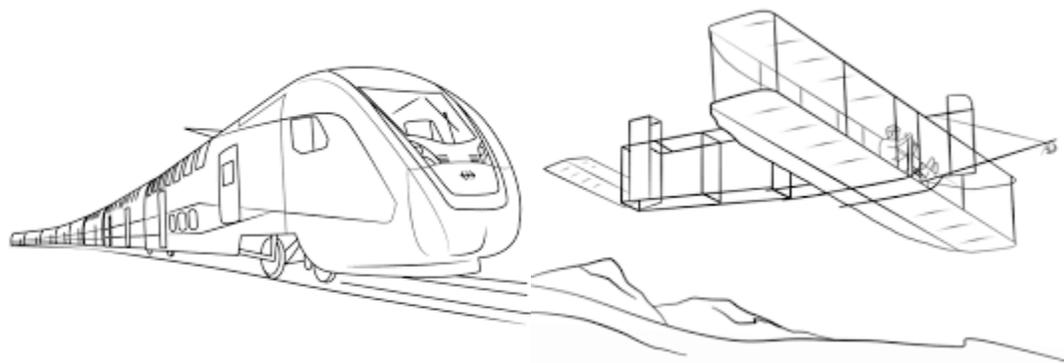


# ENGINEERING MACHINE DESIGN CONTEST

## Driving Change Through Transportation

New Berlin Elmwood High School

March 2021

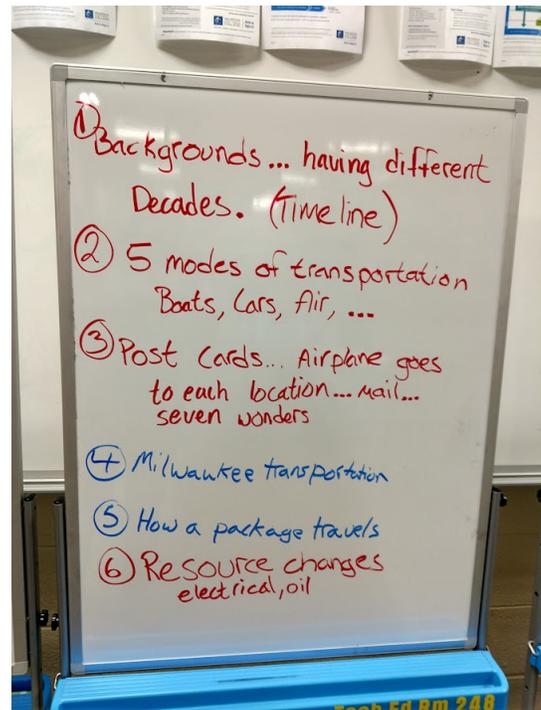
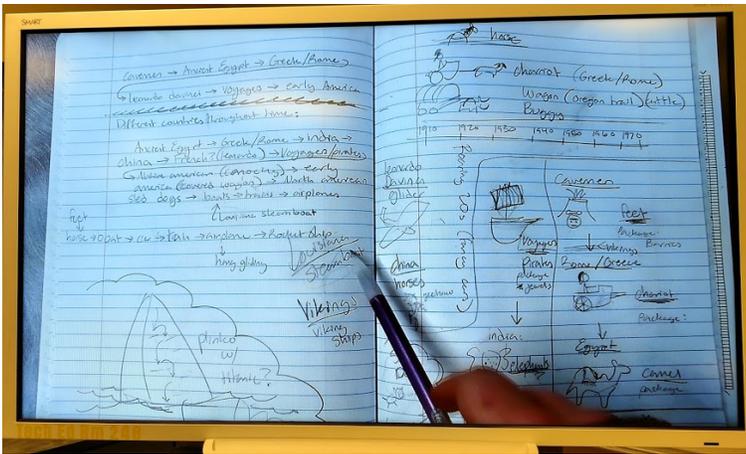


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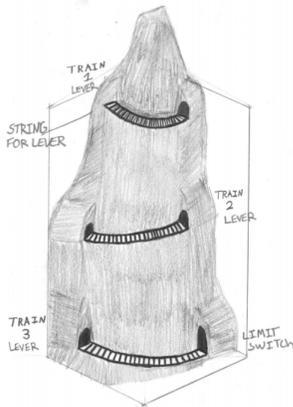
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# Planned Machine Design Sketch and Description

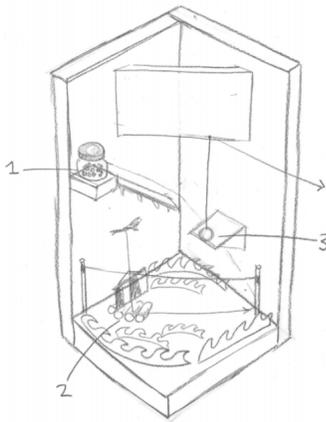
We started to brainstorm what the “timeline” theme could look like. We did some online picture searches, sketches, and written descriptions. Each team member presented their ideas to the team. We will start with building a machine at the base of the machine. The base will be a wooden frame and cardboard base. Each step of the machine will be a different decade. The chemical reaction step will be a rocket launching, the mechanical step will be a series of levers, the electrical step will be limit switches, and the fluid power step will be a pneumatic cylinder.



## Final (or Near Final) Machine Design Drawing/Image and Description



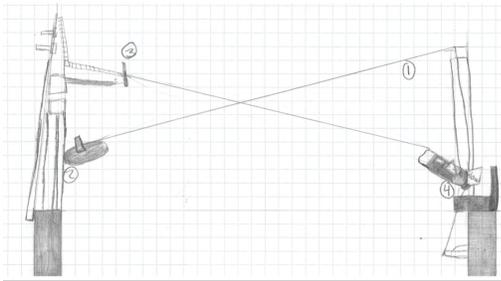
The mountain module. The mountain module starts with a pull of the string and ends with a limit switch. Between each of the steps a 1st class lever will release the next train.



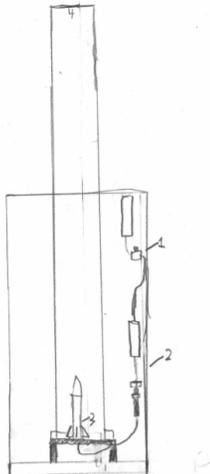
The ship module, it starts by a wheel hitting the jar of marbles down a ramp(1). The jar of marbles falls bringing the ship forward (2). Attached is the ship is a bird the bird goes forward to hit a ball. The ball falls (3) which activates the lever on the mountain module.



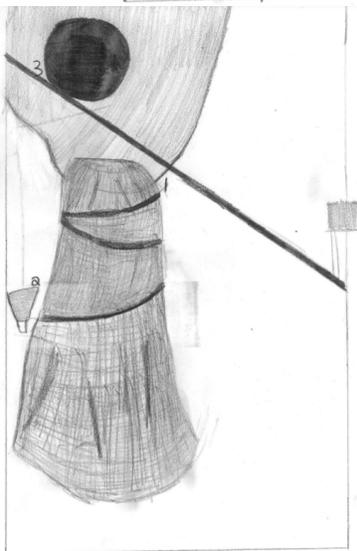
Route 66 starts with an electrical connection (1). A car will then spiral up the track and knock a stack of tires off the track (2). Connected to the tires is a string and clip. The clip will release the next plane module (3).



The airplane module is attached to the tops of other modules. A clip releases a bi-plane (1). The bi-plane runs into one side of a lever (2). The other side of the lever pushes a jet off the ledge (3). The jet hits a toggle switch for the next step (4).



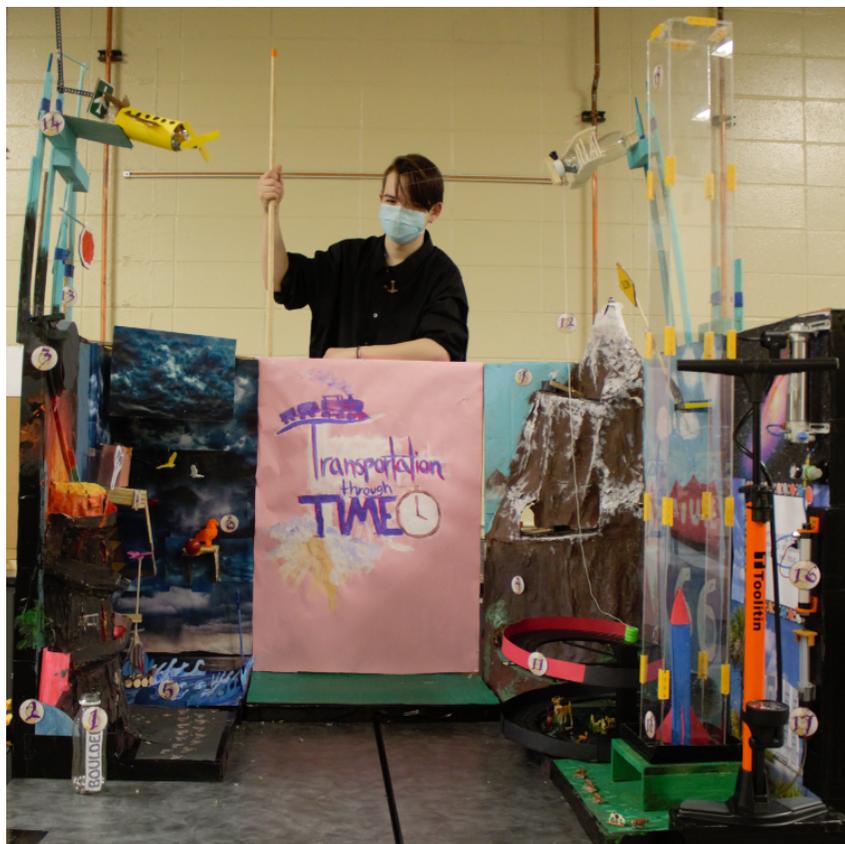
The rocket is going to be our grand finale. The airplane will turn on the switch to activate the pneumatic systems. The pneumatic system (1) will dispense coke into our chemical reaction (2) launching the rocket (3).

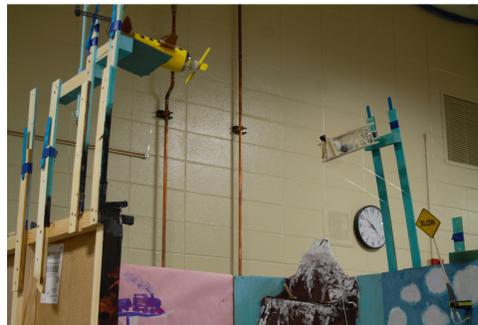


This is the volcano step. The step starts with boulders/ marbles (1) being dropped down a ramp. Then they land into a cup (2) that pulls a pin to release the wheel (3). The wheel knocks the next step.

It started with walking, Then we discovered the wheel. Next, the horse revolutionized the way we move. After nearly 300 years, the newest, fastest, most powerful form of movement thus far discovered was invented: the combustion engine. Join us through time, as me and my colleagues here at the New Berlin Eisenhower Rube Goldberg Team lead you on a journey through time, focused entirely on transportation.

The Wheel. Invented in 3500 BCE, it was the foundation for the way we move today. The Vikings had the fastest, most powerful boats and ships ever seen on the European Continent. This scene, off the coast of England, happened in 1100 AD. Further along, in the English flatlands and hills, the train started populating the ground. This one was in 1900. The car, first industrialized and made efficiently by Henry Ford in 1908 with the Model T. The airplane, however recent, was still an amazing contribution to how we move goods, and ourselves. This one is from 1903, the Wright Brothers invented it. Finally, the Space Age, the 1960s. Man touched the moon, for the first time.





## List of Machine Steps

1. A human drops boulders down the mountain into a krater (stone jar).
2. The krater falls down pulling a pin that releases a large wheel.
3. The wheel rolls down a ramp colliding into a jar of marbles.
4. The jar of marbles falls down a ramp which makes the Viking's ship move forward.
5. The bird attached to the Viking's ship knocks a golf ball off of a ledge.
6. The golf ball pulls a string which activates a 1st class lever on the mountain.
7. The 1st class lever releases a "steam train" via gravity the "steam train" runs into another 1st class lever.
8. The 1st class lever releases a "diesel train" by means of gravity the "diesel train" runs into a 1st class lever.
9. The 1st class lever releases an "electric train" via gravity the "electric train" runs into a limit switch.
10. The limit switch closes the electrical circuit to start the slot-car.
11. The slot-car goes up the track and knocks over a stack of tires.
12. The stack of tires falls releasing a clip that is holding back the Wright Brothers' Plane.
13. The Wright Brothers' Plane flies down the string into a stop sign attached to a lever.
14. The lever knocks the Jet off the runway straight towards the "slow sign" toggle switch.
15. The toggle switch completes the circuit which opens the solenoid valve to release the pneumatic linear actuator.
16. The pneumatic linear actuator presses and locks a syringe down.
17. The syringe pushed diet soda into the canister on the bottom of the rocket.
18. The diet soda reacts with the alka seltzer tablet which creates a gas that makes the canister want to expand as the gas tries to escape.
19. The expanding canister explodes and launches the rocket into the air.

## Cost of Machine and Percent of Recycled Materials Used

91.5% of the items used on our machine are recycled or repurposed items. The total cost of the machine was \$96.94

### Purchased:

Item	Cost
Hot glue sticks 100 pack	\$16.30
Masking tape 3 rolls	\$6.77
Grey duct tape	\$5.99
Black duct tape	\$3.48
Diet soda	\$4.29
Alka Seltzer tablet	\$5.50
3/8" staples	\$4.99
Wood screws variety pack	\$6.99
3D printer filament	\$18.99
Printed on paper	\$8.99
Pneumatic Cylinder	\$14.65

### Recycled

Quantity	Material Description
20	Pine 2x4 - 1.5"x1.5"x 36"
26	Pine 2x4 - 1.5"x1.5"x 15"
4	Pine 2x4 - 1.5"x1.5"x13.5"
4	Pine 2x4 - 1.5"x1.5"x 12"
3	Pine 2x4 - 1.5"x1.5"x 22"
	Cardboard
1	pneumatic reservoir
1	pneumatic on/off valve
1	pneumatic regulator
1	pneumatic solenoid valve
1	pneumatic linear actuator
	pneumatic tubing
1	battery clip
1	battery
1	3D print clip

Quantity	Material Description
8	pine 2x4 - scrap
	Cardboard
1	bottle
3	Dowels
2	plastic support bars
	hot glue
	painters tape
	paint
4	popsicle sticks
	toggle switch
4	blocks
	paper
	fishing string
	markers
	poster paper

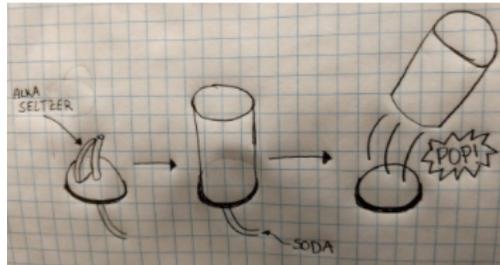
Quantity	Material Description
1	motor clip
1	20cc syringe
	1/8" tubing
1	film canister
	Plastic sheet
	plywood
	screws
	hot glue
2	Cardstock paper
	Cardboard
	Newspaper
5	1/2" square dowels
1	wood - 1/2"x8"x1/8"
12	plastic support bars
6	Large marbles
5	1/4" dowels
1	Fishing string
2	flour
2	water
	liquid glue
	Markers
	Paint
3	nuts
	limit switch
	hot glue
	wood
	rag
	String
	paint
	printed clouds
5	3D printed birds
	foam sheets
	Golf ball

Quantity	Material Description
	MDF
	craft foam
	paint
	duct tape
6	alligator clips
	Toy cows
2	Alligator clips
1	PWM cable
2	Battery
	electrical tape
2	battery connector
5	1/4" dowels
1	pine 2x4 - 1.5"x1.5"x 12"
	Paint
10	steel marbles
1	slot car
8	slot car track
	toy animals
	artificial grass
	cardboard
	newspaper
	water bottle
	flour
	glue
	water
5	steel marbles
	paper towels
	cardstock
	rigid foam for wheel
	construction paper
	fishing string
	wood scrap
	cup
	eye hooks

# Applied STEM Processes

Chemical Reaction Step:

Picture:

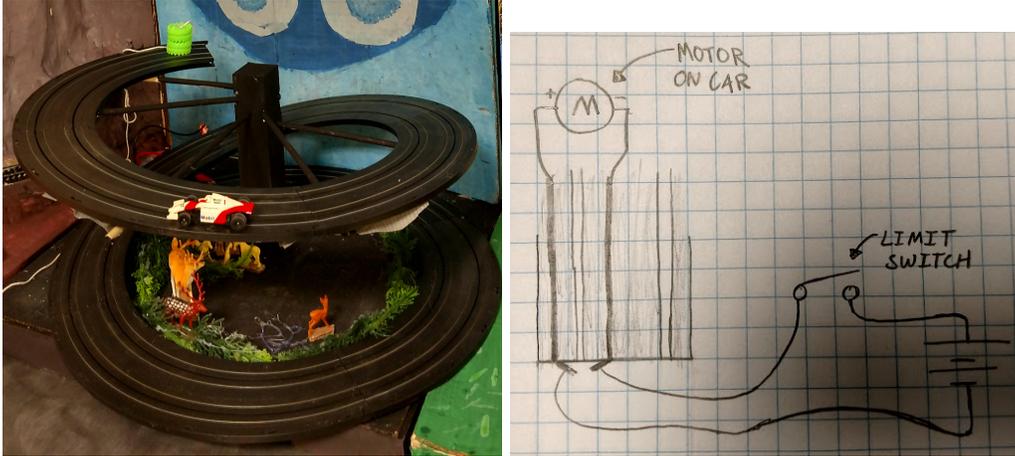


Explanation:

Soda is pumped through the tube and into the bottle that has an AlkaSeltzer tablet in it. Once all the soda is in the bottle, it starts reacting with the tablet, air compresses, and once there is enough air pressure, the bottle will explode and shoot straight up.

## Electrical Step:

### Picture:

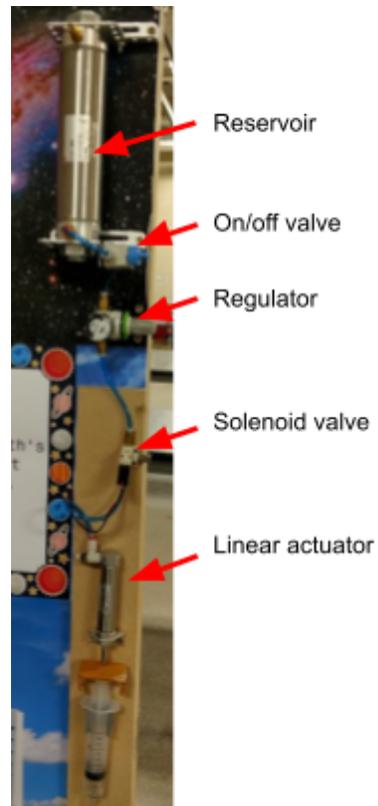


### Explanation:

Slot cars, a powered miniature car uses electricity to move along a track. The slot car has an electrical motor inside of it that runs on 10 to 19 volts normally and can have a controller that can change the speed by moving the resistor to allow more or less voltage to the car. The car has grooves that are set into the track allowing electricity to transport through the contacts allowing the motor to run and allow the car to move.

## Fluid Power Step:

### Picture:



### Explanation:

Pneumatics is a type of fluid power that uses pressurized air to power a mechanical system. This system works when we first pump air into the reservoir to about 70 psi. Then, when the airplane hits the switch, the compressed air will shoot out through the solenoid valve and into the linear actuator where that will then push the rod at the end.

## Mechanical Action Step:

### Picture:



### Explanation:

A string is pulled by a golf ball in the previous step which will go through a series of rings to direct the string into pulling one end of a first class lever. This lever that lifts up to let the first in a series of three trains through, these three trains are themed after steam trains, diesel trains, and mag-lev to show the advancements in technology over time, this first train will roll due to gravity and bump into another first class lever which moves the force downwards and pushes the second train over a small foam hump, this process of a first class lever into a small foam hump is repeated on the third train which then rolls down and bumps into a limit switch. Our three first class levers have the fulcrum closer to where they are activated than what they are pushing, so they lose force on all three at a rate of about 3:2 for the first, 4:1 for the second and 5:1 for the third.

## Reflection

Our team decided to start by going through the design process as our first step. We discussed the prompt “Driving Change Through Transportation” and came up with different ideas we could do as a team. We came up with a few ideas like going with each form of transportation or going with the idea of a package going through time. By generating these concepts we could vote as a team on what we wanted to do so we would have a more concrete idea of what to do. We each decided to go with the theme of going from caveman times to today as the general idea of our machine and each took a time period and a type of transportation.

We ran into a few issues with a few steps, for example the slot car track was having problems with electricity running through it and a good connection of the track. After fixing the track we had to replace the alligator clips that were supplying electricity to the track because they were burnt, but after the replacement the step now works consistently. After getting all the steps working consistently we could finish putting the machine together. After we reviewed our machine and went over problems we went through and how we can improve for next time. When we started finalizing our work we found that it was hard to fall into the 5 minute time limit because of how long a few of our steps were and when we started to record we realized that angling the camera for some of the steps was hard because of the weird angles.

The rube machine has helped influence all the team members to go into a STEAM career field. We are excited to use the design process in our future careers to solve big problems. For example Nick is going to UW-Platteville next year for engineering and Ethan is going to UW-Madison for Biomedical engineering. Adam is going to WCTC for a tool and die.

Word count: 334

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