Objectives

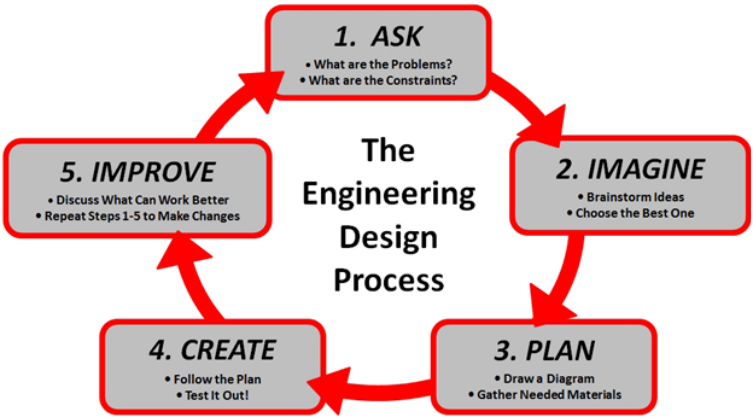
Students will:

- Apply the Engineering Design Process to solve a challenge to create a simple mini robot out of random materials, that will be able to make marks on a piece of paper automatically, and be self-driven.
- Question and develop their own opinions on the meaning and significance of computers and robots in the world of art.
- Distinguish the difference between Mechanical Engineers and Electrical Engineers.

Introduction

Use the material below that will best suit the length of your class periods.

Introduce the students to the Engineering Design Process (EDP). Use the graphic showing the ASK, IMAGINE, PLAN, CREATE, IMPROVE cycle.

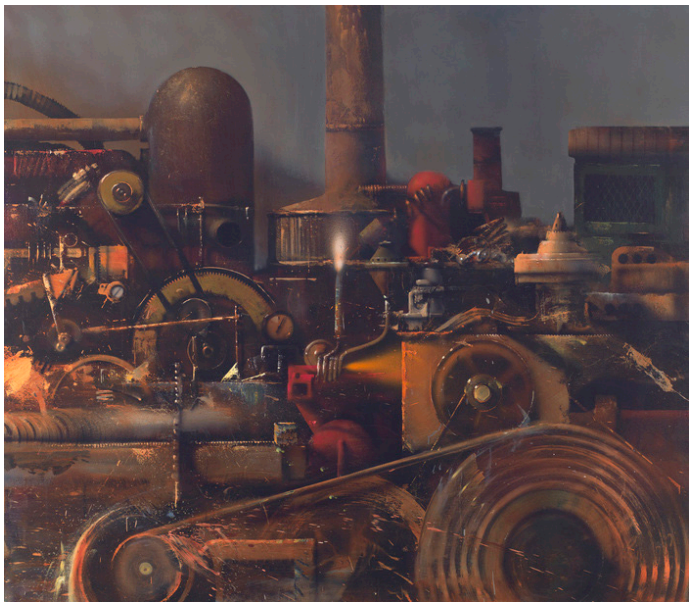


Watch one of the suggested mechanical engineering videos from Sources.

Explain the difference between mechanical engineers (those that design objects to make them move as desired) and electrical engineers (those that understand and design the flow of electricity to make things work).

Explain each step of the EDP, using the video as reference for examples.

1. ASK- what is the problem/challenge? What resources do we have? What are the constraints?
2. IMAGINE- brainstorm some solutions (the more the better). Often times sketches are made to communicate ideas. simple comparison of moving a heavy object without and with a pulley/lever/ramp.



David Dornan, *Patent Pending,* 2008

Materials

- Large sheet of butcher paper (for trial runs throughout the creative process)
- Pitsco Motor 280 (1 per group of 2-3 students)
- AA battery case holders (1 per group of 2-3 students)
- AA batteries (1 per group of 2-3 students)
- Red plastic disposable cups
- X-acto knives
- Markers
- Rubberbands
- Masking Tape
- Popsicle sticks
- Pink erasers
- Anything else you think would be a fun material to use for a robot
- Optional: googly eyes to glue onto your robot, for personality.

Images from the Museum

- David Dornan, *Patent Pending*

Utah Core Standards

Art Foundations I: Standard 1, Objective A
Explore a variety of art media, techniques, and practices.

Art Foundations I: Standard 4, Objective B
Synthesize art with other educational subjects.

Art Foundations I: Standard 4, Objective C
Evaluate the impact of art on life outside of school.

Introduction Cont.

3. PLAN- they figure it all out on paper- often times creating some sort of blueprint. (if time permits, show them images of Leonardo da Vinci's engineering sketches as an example)
4. CREATE- they make a model, or a prototype, to test it out.
5. IMPROVE- most of the time, it doesn't work out the first time, so they have to go through the EDP again.

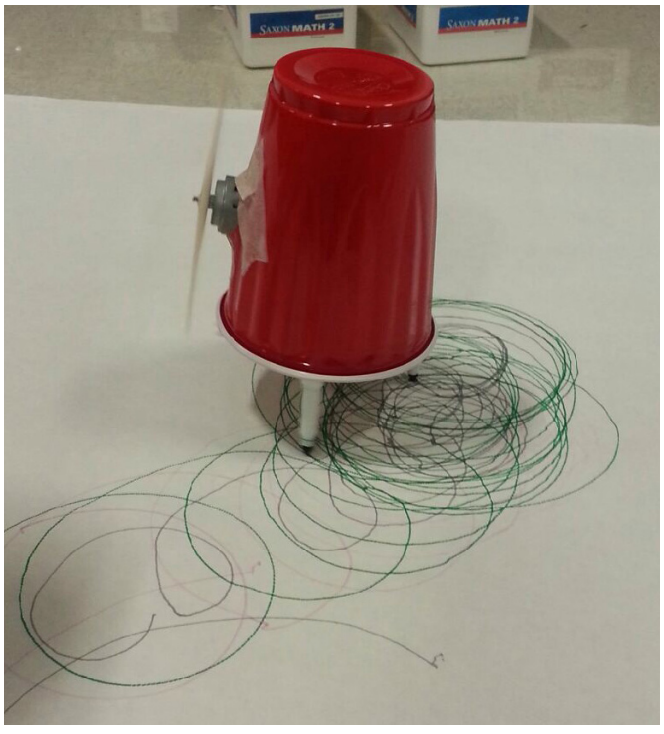
Discussion: what role does art play in the engineering video example?

Learning Activity

Present the students with the challenge - do not give them any hints as to how to accomplish the challenge, do not show them any prototypes as examples - they have to go through the EDP to figure it out themselves. They should not be afraid of failure (this could be a good time to have a discussion on the importance of accepting failure as part of the learning process- use failure quotes in Sources).

Challenge

They have to create an "Art Bot" or a mechanical device that will make marks on a large sheet of butcher paper. It must be self-propelled, or in other words it has to move by itself across the canvas (no assistance from human hands other than to turn it on).



Learning Activity Cont.

Students should complete the Engineering Design Worksheet to help them through the EDP. You can group students in groups of 2-3 persons. Have them start with the first step - ASK. Then they will IMAGINE and PLAN through a sketch (about 5 min). Have them pass off their first sketch with the teacher. Once you've signed them off, they are ready to move on to the CREATE stage of the EDP, using the piles of materials supplied by the teacher. Essential components for the robot are: the motor, battery pack, red cup, and some markers. All other materials are optional for them to use. When they are ready to test out their first design they can bring their prototypes over to the butcher paper (on table or floor) to try them out. Now they are on the IMPROVE stage, and the cycle keeps going- Ask, Imagine, Plan, Create, Improve until it works beautifully (30-50 min).

Extension

If some students need an extra challenge, suggest that they design their robot so that the markers are easily interchangeable, so that the user can decide what colors to use. Or perhaps the robot can be adapted to make two different kind of marks with a small adjustment.

Variations

After creating a working Art Bot, assign them to create a work of art with it. Give each student a large piece of paper that they need to fill with marks made by their robot. What part do they play as artist? How much control do they have, and how much is left to the robot?

Assessment

See rubric attachment

Aesthetics Discussion

Show them the video of artist Harvey Moon and/or Bruce Shapiro. Both of these artists use computers/robots to create their art. Can a robot make art? When does a computer become the tool and when does it replace human creativity? Can it?

If time permits, watch TEDTalks Oscar Schwartz: Can a computer write poetry? and have a class discussion on whether it is true poetry or not if a computer writes it.

Failure Quotes

"They taught me something I didn't know. They taught me what direction to move in." - Thomas Edison referring to failures
"I haven't failed. I've just found 10,000 ways that won't work."- Thomas Edison
"I find my greatest pleasure, and so my reward, in the work that precedes what the world calls success"- Thomas Edison
"When you have exhausted all possibilities, remember this- you haven't."- Thomas Edison
"Our greatest weakness lies in giving up. The most certain way to succeed is always to try one more time." - Thomas Edison
(Not about failures, but still a good quote for this project): "To invent, you need a good imagination and a pile of junk." - Thomas Edison
"Anyone who has never made a mistake, has never tried anything new."- Albert Einstein
"Failure is only the opportunity to begin again, only this time more wisely."- Henry Ford

Resources

Motors: http://www.pitsco.com/Motor_280
AA battery holders: http://www.jameco.com/webapp/wcs/stores/servlet/Product_10001_10001_216072_-1
http://researchparent.com/homemade-wigglebot/
http://crystalandcomp.com/motorized-coloring-machine/
http://www.skiptomylou.org/diy-battery-operated-toy-robot-that-scribbles/
http://www.sciencebuddies.org/science-fair-projects/project_ideas/Robotics_p014.shtml#procedure
http://www.fangletronics.com/2009/04/drawing-vibrobots.html

Videos

Engineering examples:
Origami in Space: BYU-designed solar arrays inspired by origami: https://www.youtube.com/watch?v=3E12uju1vgQ
Paralysed woman moves robot arm with her mind: https://www.youtube.com/watch?v=ogBX18maUiM
Spinal chord device to help treat chronic back pain: https://www.insidescience.org/content/biomedical-device-cushions-vertebrae-treat-chronic-back-pain/1033
BYU's 1700 mpg vehicle design: https://www.youtube.com/watch?v=_FPYtlNmD38#t=134
Or find a TEDTalks video you like - there are hundreds of design and engineering talks on their website: www.ted.com

Artists using robots/computers:
Harvey Moon's drawing machines: https://www.youtube.com/watch?v=VufMgHvaoG0
Bruce Shapiro: https://www.youtube.com/watch?v=Za6l4j56j0E
Sand Drawing Machines - http://www.thisiscolossal.com/2015/06/bruce-shapiros-mesmerizing-kinetic-sand-drawing-machines/ and https://www.youtube.com/watch?v=tGotmVRmZo8
http://www.taomc.com/

	Skimpy *0-1 points*	**Average** *2-4 points*	**Thorough** *5 points*	**Weight System**
Ask	Less than 3 questions, poorly thought out or obvious questions stated in class.	3-5 decent questions, beyond what was stated in class discussion	5+ well-thought out questions, addressed unique concerns	x1 *(5 points)*
Imagine/Plan	Only one sketch, or sketches without labels	2 sketches, minimal labeling	3 sketches, thorough labeling	x4 *(20 points)* *(Minus 2 points for no teacher signature)*
Create/Test *"Work" = Drawing autonomously*	Robot did not work, no testing or documentation	Robot worked, but few tests were performed (less than 3) and/or little documentation of process	Robot worked, good documentation of process and many rounds of testing (3 or more)	x4 *(20 points)* *(Mostly based on class participation)*
Improve	No documentation of improvements	Little or vague documentation of improvements	Thorough documentation of improvements	x1 *(5 points)*
Creativity				Bonus *(up to 5 points, teacher discretion)*
				Total Points *Out of 50*