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 (Pocket Lab sensor) 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.
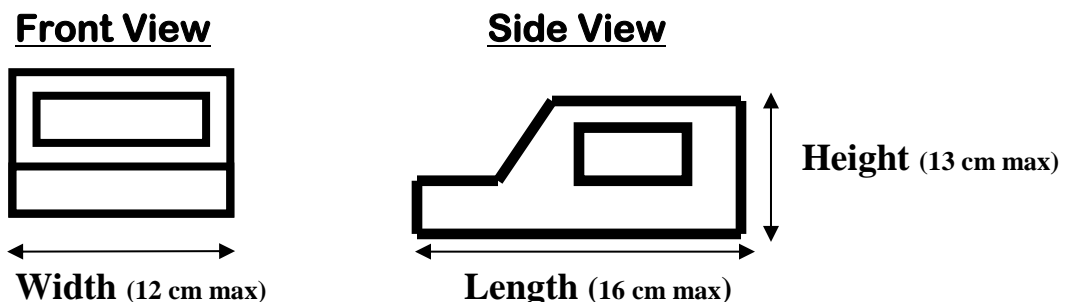- **Kinetic Energy:** $= \frac{1}{2} mv^2$

Design Requirements (Size Limitations) -

Length:	8 cm (minimum)	and	16 cm (max)	
Width:	8 cm (minimum)	and	12 cm (max)	
Height:	8 cm (minimum)	and	13 cm (max)	

Basic Design

Front View

Width (12 cm max)

Side View

Height (13 cm max)

Length (16 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 <u>not dangerous</u>, it is <u>allowed</u> at school and <u>will not shatter</u> or <u>cause people harm</u>. You can use the following materials (ask if you are not sure):

- cardboard (tissue boxes, cereal boxes, food containers, cardboard from boxes (ex: Amazon), foam, balsa wood, plastic, sponges, cotton, bubble wrap, tape or any other material that "gives", crumples or absorbs energy.
- **You cannot use your <u>shoe</u> as your PLV nor can you use <u>food</u>.**

Doors _or_ Loading Hatch - You need to either have a **top hatch** or **one side door** in which to load the <u>Pocket Lab sensor</u> easily, quickly, and safely.

Windows - Your vehicle must have a **<u>front</u>** windshield at least **8 cm x 5 cm** big. The **<u>side</u>** windows are optional. **<u>Nothing</u>** may obscure the eyes and face on the Packet Lab sensor (no tissue paper, cotton, padding, packaging, etc.).

Windows		**Pilot**
(Front View)	(Side View)	**Width** (3 cm)

Height (6.8 cm)
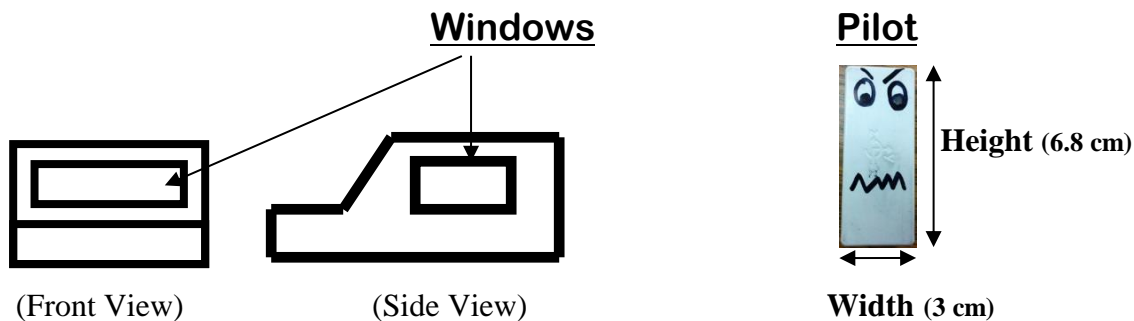
Vehicle Pilot – The <u>Pocket Lab sensor</u> will serve as your **pilot**. It must be positioned vertically with the face, facing forward (**depth is 1.6 cm**).

Seat Belts & Restraints - You may **not "pack" the pilot,** but should restrain it somehow (rubber bands, seatbelt, elastic band, etc.) At least **½ of the Pocket Lab sensor** must be visual while it sits in the seat. Remember, a pilot must see to fly.

Group Size - You can have a group of 3 (same period) 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 <u>each</u> design violating: height, width, length, window size, doors, visibility of pilot, materials, or packing of the pilot).