EnVision LABS
1550 FINNTOWN ROAD - WALDOBORO - ME 04572
WWW.ENVISIONLABS.COM

Launch Pro ™ Single Stage Starter Kit #20100

Description:

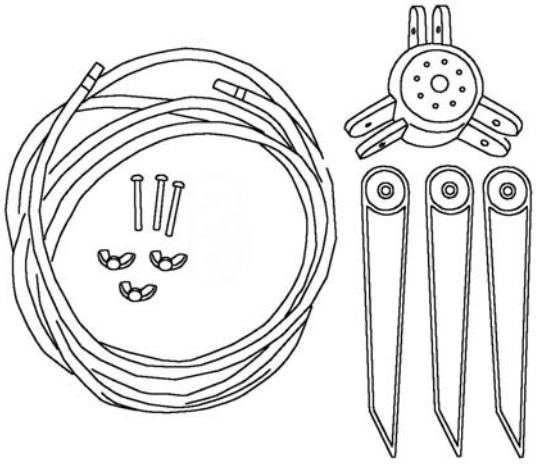

Figure 1
The Launch Pro™ Single Single Stage Starter Kit Base components

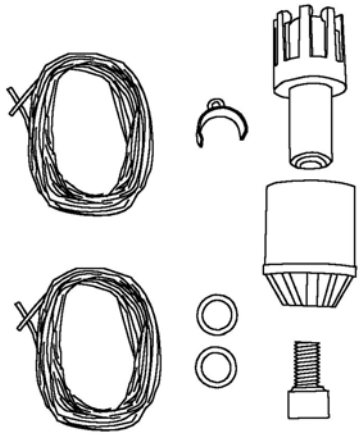

Figure 2
The Launch Pro™ Single Single Stage Starter Kit Launcher components.

This kit includes:
1 Hardware kit containing the Base Assembly including:
- 1 Hub
- 3 Legs
- 1 Fueling and Pressurizing Hose
- 3 screws
- 3 washers
- 3 wingnuts

1 Hardware kit containing Launcher Components including:
- 1 Launch Pro™ Launcher Core assembly
- 1 Launch Pro™ Release Cup
- 1 Launch Pro™ Bolt
- 1 Safety Clip
- 2 'O' Rings
- 2 Tethers

You will need:
Access to tap water
Plastic Soda Bottles (various sizes)
Source of Compressed air (bicycle pump, or small battery operated air compressor)
Pressure gage (if not already on the pump or compressor)
Various soft, light, materials for constructing fins and rocket bodies such as foam insulation
Tape - we recommend 2 inch wide packing tape.

Precautions:

- **Safety is a state of mind, not just a set of rules**.
- Always THINK before you act. Don't get caught up in the excitement. Keep yourself and everyone around you SAFE. NO ONE wants to get hurt. This is always rule number one in anything that you do, be it a science experiment, or an activity at home.
- Be aware of your surroundings whenever you engage in any activity.
- Stop and think of the possible consequences of what you

are doing.

- Remind others around you of any unsafe activity.

The following is a set of guidelines to assure safe operation of the Launch Pro™ system.

- ***DO*** Completely read and understand the operating instructions and safety guidelines before using the Launch Pro™ system.
- ***DO*** be sure the rocket is stable on the launch base before charging with compressed air. Wait 60 seconds to be sure the rocket remains upright. This is very important in windy conditions. If you are not sure, do not pressurize the rocket.
- ***DO*** wear safety glasses when at the launch site.
- ***DO*** find a large open area for the launch site that is clear of obstructions and obstacles such as buildings, parked cars, people, and roadways. A 300 foot minimum radius from the launcher is recommended. Don't forget, what goes up must come down, and you don't want your returning rocket to hit anyone or anything.
- ***DO*** use soft, light materials such as foam insulation, and tape for constructing your rocket.
- ***ALWAYS,*** when trying out a rocket for the first time, start with low air pressures first! You can always increase pressures later when you've gained confidence in the rocket's performance.
- ***DO NOT*** exceed 60 PSI(Pounds per Square Inch) when pressurizing the bottles.
- ***DO NOT*** launch in crowded area.
- ***DO NOT*** leave the rocket unattended while it is pressurized.
- ***DO NOT*** use any fluid other than ***water only*** as the fuel for the rocket
- ***NEVER*** use heavy or rigid materials in the construction of your rockets - ***never use*** metal, wood, or thick plastic.
- ***NEVER*** launch a rocket at an individual or object. Rockets in motion can have enough energy to do bodily harm or property damage.
- ***NEVER*** approach a charged rocket system. In the case of an aborted launch, after charging, bleed the pressure off through the charging line. This may take a few minutes. The best way to avoid this situation is to never charge the system until you are certain a launch is safely possible.
- If you decide to use an air compressor, use only a battery operated compressor or one that can be operated from a 12VDC outlet.

Following these simple guidelines will ensure safe launches and hours of fun. So don't forget rule one, nobody hurt, have fun.

Assembly:

To assemble the tripod base, select the tripod hub and one of the three legs. Insert the round end of the leg between the two sides of one of the mounting brackets on the hub. Notice that

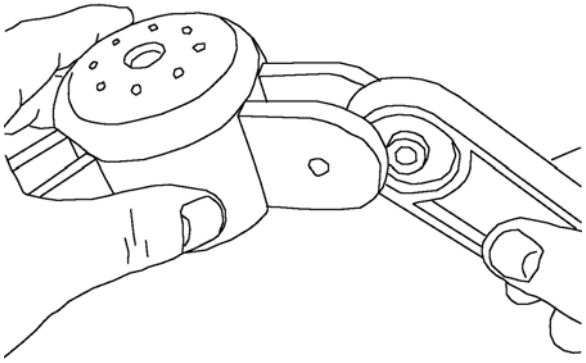

Figure 3
Mounting the legs to the tripod hub.

one side of the bracket has an hexagonal indentation, this is the side through which you will insert the screw. When the hole in the bracket lines up with the hole in the leg, push the

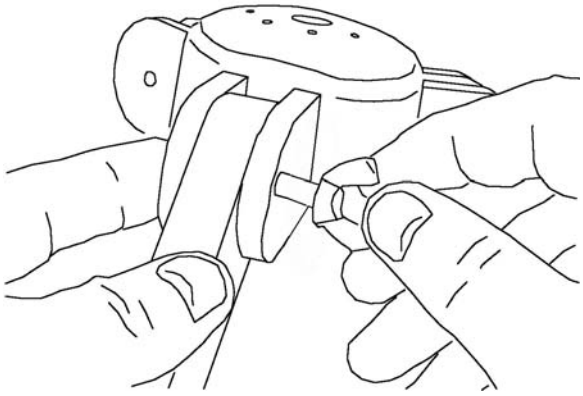

Figure 4
Fastening the leg with the washer and wingnut..

screw through the bracket pinning the leg in place. Put the washer over the screw and then fasten it in place with a wingnut. Repeat this procedure for the remaining legs.

Before you begin assembling the launching mechanims, select one of the tethers (10 foot length of cord) and insert a free end through one of the smaller holes in the hub. Continue threading this end of the tether through one of the

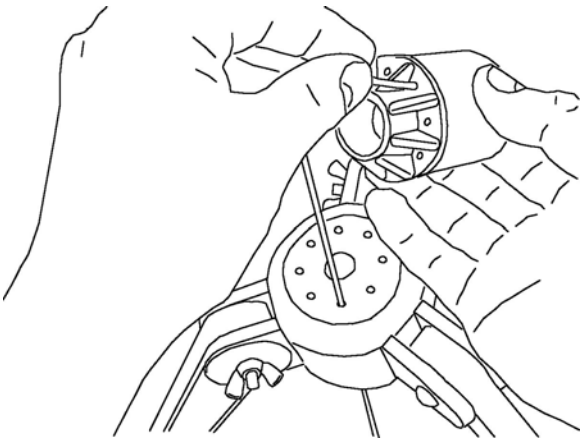

Figure 5
Fastening the launching tether to the release cup

smaller holes in the release cup of the launcher. After the tether is passed through the release cup, bend the free end of the tether over and pass it back down through one of the neighboring holes in the release cup. Tie a knot in the end of the tether to prevent it from passing back through the hole in the release cup.

Slide the release cup onto the core so that the locking fingers are completely covered by the release cup.

Select the bolt, and place an 'O' ring over the threaded end of the bolt and then insert the threaded end of the bolt into the larger central hole in the hub from the bottom side of the hub. Once the bolt pokes through the top of the hub, place the second 'O' ring over the bolt.

Fasten the core to the tripod base by screwing it onto the plastic bolt. As you're tightening the bolt, be sure the 'O' rings are centered and even and not being pinched by either the bolt on the underside of the base or the core on the top side of the base. If they are pinched, loosen the bolt a little bit and push the 'O' rings around as necessary until they lie flat against the surface of the hub. Tighten the bolt by hand so that it is snug and the core is firmly attached to the tripod hub. Do not over tighten the bolt.

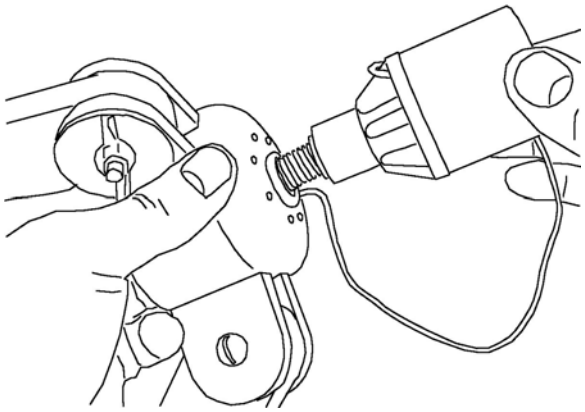

Figure 6
Assembling the launcher on the tripod base.

The legs can now be repositioned by loosening the wingnuts slightly, moving the leg to the desired position , and firmly tightening the wingnuts again.

Assemble the safety clip by selecting the second tether and passing a free end through the hole in the tab of the safety clip. Tie an overhand knot to secure the tether to the safety clip.

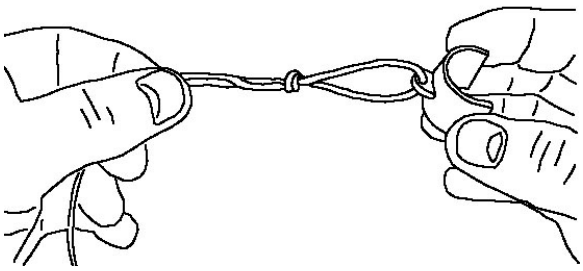

Figure 7
Attaching the tether to the safety clip.

Finally, attach the pressurization hose to the launcher. Select the plastic hose with the metal adaptors at each end. Notice that one metal adaptor has a valve in it's core and the other has a clear opening. Screw the adaptor that has the clear opening into the head of the bolt that holds the launcher onto the tripod base. Tighten this by hand only. Overtightening, may damage the threads in the head of the bolt. Never use force. This adaptor should screw on with minimal resistance.

Operation:

Building a Safe Rocket:
Use only light weight, soft materials when building your rockets. A good rocket body and fins can be made using foam insulation and ordinary packing tape. The foam insulation can be carved to any desired shape before taping it to the bottle. ***NEVER*** under any circumstances use heavy or stiff materials such as metal, wood, or thick plastic when constructing your rocket. These materials can be very dangerous if the rocket accidentally strikes someone or something.

Finding a Suitable Site:
Water rockets are capable of traveling great distances. When first launched, the rocket is under power for the first 20 to 30 feet of it's travel and during that time is capable of doing the most harm if it comes in contact with another object or person. Therefore it is critical that you have a clear area ***at least*** 100 feet in all directions from the launch pad. The middle of an athletic field is a good choice for a launch site. Wind can also push the rocket off course and this should also be considered when choosing a site. Stay away from buildings, parked cars, roadways, or anyplace where pedestrian traffic is likely to be.

Setting up the Equipment:
Place the launcher base on a flat area of turf and angle the legs of the tripod so that it provides a wide stable base for your rockets. It may be helpful to anchor the legs into the ground by pushing a tent stake or similar anchor into the ground and fastening the tip of the leg that.

Fueling the Rocket:
Tip the neck of the bottle in the rocket upward to fill the bottle about half full with water. After filling with water, bring the bottle to the launch pad, and quickly, but carefully, tip the neck of the bottle onto the core of the launcher. Press it all the way onto the core so that the gripping fingers clip over the top of the bottle's neck ring. When the bottle is in place, lift the release cup up so that it completely covers the gripping fingers and then clip the safety clip around the core just below the release cup. This will prevent the cup from sliding down again into the release position.

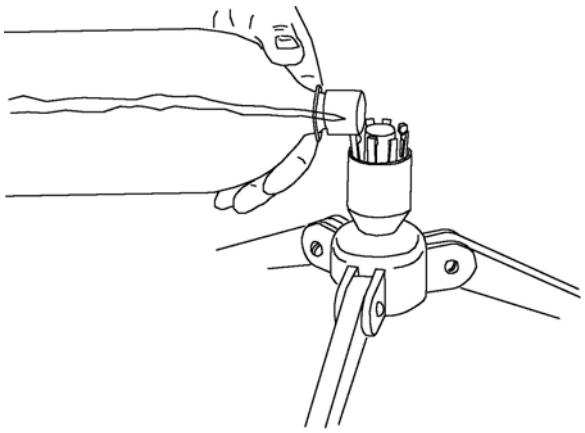

Figure 8
Placing the bottle on the launch pad.

The Pre-Launch Checklist:
Before each launch read through a checklist making sure everything is in order:

- Rocket is in good order, no loose fins, or broken parts
- Launch pad is in good working order, no broken parts
- Tripod legs are secure
- Fuel the rocket with water
- Place rocket on launcher
- Release cup is in locked position
- Safety clip is in place
- All tethers are secure (no loose knots)
- Wind check (allow wind to die down)
- Clear the launch area and alert spectators
- Safety glasses ON
- Pressurize the rocket
- Countdown to launch
- Pull safety clip tether on the count of 3
- Pull launch tether on the count of 0

Pressurizing the Rocket:
When the launch area is clear of obstructions, the wind is calm, the prelaunch checklist has been completed, and everyone is alerted that the launch is ready to proceed. Only then are you ready to pressurize the rocket.

Connect the pressure source to the pressurizing hose and begin pressurizing the rocket. Check the pressure frequently and do not exceed 60psi. Small leaks around the bottle and connectors are not unusual and will not affect the performance of the rocket. If you detect a large leak, stop pressurizing the rocket and release the pressure from the bottle rocket before fixing the leak.

Launching the Rocket:
Always be cautious and assume the rocket may launch when the safety clip is removed. After pulling on the safety tether to remove the safety clip. Give a count down warning to everyone on the launch site. When the count down reaches zero, give a short quick tug on the trigger tether, this will pull the release cup downward and allow the rocket to escape from the launch pad.

Maintenance:

- To keep your Launch Pro™ Bottle Rocked Launcher in the best possible operating condition always rinse the launcher with clean water after use.
- To clean, wipe with a clean damp cloth if necessary. ***Do not use solvents of any kind.***
- Avoid using abrasive cleansers that may scratch the plastic finish.
- Lubricate the 'O' rings that form a seal between the bottle and the core before each session or as necessary, with petroleum jelly, or silicone grease to insure smooth, trouble free launches.
- Inspect the pressurization hose valves periodically for grit or dirt and rinse clean with water if necessary.

Water Rockets: How they Work

A water rocket is powered by water and compressed air. The water provides the mass which is expelled from the rocket at high speed by the compressed air within the bottle which acts like a spring to store energy until it is released. The higher the pressure, the tighter the "spring" is compressed and the more energy is stored. As more energy is stored, the rocket's potential to travel further is increased.

Rocket propulsion is based upon the principle of ***Conservation of Momentum***. Momentum is the product of an object's mass and it's velocity, and can be written mathematically as:

$$p=mv$$

where:

p is the momentum of an object
m is the mass of the object and
v is the objects velocity

As water is expelled from the rocket, it's mass is forced outward with a velocity determined by the amount of pressure within the bottle. This mass times it's velocity is the momentum of the water leaving the rocket. To conserve momentum, the rocket must move in the opposite direction from the water being expelled and the change in momentum of the rocket must equal the change in the momentum of the escaping water. This can be written mathematically as:

$$\Delta p_{fuel} = \Delta p_{rocket}$$

where the Δ symbol means "change". If we substitute mv for the momentum, p in the above equation, we have:

$$m_{fuel}\,\Delta v_{fuel} = m_{rocket}\,\Delta v_{rocket}$$

For example, if 10 grams of water were expelled from the rocket, at 50 meters/ second, and the rocket with the water it carried had a mass of 2 kilograms, then the change in speed that the rocket would experience can be found by:

$$\Delta v_{rocket} = m_{expelled\ fuel}\,\Delta v_{expelled\ fuel} / m_{rocket}$$

If we substitute the numbers from the example into this equation, we have:

$$\Delta v_{rocket} = 0.01\text{kg} \cdot 50\text{m/sec} / 2\text{kg}$$

Doing the math gives us:

$$\Delta v_{rocket} = 0.25\ \text{m/sec change in velocity}$$

Estimating Altitude:

The height of any object (including rockets!)can be estimated by knowing your horizontal distance from the object and then measuring the angle above the horizontal to the top of the object. The height can then be calculated by:

$$H = D \cdot \text{Tan}(\theta)$$

where:

H is the height of the object or rocket
D is the horizontal distance to the object and
θ is the angle above the horizontal to the highest point of the object.

The most accurate measurements will be made when you are standing approximately as far away from the object as the object is tall (this will be an angle of 45 degrees). When measuring the altitude of a rocket, this is sometimes tricky because the wind or the rockets trajectory will place it's highest point of travel somewhere other than directly over the launching site. In this case, you may need to estimate where the highest point of it's travel is over the ground and then measure your horizontal distance to *that* point instead.

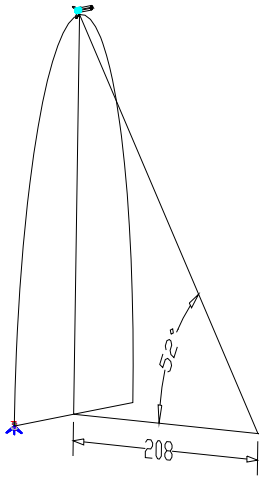

Figure 9
Measuring a rocket's altitude.

In this example, the horizontal distance is 208 feet and the angle is 52 degrees. Using the above equation, the rocket's altitude is:

$$H = 208 \text{ feet} \cdot \text{Tan}(52)$$
$$H = 266 \text{ feet}$$

Troubleshooting Notes:

Occasionally, you may notice leaks around the location where the bolt and core screw together. With higher pressures, the O-ring between these parts may get pushed out, resulting in a leak. To prevent this, simply apply a heavy coating of silicone tub and tile sealer to the bolt just prior to assembling. If your launcher has already been used and you've discovered a leak, unscrew the bolt from the core and if the parts are wet, allow them to dry throughly. Coat the threads of the bolt with tub and tile sealer and then reassemble the components. Allow the assembly to dry throughly for at least 48 hours before pressurizing.

An alternative method is to wrap the threads of the bolt with multiple layers of teflon tape (found in the plumbing section of any hardware store). This solution has the advantage of not requiring any drying time and can be used to repair a leak while in the field.