

To: Cait Cramer, ENGT 120 Faculty
From: Ryan Albers, Darrick Elliott, Jeanie Hess, Cory Rhodes
Project: Proposal for a Pneumatic Vehicle
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DRAFT
Draft proposal based on
Proof-of-Concept Models

1.0 Summary

We were asked to design a project that solved a particular problem. We propose to design a vehicle that runs on air. The vehicle will utilize a compressed air system. This would allow a child to use the car safely and learn about pneumatic systems.

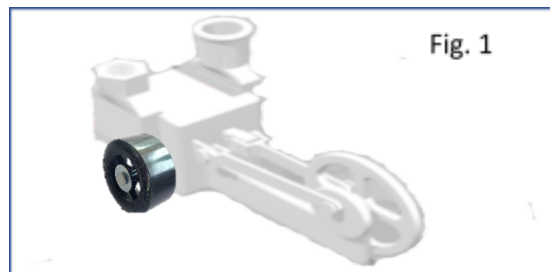
2.0 Compressed Air; Pneumatics

A pneumatic system uses compressed air to transmit force and energy. Every pneumatic system requires five components:

- 1) A compressor that turns ordinary air into compressed air by squeezing it into a small space, thereby increasing the atmospheric pressure of the air
- 2) A reservoir strong enough to withstand the increased air pressure
- 3) Valves to control the air flow
- 4) A circuit or path of tubing or other mechanics through which the air travels
- 5) A motor or actuator that uses the air to perform work. An actuator (or “mover”) is often powered by pistons sliding back and forth inside cylinders; the movement is caused by compressed air that flows in and out of the cylinders. Since our project involves a child’s toy, safety is of primary concern. The system will be low power since it will be powered by a balloon. Pneumatic systems pose little or no risk of fire, overheating, leakage, or pollutants, unlike other systems.

3.0 Details of Proposed Work

Our proposal is a small (approximately 2'x1'x1') vehicle that runs on compressed air. The chassis will be primarily constructed of a 3D-printed air piston structure (Fig. 1). The structure consists of an air reservoir (a balloon), valve chamber, cylinder chamber, cylinder, two arms, flywheel (which is also the drive wheel), an axle, and two additional wheels. Adding the wheels directly to the piston minimizes weight and thus the friction that the system will need to overcome in order for the car to move. Adding rubberized paint to the flywheel will allow the necessary grip to the ground.



A proof of concept design will be used to demonstrate the feasibility of the concept. The final design could be 25% to 50% larger than the prototype and may be glued or epoxied together at the critical pressure interfaces to prevent air pressure from leaking.

3.0 Explanation of Expertise/Roles

Based on experience and interests, each team member will serve as team leader for a portion of the build and be responsible for that portion, including any necessary research, creation, testing, integration, and precise fit with the other parts.

3.1 Ryan Albers: Ryan has some experience in 3-D printing, and he enjoys teaching and writing. Ryan has researched the underlying engineering concepts and he built proof-of-concept models to teach the engineering principles to the rest of the team. Ryan will be responsible for printing the 3D parts, and he will also serve as co-editor for the reports and presentation materials.

3.2 Darrick Elliott: Darrick has management experience and is familiar with creating reports, schedules, and purchasing/requisition forms. Darrick will serve as co-editor with Ryan helping to write the reports and final presentation materials. He will also create a schedule for the build, ensure that the team meets each milestone, and be responsible for making sure the team has received (or has access to) all required purchased materials and equipment from Ivy Tech, including adequate workshop access.

3.3 Jeanie Hess: Jeanie has experience in robots and engineering design, and she is a natural leader. In addition to serving as overall Team Leader, Jeanie will also be in charge of any electronics. The team is considering the addition of an RC (radio control) to the project. Jeanie will research the components found on an RC board, study the circuitry and physics involved, and determine whether including an RC is feasible given the weight and integration issues, with particular attention given to the ability to tie the RC to the axles and to provide enough power to overcome the extra weight of the RC and batteries. Jeanie will work with Cory and Ryan to integrate the RC into the project. Jeanie will also work with Cory to develop a detailed parts list involving any RC components, if needed.

3.4 Cory Rhodes: Cory has experience in mechanics, he is very detail oriented, he understands how to find information and materials, and he is a conceptual engineer - he discovered the idea of a pneumatic vehicle on a YouTube video. Cory will be responsible for maintaining a detailed parts list with each iteration of the project, for locating possible vendors of those parts, and for transmitting that information to Darrick for acquisition. Cory will also work with Ryan and Jeanie to conduct testing to ensure the components fit together and the vehicle operates as intended.

4.0 Testing and Validation

The project will be complete when the vehicle can demonstrate the following features:

- The vehicle must be capable of traveling 2 feet under its own power
- The vehicle must be driven by air power and be safe for use by children 10 years old and up.
- Refueling the system should be as easy as possible. In this case, blowing up a balloon will be considered "refueling".
- The vehicle should be durable enough to survive 5 trials.

5.0 Material and Equipment Requirements

Materials List (hyperlinked)	Unit Cost	Links
Filament for 3d printer	\$ 14.69	https://www.amazon.com/Filament-filament-Different-High-Precision-Diameter/dp/B073XP8BZN/ref=sr_1_5?ie=UTF8&qid=1521393514&sr=8-5&keywords=filament+3d+printer
Gorilla Epoxy	\$ 4.96	https://www.amazon.com/Gorilla-Epoxy-85-oz-Clear/dp/B001Z3C3AG/ref=sr_1_3?s=industrial&ie=UTF8&qid=1521393736&sr=1-3&keywords=epoxy
Loctite Super Glue	\$ 5.97	https://www.amazon.com/Loctite-Liquid-Professional-20-Gram-1365882/dp/B004Y960MU/ref=sr_1_9?s=industrial&ie=UTF8&qid=1521393866&sr=1-9&keywords=super+glue
Sand Paper	\$ 7.99	https://www.amazon.com/Sandpaper-Furniture-Finishing-Automotive-Polishing/dp/B01LZ6TG05/ref=pd_sbs_60_1?_encoding=UTF8&pd_rd_j=B01LZ6TG05&pd_rd_r=A4T0YKJQMDFER0R9JY5J&pd_rd_w=BRZoQ&pd_rd_wg=tkokc&psc=1&refRID=A4T0YKJQMDFER0R9JY5J&dpID=51deVPdvOyL&preST=SY300_QL70_&dpSrc=detail
File Set	\$ 7.99	https://www.amazon.com/Needle-HIGHEST-QUALITY-Hardened-Strength/dp/B01MRCZKIX/ref=sr_1_4?s=hi&ie=UTF8&qid=1521394197&sr=1-4&keywords=file+set
Plasti Dip Coating	\$ 13.14	https://www.amazon.com/Performix-11201-Dip-Multi-Purpose-Coating/dp/B00176DDPK/ref=sr_1_1?s=hi&ie=UTF8&qid=1521394278&sr=1-1&keywords=Plastidip&refinements=p_n_feature_twenty_browse-bin%3A3267892011
Balloons	\$ 10.99	https://www.amazon.com/CTI-Industries-Crystal-Balloons-Sapphire/dp/B0077SWC7C/ref=sr_1_8?s=home-garden&ie=UTF8&qid=1521420271&sr=1-8&keywords=blue+balloons&refinements=p_n_srvg_2947266011%3A2972983011
Masking Tape	\$ 6.59	https://www.amazon.com/ScotchBlue-Painters-Multi-Use-1-88-Inch-60-Yard/dp/B00004Z4DU/ref=sr_1_3?ie=UTF8&qid=1521420499&sr=8-3&keywords=blue+masking+tape
Wheels and Nails	\$ 3.49	https://www.amazon.com/Revell-Pinewood-Officially-Licensed-America/dp/B0031L4WJE/ref=sr_1_1?s=toys-and-games&ie=UTF8&qid=1521394394&sr=1-1&keywords=pinewood+derby+wheels

Total \$ **75.81**

Equipment

3D Printer - Ideally with 1'X1'X1' Printer Bed
Table Saw
Hack Saw
Razors / Exacto Kit
Files and Sandpaper (May not need to buy)
Hammer
Drill and Drill Bits
Masking Tape (May not need to buy)

6.0 Conclusion

Our project is an air-powered pneumatic vehicle that is safe and educational for children. It effectively and creatively demonstrates pneumatic systems, it poses little to no risk of fire, overheating, leakage or pollutants, it is inexpensive to operate, and it is fun to use. Assuming Ivy Tech's timely acquisition of the materials and availability of the workshop and equipment, the project can be completed within the time allotted and will allow each team member to not only utilize their unique talents, but also to learn new skills from each other.