**Payload Material Checklist:**

*Tweezer*

*RNAlater*

*Centrifuge Tubes (15x)*

*Knife*

*Dry Ice Container*

*Flashlapse units (10+)*

*Computer*

*Plants*

*Scissors*

*Electrical Tape*

*Tube Racks*

*“This Side Up” stickers*

*Gloves*

*Payload units*

*Charging cord for FlashLapse units*

*USB adapter*

*Goggles*

*Rubbing Alcohol*

*Permanent markers*

*Power strips*

*Router*

*Soldering Iron*

*Medical micropore tape*

*Printer Cables*

*Plant lights*

*Timer*

*Caliper*

**Vehicle Material Checklist**

*Screwdrivers*

*Wire strippers and cutters*

*Very small flathead screwdriver*

*Small Philips Head*

*Pliers*

*Superglue*

*Wood glue*

*Epoxy*

*Sandpaper*

*Masking tape*

*Electrical tape*

*Duct seal*

*Sharpies*

*Needlenose Pliers*

*Scissors*

*Wire*

*Spare 9 Volts*

*Spare ejection charge capsules*

*Portable drill and drill bits*

*Paper towels*

*Black powder*

*Hot glue*

*X-acto knives*

*Box cutters*

*Small flatheads*

*Big flatheads*

*Big Philips heads*

*Extra shock cord*

*Alcohol/Clorox wipes*

*Pad of Paper*

*Vaseline*

*Altimeter keys*

*Zip ties*

*Screws*

*Vinyl screws*

*Shear pins*

*Scale*

*Flashlight*

*Tape measure*

*Baby powder*

*Level*

*C-clamps*

*Extra nuts + T-nuts*

*Extra rail buttons*

*Multi-meter*

*Washers*

*Gloves*

*Garbage bags*

*Extra (good) parachute*

*Quicklinks*

*Trackimo*

*Soldering iron*

*Solder*

*Blue cord*

*DP420 + epoxy gun*

*Ruler*

*Teflon tape*

*Canton Tape*

*Vacuum pump*

*Hand pump*

*File*

*Wrenches*

**PRE-LAUNCH SITE**

* Drive to launch site
* Bring all experimental plant groups (except Z group)
* Bring dry ice and other materials from payload materials checklist
* Unload rocket from Ground Support Vehicle
* Check all rocket components for damage
* Record total accurate weight
* Comply with procedures of organization running the launch

**PAYLOAD**

* Insert fresh batteries into payload
* Verify the health of the flight group of *Arabidopsis thaliana*
  + If flight group is damaged or not able to fly, fly backup group instead
* Assemble payload and insert tie rods
* Turn on payload, verify power buzzer and LED functionality
  + If they do not function properly, insert new batteries and retest
* Insert payload into designated rocket section and secure payload; attach nylon ropes for payload removal
* Attach payload section to the rest of the rocket

**VEHICLE**

**Ejection Charges: This checklist will be executed by our Level 2 Mentor**

* Test altimeters for functionality
  + If any altimeter fails to report any required data prior to flight
    - Remove and disarm rocket
    - Turn off and turn back on altimeters
    - If altimeters still do not function
      * Open e-bay
      * Check that altimeters are receiving battery power
        + If necessary, replace batteries
      * Check that all altimeter wiring is intact
      * Reassemble e-bay and re-test altimeter function
* Check that altimeters beep out correct altitude for deployment
* Test ejection ports for conductivity
  + Drogue ports will beep once, main ports will beep twice
* Prep drogue ejection charges
  + Measure out black powder and pour into bottom of ejection charge capsule
  + Pack capsule with paper towel to ensure powder remains in contact with e-match
  + Cap the capsule
  + Strip ends of e-match wires and twist into proper shape
  + Insert e-match wires into corresponding terminal ports
* Prep main ejection charges
  + Measure out black powder and pour into bottom of ejection charge capsule
  + Pack capsule with paper towel to ensure powder remains in contact with e-match
  + Cap the capsule
  + Strip ends of e-match wires and twist into proper shape
  + Insert e-match wires into corresponding terminal ports
* Insert charges to corresponding compartments prior to inserting parachutes

**Parachutes: Executed by students**

* Ensure tracker is powered on and transmitting accurate location
  + If the tracker fails to accurately record location
    - Remove tracker from rocket
    - Check that tracker has battery power and is properly activated
    - If tracker still fails to work, switch to radio-transmitting based tracker
* Check full length of recovery harness for damage and brittleness
* Check both parachutes for tearing
* Ensure shroud lines are untangled
* Fold both chutes
* Coil shroud lines on top of chute
* Wrap chutes and shroud lines in Nomex
* Coil recovery harnesses and insert into compartment
* Insert parachutes on top of recovery harnesses
* Reassemble rocket with parachutes in place
* Insert any necessary shear pins

**Motor preparation: Executed by L2 mentor**

* Our motor will be prepared and inserted into the rocket by our level 2 mentor

**Setup on Launcher: Executed by students and L2 Mentor**

* Weigh assembled rocket and complete flight sheet
* Carry assembled rocket to pad
* Carefully slide rocket onto rail
  + Support full weight of rocket until both rail buttons are on rail
    - If rail buttons break, carefully slide rocket off the rail and reattach the rail buttons before attempting to slide it back on the rail.
  + Carefully erect launch rail, guiding rocket down to blast plate
* Power on first altimeter
  + Wait until beep sequence finishes and “ready” beeps begin
  + Beep sequence: 3 beeps (altimeter preset), 2 second pause, beeps corresponding to deployment height (700ft), beeps corresponding to last recorded altitude, beeps corresponding to number of volts supplied to the altimeter in tenths of a volt (Roughly 90 for ours), then three beeps every .8 seconds reporting ejection charge continuity.
* Power off first altimeter
* Power on second altimeter
  + Wait until beep sequence finishes and “ready” beeps begin
* Power on first altimeter
  + Listen for both sets of “ready” beeps
* If any altimeter fails to report any required data prior to flight
  + Remove and disarm rocket
  + Turn off and turn back on altimeters
  + If altimeters continue to not function
    - Open e-bay
    - Check that altimeters are receiving battery power
      * If necessary, replace batteries
    - Check that all altimeter wiring is intact
    - Reassemble e-bay and re-test altimeter function
* Insert igniter into rocket
* Attach igniter wires to alligator clips
* Ensure the clips will not touch and no short will occur
* Test igniter continuity if method is provided
* Retreat to safe distance and wait for launch

**Igniter installation: Executed by L2 Mentor**

* Our L2 Mentor will prepare and install igniter

**RIGHT BEFORE LAUNCH**

* Ensure range and sky are both clear
* Ignite motor
  + If motor fails to ignite, do not approach vehicle until indicated by launch directors
    - Attempt to launch a second time (re-flip switches)
    - If rocket still fails to launch, wait one full minute before approaching
    - L2 mentor will approach rocket
      * Check continuity
      * Replace igniter
  + Attempt to re-launch

**DURING LAUNCH**

* Maintain as many visuals on rocket as possible for as long as possible during flight
* Listen carefully for rocket events

**POST LAUNCH**

* Prepare for fixation at landing site
* Listen to altimeter and record altitude data
* Ensure all ejection charges have been discharged
  + If any ejection charges are not discharged, evacuate immediate area and have L2 mentor deactivate charges
* Check all components for damage
* Remove payload and deliver to payload team for analysis
  + Remove payload from rocket
  + Turn off payload
  + Remove *Arabidopsis* from payload section of rocket
  + Remove plants of subgroup F1 (5 dishes) from petri dish with tweezers and place plants in sterile centrifuge tubes, fixate subgroup F1 of *Arabidopsis* with RNA*later™* (20mL) immediately after removal from payload
  + Place fixated subgroup F1 of *Arabidopsis* in dry ice
  + Fixate subgroups T1 and place in dry ice
    - Contact representative in Madison to fixate Z1
  + Subgroups F2, F3, and F4 will stay in payload units
* Reassemble rocket and leave launch site OR
* Return to preparation area and prepare for re-flight if required
* Perform gravitropic assay
  + Return to Embassy Suites to set up FlashLapse systems for subgroups F4 and T4
  + Contact representative in Madison, assay will be simultaneously set up for subgroup Z4
  + All assays will be started simultaneously
  + Return subgroups F4 and T4 to controlled units after assay is complete
* Return to lab in Madison
* Perform RNA extraction and genetic analysis on all subgroups 1 (except backup group) of *Arabidopsis*
* Move all subgroup 3 and 4 (except backup group) plants to soil
* Perform microscopy on all subgroups 2 (except backup group) plants
* Continue to observe the growth and yield of *Arabidopsis* all subgroups 4 (except backup group) over the next few weeks with time lapse imaging
* Harvest seeds of all subgroup 4 (except backup group) plants