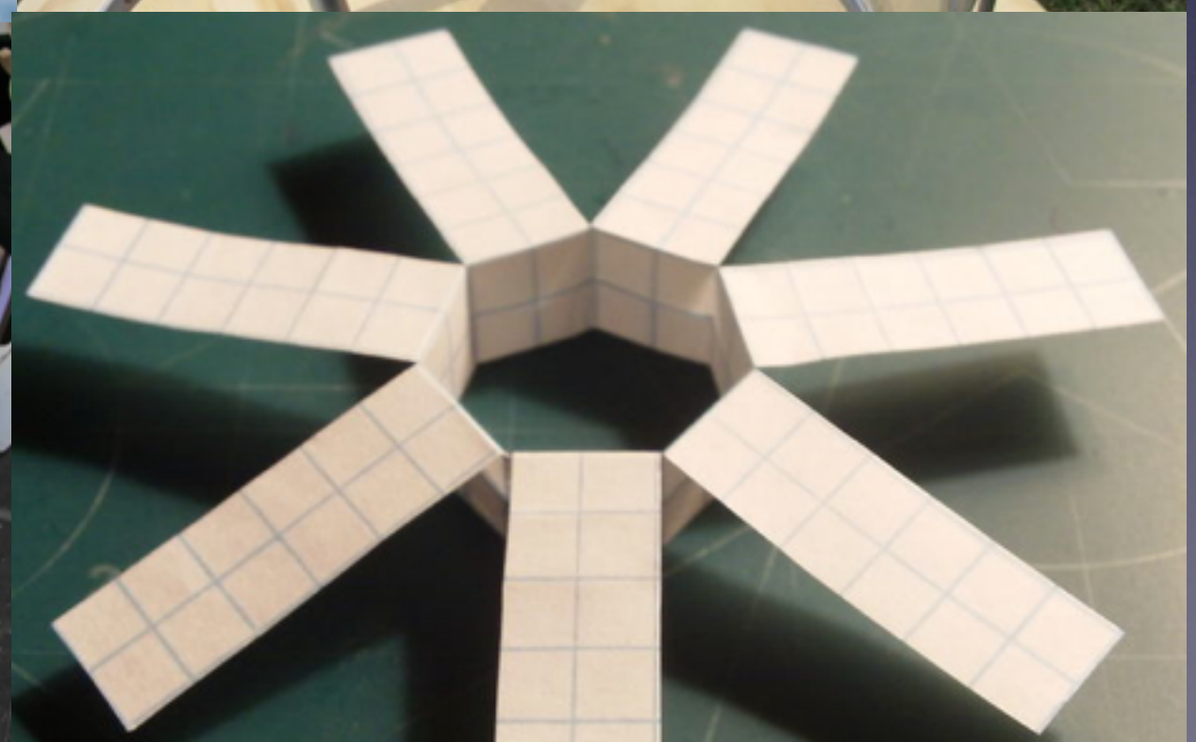
Engineering Criteria: Make something that flies!

Design Limitations: Materials

Concept developed by San Francisco Exploratorium

Wind Tube Flying Designs





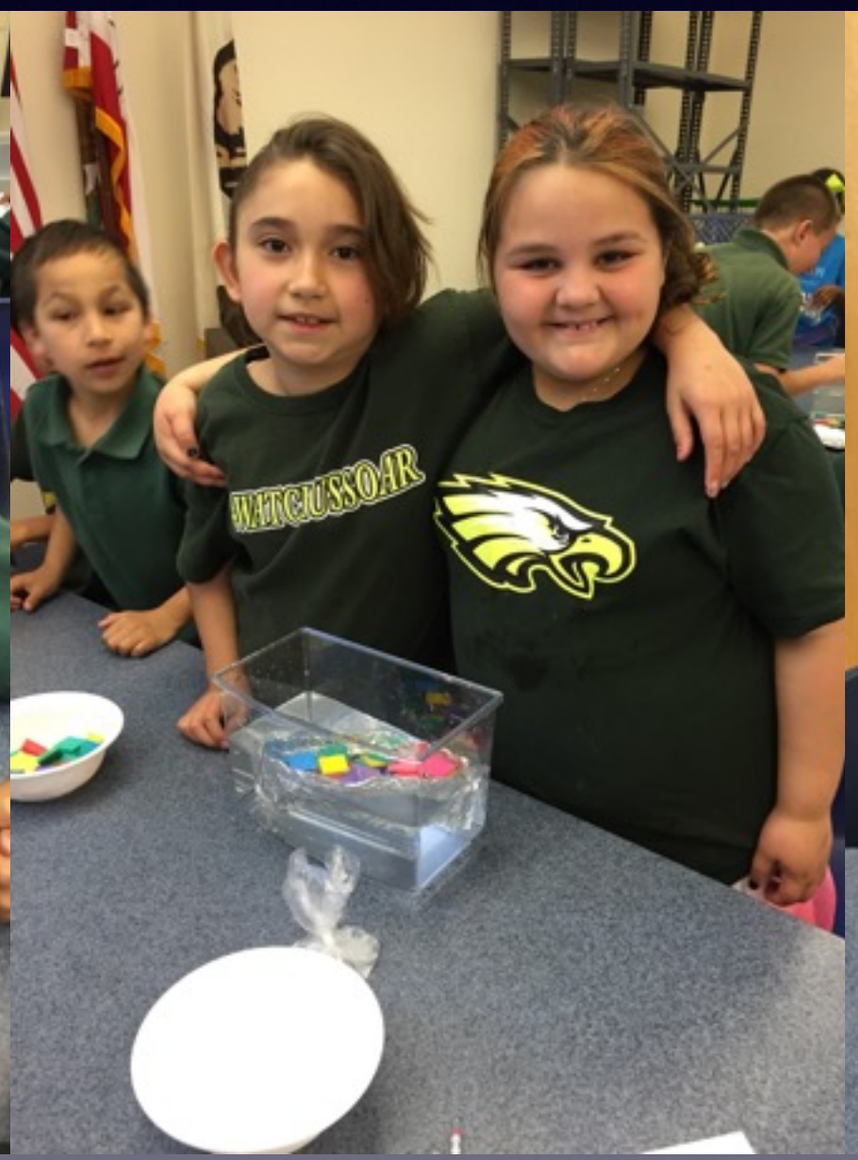
Testing Helicopter Designs

Emergency Rescue Vehicle

Engineering Criteria: Make a buoyant craft that supports the weight of astronauts when they land in water.

Design Limitations: Materials

Lifeboat Engineering Teams



Lifeboat Capacity Tests

Acknowledgments

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