

2019 Propeller Powered Vehicle (PPV)

Background:

Concerns about the environment and rising costs of fossil fuels are driving automakers to design and build more aerodynamic, energy efficient vehicles. Everyone is trying to develop their own concept vehicle these days, and automakers are watching. Your new concept vehicle could be the next million dollar idea. Do you have what it takes to design and fabricate the next futuristic vehicle?

- Quote #1: "To Invent, you need a good imagination and a pile of junk" – Thomas Edison
- Quote #2: "Inventors search for ways to improve the lives of others and always think larger or greater than themselves" – Mr. Mitchell

Design Challenge:

The student will design and fabricate a purposeful Propeller Powered Vehicle that will be able to travel down a long hallway to achieve maximum distance, speed and drag race for time against other students. Other specified events determined by the instructor.

Please read all information and instructions before beginning any activity or design process.

Objectives – Standards:

- Students design and conduct a scientific investigation.
- Students demonstrate applied physics principles of motion, vector geometry and friction.
- Students develop and evaluate inferences and predictions that are based on data.
- Work with tools to process materials and assemble a product.
- Demonstrate gluing or fastening techniques.
- Understand electronic components including wiring, DC motors, ON/OFF switch and soldering.
- Incorporate design and sketching techniques.
- Incorporate problem solving techniques.
- Students solve problems involving scale factors, using ratio and proportion.
- Better understand Newton's Law of Motion.
- Demonstrate skills in accommodating friction and alignment geometry.
- Demonstrate basic understanding of aerodynamics and the effects of acceleration.
- Apply mathematical calculations and measurements and recognize and apply mathematics in contexts outside of mathematics.
- Students learn that modeling, testing, evaluating, and modifying are used to transform ideas into practical solutions.
- Students develop an understanding of the role of troubleshooting, research and development, invention and innovation and experimentation in problem solving.
- Students learn to test and evaluate the design in relation to pre-established requirements, such as criteria and constraints, and refine as needed.
- Students learn to make a product or system and document the solution.
- Work individually and/or cooperatively as well as competitively.

Vehicle Constraints:

- Vehicle may be made from any material the student chooses.
- Maximum vehicle length not to exceed 16" with propellers attached.
- Maximum vehicle width not to exceed 14" with propellers attached.
- NO height restrictions.
- Maximum of 4 wheels (mini CD's) that touch the ground all at the same time.
- Maximum of 2 DC electric motors. (supplied by instructor)
- Maximum of two 9 Volts rechargeable batteries (supplied by instructor)
- Up to 4 propellers maximum – you determine the size.
- Vehicle must have a power ON/OFF switch easily accessible and away from propellers.
- Motors can only drive the propellers, not the wheels.
- Vehicle must have a Safety Ring or Halo to protect propellers.

Material:

- Students may use any materials in the fabrication for their PPV including the following:

• Sintra	• Mini CD's	• CD Wheel Hubs
• Matte Board	• Axle Rod	• Fasteners
• Plywood	• Axle Bushings	• Pulleys
• Balsawood	• Nylon Spacers	• Gears
• 9 Volt Batteries	• 9 Volt Wire Harness	• Super / Stick / Hot Glue
• Electrical Switch	• Electrical Wire	• Propeller (multiple type)

Safety First:

Be careful and avoid injury when working with all tools and equipment. Disclaimer: This product requires the use of tools that could be dangerous and might cause an injury if not handled with care. Follow all safety procedures and guidelines for each tool as provided for by the instructor and identified in the fabrication lab safety guidelines.

Procedures:

1. Remember this is a true ***Engineering Project*** not a Tech Ed Hot Glue Fest
2. Research and Brainstorm ideas for the Propeller Powered Vehicle (PPV) different from any of the pre-designed vehicles with which you have researched.
 - *Students may complete this part of the activity in a group, however each student should bring their own ideas to find the best solution for the team.*
3. Select your best idea for your PPV and on an "A" size sheet create a rough sketch of the idea you chose as a team.
 - *The sketches do not need to be precise but should give a general impression of each idea. While the sketches do not need to be to scale, they should give a general idea of the size and shape of each proposed vehicle.*

Procedures: (continued)

4. Create a 3D Solid Model Assembly – Inventor .iam and .ipt files.
 - *Pay close attention to this demonstration during lecture to ensure a precise design.*
5. Create 2D IDW (detail drawing) with dimensions for all components to be fabricated by you.
 - *Pay close attention to this demonstration during lecture to ensure a precise design.*
6. Fabricate or alter parts per your design requirements in the Fabrication Lab. (quality and precision of each part will ensure a smooth and functional assembly process)
7. Determine where components will be placed and use appropriate methods to attach using fasteners or gluing.
8. Verify final assembly for quality, completeness and basic function.
9. Test your vehicle periodically and make adjustments as needed. Modify if necessary and retest. Any flaws in your design and fabrication should be corrected to achieve maximum results and best scores.

Helpful Hints

- Research, Analysis and Discover
- Keep in mind that **precision** fabrication will result in better performance during vehicle testing.
- Students should keep in mind the size and weight of their PPV. Most of the time longer is better. Shorter vehicles tend to veer or spin out easily.
- Propellers need airflow and that some propellers are “Pushers” and some are “Pullers”.
- Make one axle adjustable for steering purposes. – “Highly Recommended”
- Identify each of the material components provided and possible purposes they will serve.
- Pre-test vehicle and make needed adjustments to the wheel alignment.
- Design and fabricate for functionality. Is my vehicle built for speed or torque?
- Design and fabricate for durability. Accidents can damage a fragile design.
- Design and fabricate for easy repair. Keep it simple. Complex designs are more prone to breakdowns and are difficult to repair.
- Design and fabricate to race down a long hallway track. Low ground propeller clearance may hinder the vehicle performance.
- Choose a vehicle that fits your personality and demonstrates your creativity.
- The most successful vehicles are usually those that are built with precision.
- Remember to have fun and to not over think it.

Official Testing / Grading:

Testing:

- The vehicle may be unofficially tested as much as needed without penalty.
 - Upon deadline, vehicle **MUST** be tested.
- Instructor will pre-determine the scope of each test.
- Student must state "**official run**" before a scored run. This must be witnessed by the instructor.
- Vehicle must complete the entire course for full points. The course may be tested on multiple surfaces thus the challenge will be variable and have a range of difficulty.

Distance:

- Students will test their PPV vehicle for maximum distance traveled. Farthest distance wins and all others will be graded on distance traveled relative to class leader.

Drag Race:

- Students will drag race for time and each other while using a common starting and ending point. Instructor will determine distance of race on testing day. Students with the fastest elapsed time or the most race wins will achieve the highest grade while all others will be graded based on finish time.

Open Testing

- Instructor will provide a testing scenario or gaming event depending on time left with project.
 - Testing may include: Bowling, Demolition Derby, Tug-O-War, etc.....

Grading:

- Points will be earned and calculated by using the entire sketching, Precision CAD Design, fabrication and testing process.
 - Students must attempt / complete (3) three official runs. An average of all three attempts will be used for grading. **50 points** maximum per event
 - The Precision CAD Drawings / Sketches: **50 points**
 - Vehicle Appearance: **50 points**
 - Build Quality / Craftsmanship: **100 points**
 - Participation: **75 points**
 - Extra Credit: up to **25 points** determined by the instructor

Time Line – (*may vary based on general school calendar and class pullouts etc..*)

Introduction / Research	Week 1
Sketches and CAD Drawing	Weeks 2 and 3
Vehicle Construction	Weeks 4 thru 6
Vehicle Preliminary Testing	Weeks 7
Official PPV Competition	Week 8
PPV Final Summary Report Due	Week 9 (underclassmen only)

Final Summary Report

- Students will develop a **Propeller Powered Vehicle** project summary and reflection paper.
 - Instructor will hand out requirements after the final testing has been completed.