



PLANETARY LANDING VEHICLE (PLV)

(Car Crash Design Project)

(Developed by B. Mayfield)

Purpose - Apply what you know about **Newton's Laws of Motion**, forces, motion, kinetic energy and vehicle safety to design a space vehicle that will protect its pilot (an egg) from a simulated, high-force landing on an exoplanet.

In this project, you will research, engineer, and build a landing vehicle that can withstand a rapid change in velocity (deceleration) while keeping the level of g-force (acceleration) experienced by the pilot to a minimum.

Your design should reflect how your understanding of the physics involved in car crashes was used to incorporate **force redirecting** and **absorbing** safety devices.

Background Information –

Start off this project by doing **research online** to help you design your vehicle and possible ways to *mitigate* (control and handle) the forces experienced by the pilot.

- **Newton's 1st Law:** *an object in motion will stay in motion until acted on by another force.*
- **Newton's 2nd Law:** *the more force that is applied to an object the greater the acceleration the object will experience ($F=MA$).*
- **Newton's 3rd Law:** *force every action there is an equal and opposite reaction.*
- **Kinetic Energy:** $= \frac{1}{2} mv^2$

Design Requirements (Size Limitations) -

Length: 10 cm (min.) and 16 cm (max)

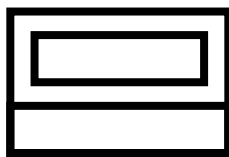
Width: 10 cm (min.) and 13 cm (max)

Height: 10 cm (min.) and 14 cm (max)

Front Window: 10 cm x 5 cm (min)

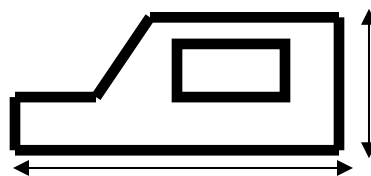
Basic Design

Front View



Width (13 cm max)

Side View



Length (16 cm max)

Height (14 cm max)

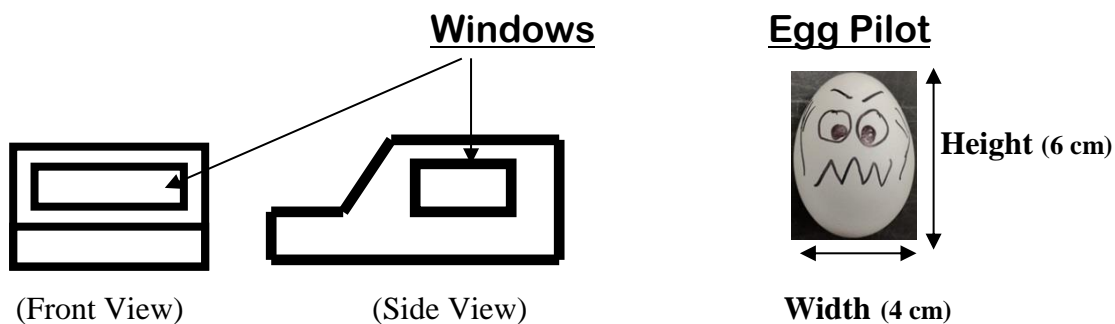
Note: The vehicle **must fit on the sled to be tested**. If your PLV is not within the correct size limitations (*see above*) it will result in a lower grade.

Body Material - You may use any material you like as long as it is not dangerous, it is allowed at school and will not shatter or cause people harm. You can use the following materials (ask if you are not sure):

- cardboard (tissue boxes, cereal boxes, food containers, “thin” cardboard (not double walled), foam, balsa wood, plastic, sponges, cotton, bubble wrap, tape or any other material that “gives”, crumples or absorbs energy.
- “Amazon” or other double wall cardboard is not allowed.
- You cannot use your shoe as your PLV nor can you use food.

Doors or Loading Hatch - You need to either have a **top hatch** or **one side door** in which to load the **egg pilot** easily, quickly, and safely.

Windows - Your vehicle must have a **front** windshield at least **10 cm x 5 cm** big. The **side** windows are optional. **Nothing** may obscure the eyes and face on the egg pilot (no tissue paper, cotton, padding, packaging, etc.).



Vehicle Pilot – The **egg** will serve as your **pilot**. It must be positioned vertically with the face, facing forward.

Seat Belts & Restraints - You may **not** “pack” the pilot, but should restrain it somehow (rubber bands, seatbelt, elastic band, etc.) At least **1/2 of the egg pilot** must be visible while it sits in the seat. Remember, a pilot must **see** to fly.

Group Size - You can have a group of up to 3 ,or you can work alone.

Due Date – The due date for your vehicle is **written on BOK**.

Testing Day -There will be **1** simulated high-speed landing on your exoplanet.

Assessing PLV Design: (1000 pts) - You will receive a base score of **700 pts** if your PLV meets all the design and size requirements, but exceeds the g-force amount for a safe landing. See the board for point awarded criteria.

-100 pts for each design violating: height, width, length, window size, doors, visibility of pilot, materials, or packing of the pilot).