



KRUEGER MIDDLE SCHOOL

Fighting Falcons

438 Lanark Drive San Antonio, TX 78218 Telephone: 650-1350 Fax: 650-1374



Preliminary Design Review

Vehicle and Payload Experiment Criteria

1) Summary of PDR

Team Summary

Krueger School of Applied Technologies—Krueger Middle School

438 Lanark Drive

San Antonio, TX 78218

Lead Teachers:

Russell Claughton, Tracy Thomas

Mentors:

Payload—Kevin Marafioto

Rocket— Bill Wagner

Safety—William Casteel

Website— Josh Beck

Launch Vehicle Summary

We will be using a dual deployment recovery system on our rocket to minimize mistakes and to make sure that our rocket is fully recovered. Our rocket will be launching to reach the optimum altitude at 5280 feet.

Size: 83" Length x 4" Diameter

Motor Choice: J415

Recovery System: Dual Deployment

Payload Summary

Our scientific experiment is to sample the concentration of ozone levels comparing ground ozone level to that of the ozone level one mile up in the air.

II) Changes made since Proposal

Highlight all changes made since the proposal and the reason for those changes.

➤ Changes made to Vehicle Criteria

We are now using a J415 motor instead of the K550 motor listed in the proposal. This change was made to lower the altitude of the rocket; after running a RocSim analysis, the original motor caused the rocket to far exceed the desired altitude.

➤ Changes made to Payload Criteria

We will be buying a second ozone sensor that will be used to measure the ground level ozone concentration at ground level during the rocket launch. We will use this information as a control for the experiment.

➤ Changes made to Activity Plan

The activity plan has a few additions; John Blaha, a local astronaut, will be visiting our campus on March 14 to speak with all the students in the magnet program. We will also be using a new location for a December test launch in Hutto, TX. Meeks Ranch will not be available until March 2007. Local organizations have been contacted for support. In addition, parent sponsors have made donations.

III) Vehicle Criteria

Selection, Design, and Verification of Launch Vehicle

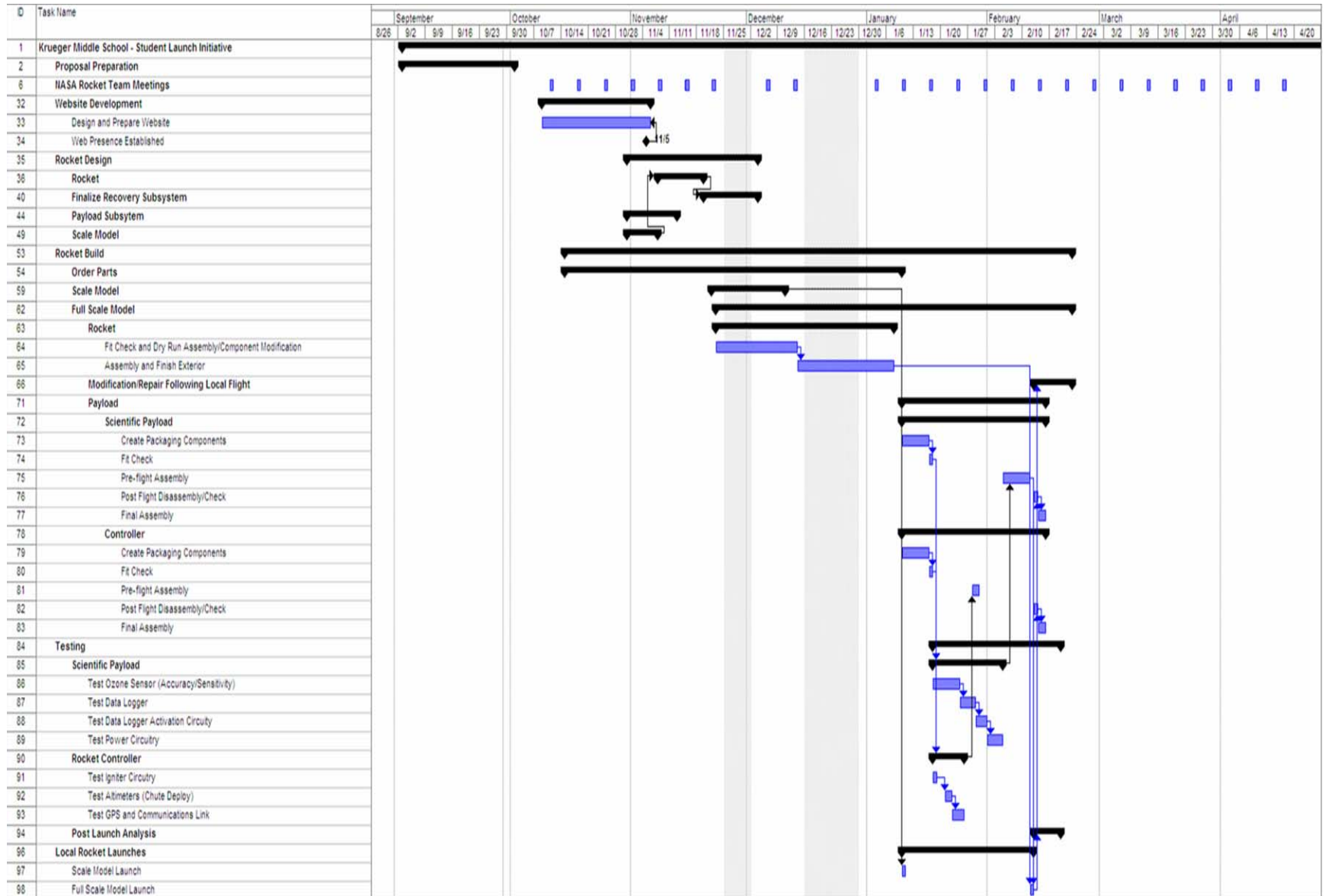
➤ **Mission Statement, Requirements, and Mission Success Criteria**

A. **Mission Statement:** The Krueger SLI team will launch a rocket a mile high and sample the ozone concentration at various altitudes during descent. Once the data is recovered it will be compared with ground level concentration.

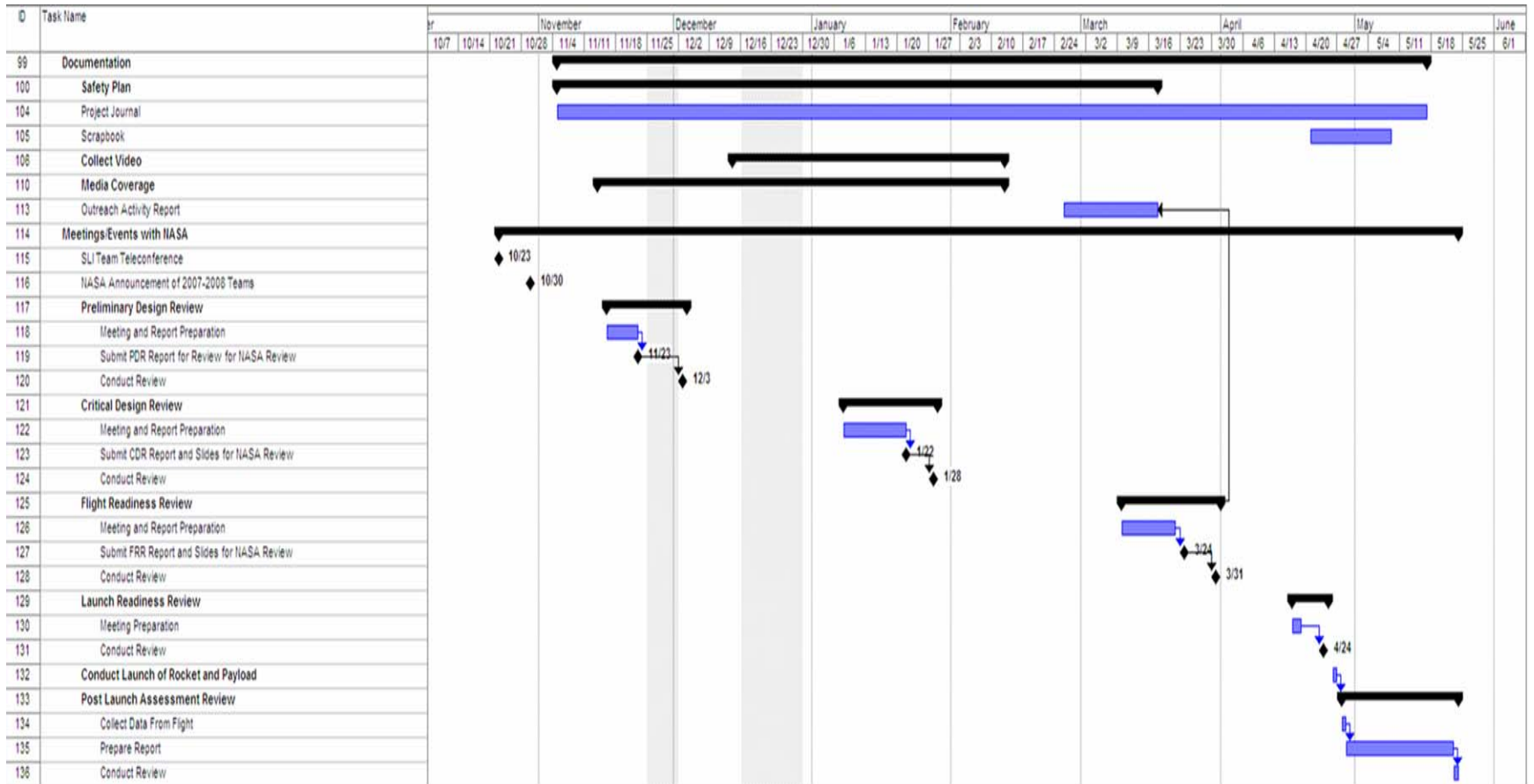
B. It requires an eight (8) month commitment to successfully design, construct, test, launch, and recover a reusable rocket and science payload. The initiative is more involved than designing and building a rocket from a commercial kit. It involves diverse aspects such as: scheduling, purchasing, performing calculations, financing the project, coordinating logistics, arranging press coverage, and documenting impact made on education through reports and design reviews. Teams are encouraged to involve a diverse group of departments such as mathematics, science, technology, English, journalism, and art.

C. **Success Criteria:** If the Krueger SLI rocket goes the required height (one mile), is recovered relatively undamaged, and if the team is able to retrieve readable data then, and only then, can the mission be declared a success.

➤ Major Milestone Schedule(Project Initiation, Design, Manufacturing, Verification, Operations, and Major Reviews)



Major Milestones Schedule cont.



- Review the design at a system level, going through each system's functional requirements (Includes sketches of options, selection rationale, selected concept and characteristics)

The performance targets for the reusable launch vehicle and payload are:

- The vehicle shall carry a science payload.
 - The vehicle shall be developed so that it delivers the science payload to a specific altitude of 5,280 feet above ground level (AGL).
 - The vehicle shall be designed to use a standard launch rail.
 - The launch vehicle and science payload shall be designed to be recoverable and reusable.
 - Preparation of the vehicle and payload on launch day shall not exceed 4 hours.
 - Data from the science payload shall be collected, analyzed, and reported by the team following the scientific method.
 - The vehicle shall use solid motor propulsion using commercially available ammonium perchlorate composite propellant (APCP) motors.
 - A tracking device shall be placed on the vehicle allowing the rocket and payload to be recovered after launch.
- Describe the subsystems that are required to accomplish the overall mission:
 - a. Main Airframe Subsystem
 - Rocket motor- J415
 - Fin Section- to hold the motor tube as well as the parachute, deployment charge, and the fins
 - Nosecone
 - b. Payload Subsystem
 - Altimeter- ALTS2- will sense altitude based on air pressure to set off the drogue chute
 - GPS- Part of Cansat package- will track rocket to help with recovery
 - Ozone Sensor System-will sample ozone levels from an altitude of one mile and below during descent and store the data for post-flight retrieval
 - Telemetry- Senses airspeed
 - c. Recovery Subsystem
 - Deployment charge- Deploys the drogue chute when the altimeter reads the correct altitude
 - Main parachute- Slows the rocket for a safe recovery and landing

- Describe the performance characteristics for the system and subsystems and determine the evaluation and verification metrics.

The Mark Twain rocket is designed to carry a scientific payload one mile high. Once the rocket achieves the desired altitude, the drogue chute will deploy and the Data logger attached to the Ozone Sensor will start to record Ozone levels as the rocket descends back to the ground. When the rocket is successfully retrieved, the information on the data logger will be downloaded onto a computer for analysis.

Evaluation and verification matrices:

- Motor:
Ignites / does not ignite
Appropriate burn rate / inappropriate burn rate
Rocket will achieve desired altitude / Rocket does not achieve desired altitude
- Payload:
Altimeter deploys chute / Altimeter Does not deploy chute
Ozone levels are recorded / Ozone levels are not recorded
GPS signal is transmitted / GPS signal is not transmitted
Telemetry is transmitted / Telemetry is not transmitted
- Recovery:
Ejection charge fires / ejection charge does not fire
Drogue chute is deployed / drogue chute is not deployed
Main chute is deployed / main chute does not deploy

- Describe the verification plan and its status.
The verification plan has been reviewed and will be constantly updated through out the development phase of the project.
- Define the risks and the plans for reducing the risks through analysis or testing for each system. A risk plot that clearly portrays the risk mitigation schedule is highly encouraged. Take all factors that might affect the project including risks associated with testing, delivery of parts, adequate personnel, school holidays, budget costs, etc. Demonstrate an understanding of all components needed to complete the project and how risks/delays impact the project

Risk Assessment

Table 1: Krueger SLI Risk Assessment

KSAT-Student Launch Initiative, Risk Assessment					Krueger Middle School
September 23, 2007					Prepared by: Kirsten Casteel
Project Phase	Potential Problem/Hazard	RAC	Risk Control Options Who-does what-by when?	Adjusted RAC	Comments-is the control effective?
Propulsion System testing	Engine explodes on launch pad; can injure any one within 400 feet of the rocket from debris or the overall explosion	EH	The launch station needs to be at least 400 feet away from the launch pad, spectators need to be at least 500 feet away from the launch pad	H	All of our motors are pre-tested so we will not be testing them
Propulsion System testing	Engine explodes in the air; can injure any one within 400 feet of the rocket from debris or the overall explosion	EH	The launch station needs to be at least 400 feet away from the launch pad, spectators need to be at least 500 feet away from the launch pad	H	All of our motors are pre-tested so we will not be testing them
Propulsion System testing	Recovery system does not deploy; can come down very fast, land on someone and cause major	EH	The launch station needs to be at least 400 feet away from the launch pad,	H	All of our motors are pre-tested so we will not be testing them

KSAT-Student Launch Initiative, Risk Assessment					Krueger Middle School
September 23, 2007					Prepared by: Kirsten Casteel
Project Phase	Potential Problem/Hazard	RAC	Risk Control Options Who-does what-by when?	Adjusted RAC	Comments-is the control effective?
	injuries		spectators need to be at least 500 feet away from the launch pad, keep your eyes on the rocket at all times while it is in the air		
Payload Test	The rocket we are testing our payload in can explode on the launch pad; can injure any one within 400 feet of the rocket from debris or the overall explosion	EH	The launch station needs to be at least 400 feet away from the launch pad, spectators need to be at least 500 feet away from the launch pad	H	We may not be testing our payload because they are also pre-tested
Payload Test	The rocket we are testing our payload in can explode in the air; can injure any one within 400 feet of the rocket from debris or the overall explosion	EH	The launch station needs to be at least 400 feet away from the launch pad, spectators need to be at least 500 feet away	H	We may not be testing our payload because they are also pre-tested

KSAT-Student Launch Initiative, Risk Assessment					Krueger Middle School
September 23, 2007					Prepared by: Kirsten Casteel
Project Phase	Potential Problem/Hazard	RAC	Risk Control Options Who-does what-by when?	Adjusted RAC	Comments-is the control effective?
			from the launch pad		
Payload Test	Recovery system on our rocket does not deploy ; can come down very fast, land on someone and cause major injuries	EH	The launch station needs to be at least 400 feet away from the launch pad, spectators need to be at least 500 feet away from the launch pad, keep your eyes on the rocket at all times while it is in the air	H	We may not be testing our payload because they are also pre-tested

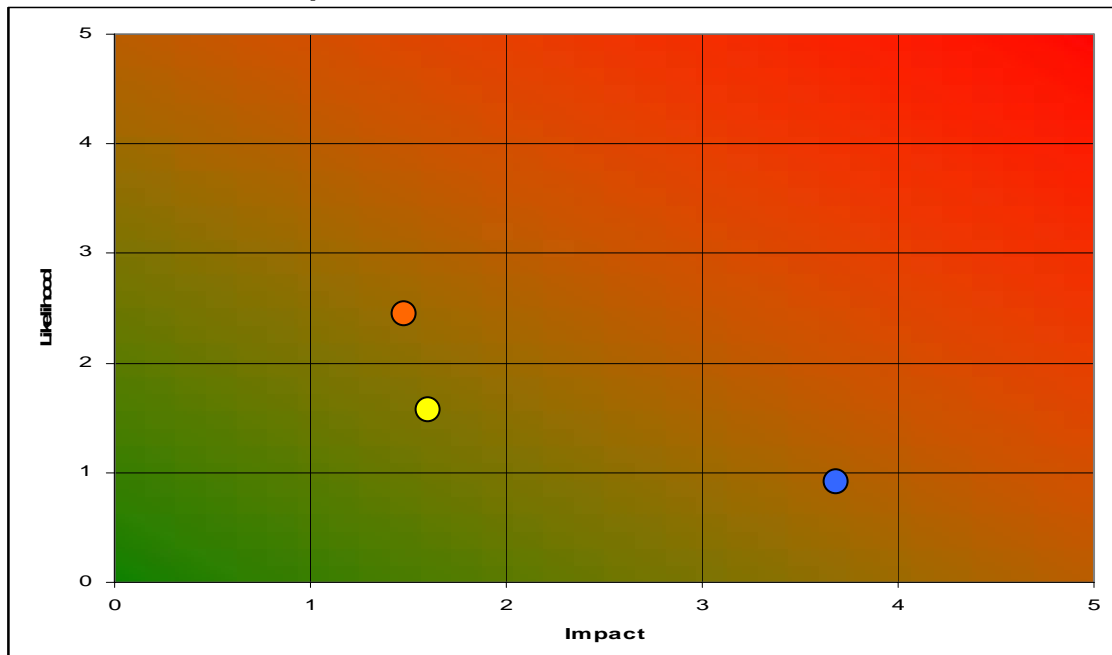
KSAT-Student Launch Initiative, Risk Assessment					Krueger Middle School
September 23, 2007					Prepared by: Kirsten Casteel
Project Phase	Potential Problem/Hazard	RAC	Risk Control Options Who-does what-by when?	Adjusted RAC	Comments-is the control effective?
General Launch procedures	The rocket can explode on the launch pad; can injure any one within 400 feet of the rocket from debris or the overall explosion	EH	The launch station needs to be at least 400 feet away from the launch pad, spectators need to be at least 500 feet away from the launch pad	H	
General Launch procedures	The rocket can explode in the air; can injure any one within 400 feet of the rocket from debris or the overall explosion	EH	The launch station needs to be at least 400 feet away from the launch pad, spectators need to be at least 500 feet away from the launch pad	H	
General Launch procedures	Recovery system on our rocket does not deploy; can come down very fast, land on someone and cause major injuries	EH	The launch station needs to be at least 400 feet away from the launch pad, spectators need to be at least 500	H	

KSAT-Student Launch Initiative, Risk Assessment					Krueger Middle School
September 23, 2007					Prepared by: Kirsten Casteel
Project Phase	Potential Problem/Hazard	RAC	Risk Control Options Who-does what-by when?	Adjusted RAC	Comments-is the control effective?
			feet away from the launch pad, keep your eyes on the rocket at all times while it is in the air		

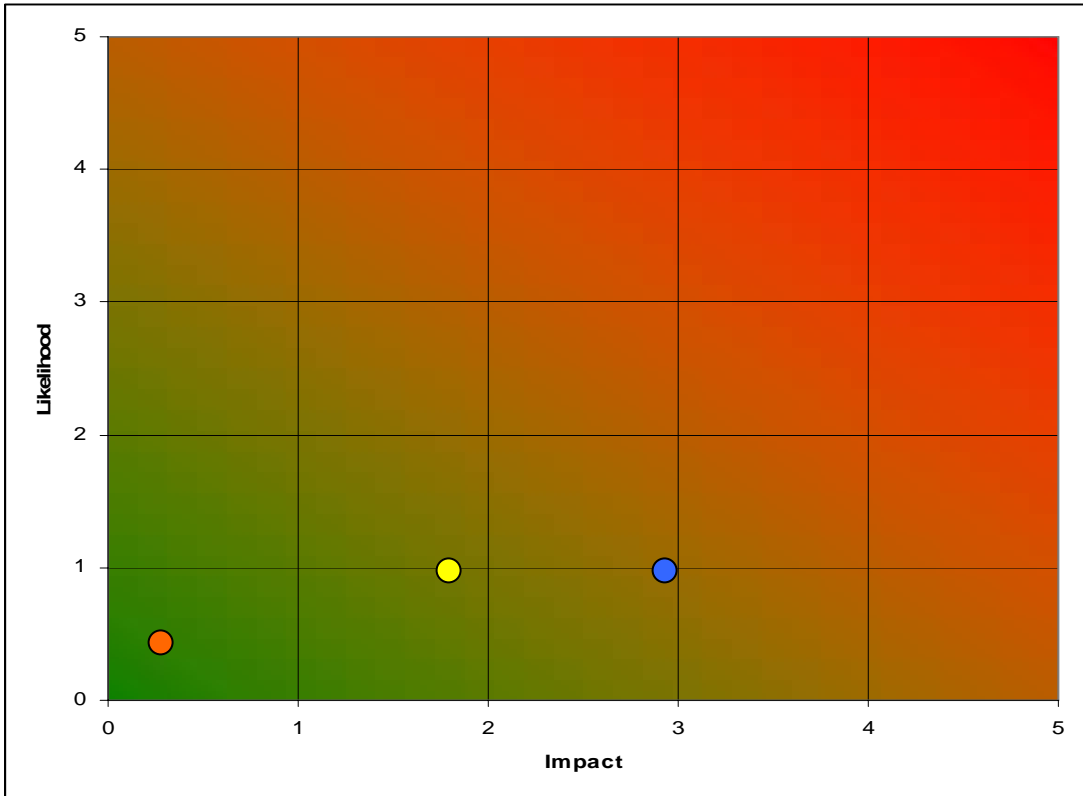
Vehicle Development and Testing Risk Plots

Color Code:
Red - Technical
Blue - Schedule
Yellow - Cost

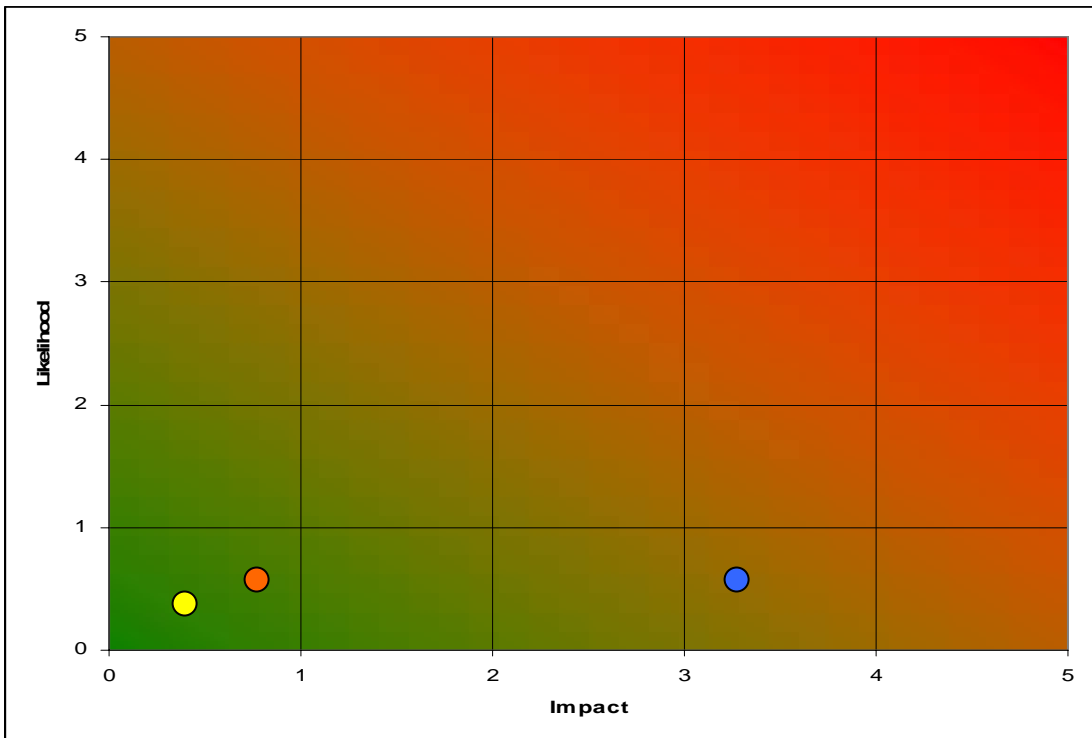
Impact-Likelihood for rocket test Failure



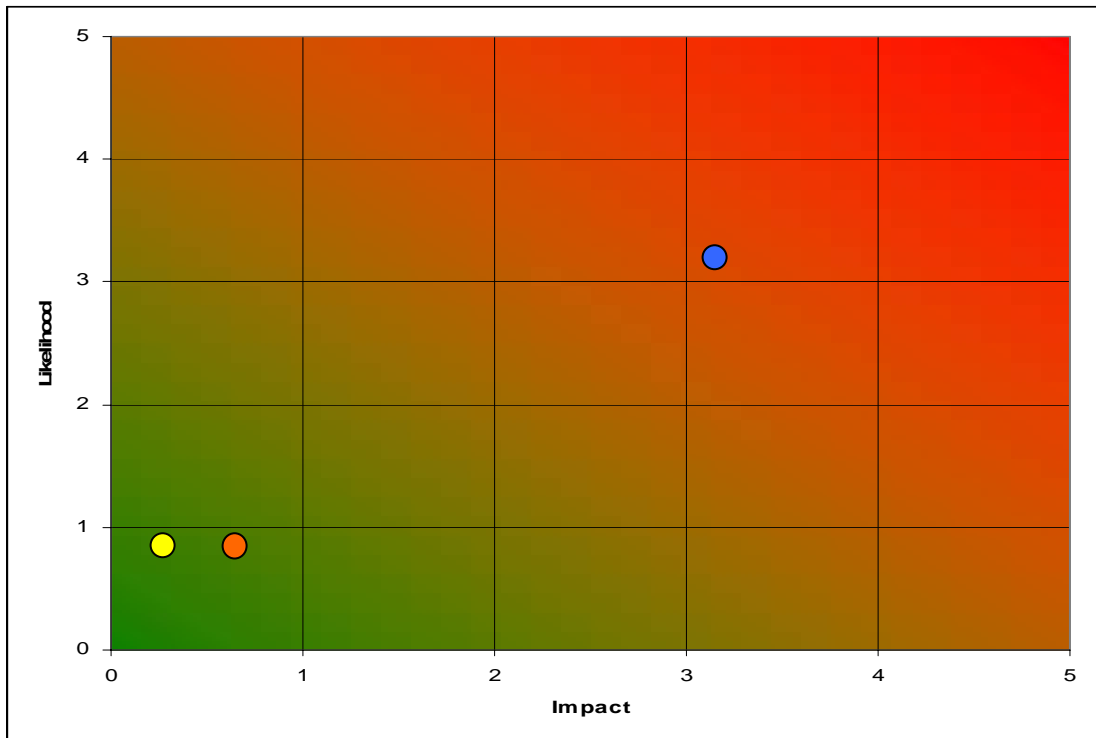
Impact-Likelihood for the delivery of the parts



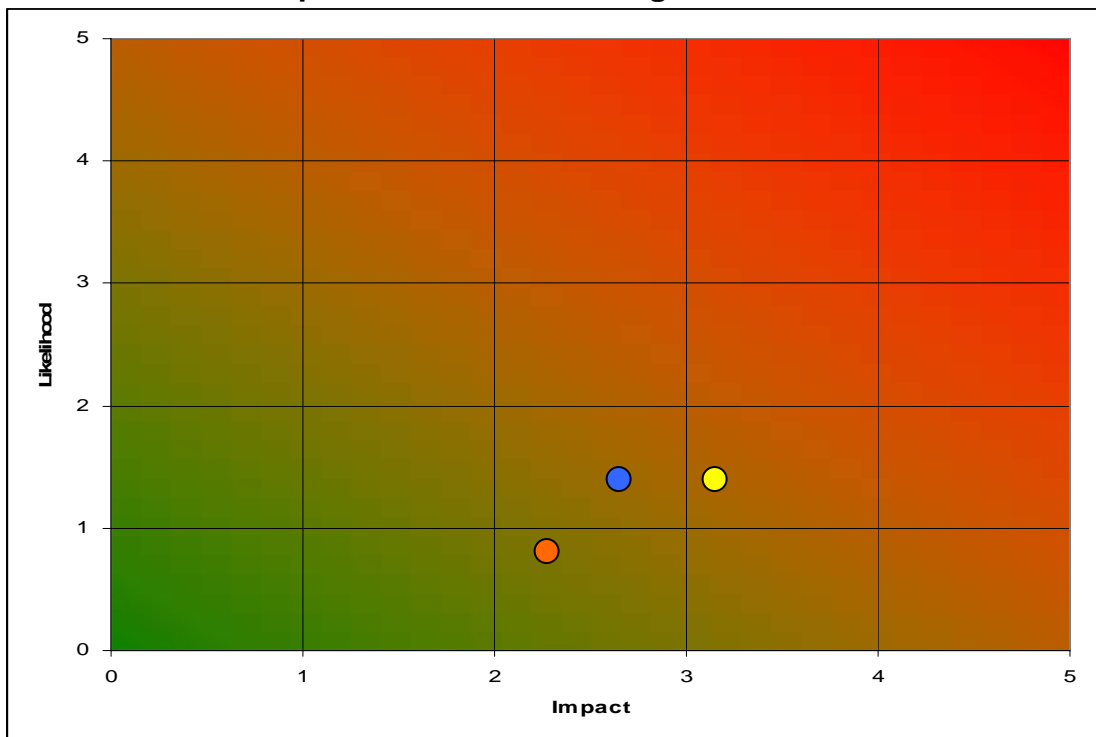
Impact-Likelihood for in-adequate personnel



Impact-Likelihood for School Holidays



Impact-Likelihood for budget costs



Overall Mitigation: Once the team has identified the project completion risk they will plan in advance what will need to happen to prevent the project from being unsuccessful.

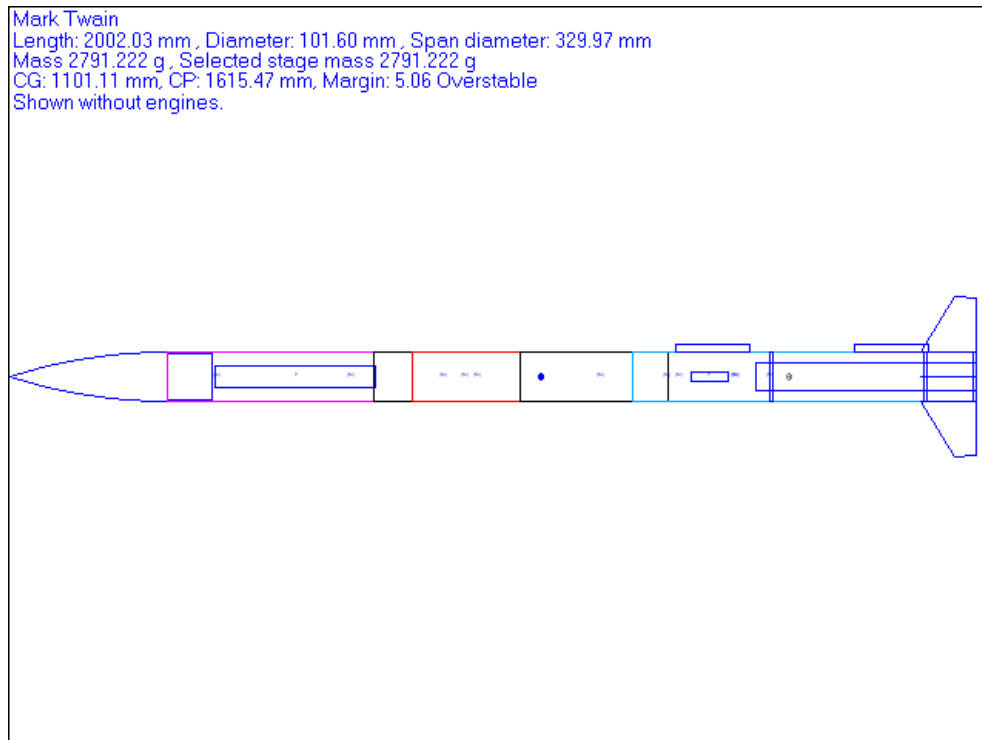
- Demonstrate planning of manufacturing, verification, integration, and operations. (Include component testing, functional testing, or static testing)

The project timeline provided in the Vehicle Criteria section of this report details the planned project construction and test dates.

- Confidence and maturity of design

The students and staff have been building model rockets for several years. The Mark Twain rocket design has been used successfully as part of our after school High K program.

- Include a dimensional drawing of entire assembly, such as a Rocsim graphic. Show Stability margin, simulated CP: Center of Pressure/ CG: Center of Gravity relationship and locations. See graph on RocSim below.



Recovery Subsystem (*Highlighted Because of Criticality*)

- Demonstrate that analysis has begun to determine size for mass, attachment scheme, deployment process, test results with ejection charge and electronics

Mission Performance Predictions (*Highlighted Because of Criticality*)

- State mission performance criteria
 - Rocket will achieve an altitude of 5280 feet (1 mile) above ground level.
 - The rocket will carry a scientific payload during flight.
 - The scientific payload will record and store ozone concentration levels during descent
 - The stored data will be retrieved and analyzed once the rocket is recovered post-flight.

- Show flight profile simulations, altitude predictions with simulated vehicle data, component weights, and simulated motor thrust curve

Mark Twain – Motor Comparison

1	0		[J415W-None]	4632.64	572.07	282.93	17.20	18.03	4632.64
2	1		[K550W-None]	6463.19	750.90	433.47	19.45	40.05	6463.19
3	2		[K550W-None]	6471.42	750.58	433.30	19.43	21.35	6471.42
4	3		[K550W-None]	6155.31	742.22	433.45	18.88	4.76	6155.31
5	4		[K550W-None]	6153.41	742.21	433.45	18.87	9.48	6153.41
6	5		[K550W-None]	5971.13	741.03	433.45	18.56	76.70	5971.13
7	6		[K550W-None]	6053.90	741.43	433.45	18.70	55.33	6053.90
8	7		[K550W-None]	6044.72	741.39	433.45	18.68	58.11	6044.72
9	8		[K550W-None]	6056.46	741.45	433.45	18.70	54.52	6056.46
10	9		[K550W-None]	5991.04	741.13	433.45	18.59	72.17	5991.04

Mark Twain - Simulation results

Engine selection

[J415W-None]

Simulation control parameters

Flight resolution: 800.000000 samples/second

Descent resolution: 1.000000 samples/second

Method: Explicit Euler

Launch conditions

Altitude: 325.00000 Ft.

Relative humidity: 50.000 %

Temperature: 99.000 Deg. F

Pressure: 29.9213 In.

Wind speed model: Light (3-7 MPH)

Low wind speed: 3.0000 MPH

High wind speed: 7.9000 MPH

Wind turbulence: Fairly constant speed (0.01)
Frequency: 0.010000 rad/second
Wind starts at altitude: 0.00000 Ft.
Launch guide angle: 0.000 Degrees from vertical
Latitude: 1.571 Degrees
Launch guide data:
Launch guide length: 0.0960 In.
Velocity at launch guide departure: 60.7595 ft/s
The launch guide was cleared at : 0.256 Seconds
User specified minimum velocity for stable flight: 43.9993 ft/s
Minimum velocity for stable flight reached at: 50.8665 In.
Max data values:
Maximum acceleration:Vertical (y): 282.935 Ft./s/sHorizontal (x): 1.534
Ft./s/sMagnitude: 282.935 Ft./s/s
Maximum velocity:Vertical (y): 571.5059 ft/sHorizontal (x): 5.2081 ft/sMagnitude:
572.0669 ft/s
Maximum range from launch site: 479.58990 Ft.
Maximum altitude: 4632.64436 Ft.
Recovery system data
P: Parachute Deployed at : 84.090 Seconds
Velocity at deployment: 65.6175 ft/s
Altitude at deployment: 499.96719 Ft.
Range at deployment: 294.46227 Ft.
P: Parachute Deployed at : 17.198 Seconds
Velocity at deployment: 18.0322 ft/s
Altitude at deployment: 4632.64436 Ft.
Range at deployment: -309.50361 Ft.
Time data
Time to burnout: 3.500 Sec.
Time to apogee: 17.198 Sec.
Optimal ejection delay: 13.697 Sec.

Payload Integration

- Describe integration plan with an understanding that the payload must be co-developed with the vehicle, be compatible with stresses placed on the vehicle and integrate easily and simply.

The rocket payloads (control, scientific, and recovery) will be mounted on an assembly designed to slide in and out of the rocket airframe. The assembly will be constructed of wood, fiberglass cloth, and Epoxy will consist of two cylindrical disks at the ends, with a 2-sided, flat mounting surface spanning the length between the ends. The two cylindrical disks will be constructed such that they are snug with the inner diameter of the airframe to prevent movement during flight, but will still be able to be removed as a single unit when disassembling the rocket.



**** Photograph Provided by Ray Kinsel**

The payloads will be mounted to the flat surface using shock mounts to minimize the stresses transmitted to the payloads during lift-off and landing. All electrical interconnects will be secured in a way to provide adequate stress relief while preventing inadvertent disconnects.

Air flow to the ozone sensor will be achieved by a drilling a small hole in the airframe. The hole will also serve as the air pressure source for the altimeter.

Launch Operation Procedures

- Determine what type of launch system and platform will be used

The Krueger SLI team will be using a rail launch platform and a 12 volt launch control system. The launch rail provides a high degree of stability during lift-off to ensure safe launch conditions. In addition, the 12 volt launch control system includes a safety key, meeting model rocket safety guidelines.

- Develop an outline of final assembly and launch procedures
 - Launch rails and launch stand with metal plate for protection
 - Propulsion:
 - Make sure that rocket motor is assembled correctly
 - Make sure that igniter is in place and grounded
 - Recovery for lower section:
 - Make sure that shock cord is attached to all components
 - Parachute is wrapped in flame resistant cloth
 - Altimeter:
 - Make sure that batteries are connected and charged
 - Verify that it works
 - Prep charges

- Ensure that igniters are connected and secured
 - Make sure that black powder is packed in place
- Ozone sensor:
 - Ensure that batteries are secured and fully charged
 - Ensure that it is in the correct place
 - Ensure that all components are working properly
- GPS:
 - Ensure that batteries are connected and charged
 - Ensure that GPS is connected to a laptop and works
- Telemetry package:
 - Ensure that batteries are connected and charged
 - Ensure that GPS is connected to a laptop and works
- Main Parachute:
 - Make sure that shock cord is attached to all needed components
 - Wrapped in parachute protector
- Deployment charge:
 - Make sure that ejection charge is connected
 - Ensure that black powder is in place

Safety and Environment (Vehicle)

- The Safety Officer for the Krueger SLI team is Kirsten Casteel.
- Provide a Preliminary analysis of the failure modes of the proposed design of the rocket, payload integration and launch operations, including proposed and completed mitigations.

This information is addressed in Table 1.

- Provide a listing of personnel hazards, and data demonstrating that Safety Hazards have been researched.

The Krueger SLI team will follow all safety precautions and direction provided in the MSDS sheets for potentially hazardous material used during rocket construction.

The ozone sensor, which utilizes a heated substrate for ozone sensing, will be enclosed in the original manufacturing packaging. This will prevent team member exposure to a potential burn hazard.

Additionally, the electrical systems on the rocket use low voltages (9VDC).

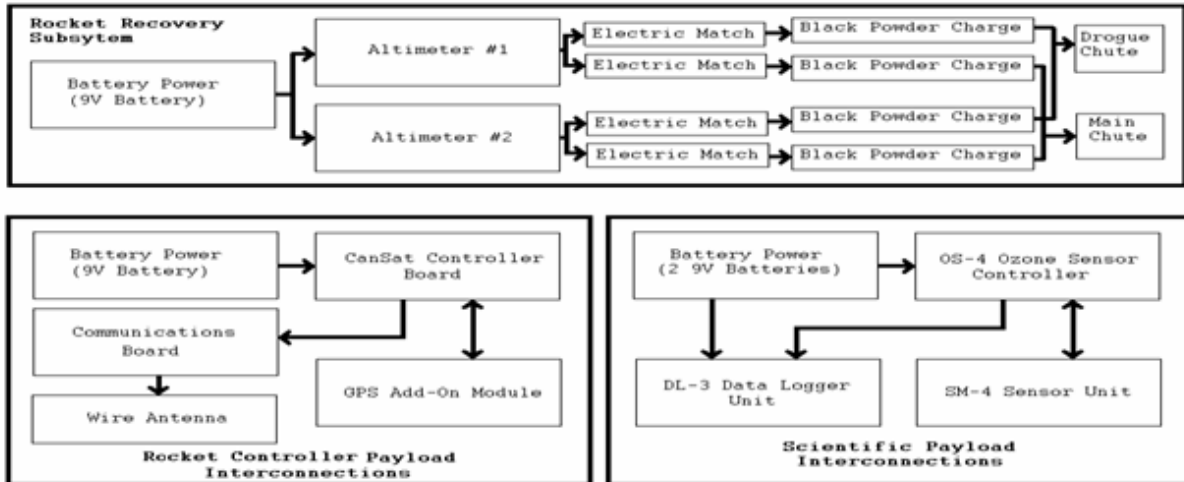
- Environmental concerns.

There are no notable environmental concerns anticipated at this time.

II) Payload Criteria

Selection, Design, and Verification of Payload Experiment

- Payload system level diagram:



- Payload subsystems

Ozone Sensing

The Ozone sensing system is made up of four major components:

- The OS-4 Ozone Sensor Monitor
- The SM-4 Sensor Module
- The DL-3 Data Logger
- Battery Pack

The OS-4/SM-4 Ozone Sensor system has a range of 0.05-10.0 PPM. It is relatively small and lightweight. The sensor works by heating a substrate made of a semi-conductive material. When the semiconductor heats up, it is sensitive to ozone. The sensor system measures the voltage across the semiconductor. The amount of voltage measured across the heated semiconductor is indicative of the amount of ozone that it is coming into contact with. One of the key safety features of the device is that the heated element is flame-arrestor resistant.

Packaging

The ozone sensor system will be packaged into a payload section that can be easily inserted and removed from the rocket body. Each of the system components will be mounted to wood supports inside the section to secure the hardware during flight.

Scientific Payload Control

The OS-4 module provides control for the scientific payload. It interprets the data coming from the SM-4 sensor module and stores the data in the DL-3 data logger. The SM-4 sensing module requires a long warm up period prior to launch.

Data Logging

The data logger will record the data fed to it by the OS-4 sensor monitor, so that the data can be retrieved after the flight. As part of the DL-3, Eco Sensors provides software that will allow the DL-3 to interface to a PC to download the data. Once downloaded, the software also allows for data analysis and reporting. The data logger is 73 X 41 X 59 mm and weighs 140 g. The DL-3 can store over 8,000 readings which will allow for a high level of sampling during flight.

- Performance characteristics for the system and subsystems.

CANSAT

1. GPS tracking- will help us find the rocket once it has landed and will give us airspeed.
2. Power pack- will provide power to the systems
3. Telemetry transmitter- will send information to ground computer for graph analysis and location

Ozone Sensor Package

1. OS-4 Ozone Sensor will make continuous measurements of ozone concentrations from one mile high to ground level.
2. DL-3 data logger will start to record sensor readings when the drogue chute is deployed at apogee.
3. Power pack- will provide power to the systems

Altimeters

1. Two ADEPT-ALTS2 altimeters (one primary and one secondary) will be used to control deployment of drogue chute and main parachute.
2. Both altimeters will have separate power supply and black powder charges.

- Describe the verification plan and its status.
 1. Test Ozone sensor for accuracy and repeatability using an ozone generator.
 2. Perform analysis using Original Equipment Manufacturer (OEM) provided dimensions to ensure mounting
 3. Once received, perform a fit check to verify placement
 4. Verify payload is secure in the payload section of the rocket
 5. Make sure sensor is mounted using shock mounts to avoid stress

- Preliminary integration plan

The preliminary integration plan of the scientific payload will consist primarily of a layout using the dimensions provided by the OEM. Once the components are received, a fit check will be performed to ensure the feasibility of the designed mounting.

- Determine the precision of instrumentation, repeatability of measurement and recovery system

Testing of the scientific payload is planned prior to launch. Primary tests include accuracy and repeatability tests using an ozone generator in a controlled environment.

Payload Concept Features and Definition

- Creativity and originality

The Krueger SLI team is taking a product not originally meant for a rocket application and integrating it into a scientific payload section mounted in the airframe. The creativity involved in this project is primarily the selection of this particular experiment along with the process of how to successfully integrate the sensor system into the rocket.

- Uniqueness or significance

The Krueger SLI team intends to use the ozone concentration data recovered from the launch to further students' understanding of ozone ground level concentrations in different environments and at altitude.

- Suitable level of challenge

Members on the Krueger SLI team have been involved in rocket development and fabrication for over two years. However, the Krueger SLI team members have never sent a rocket this high with this kind of payload.

Science Value

- Describe Science Payload Objectives:

The goal for the scientific payload is to log ozone measurements at different altitudes during descent.

The team will determine if the levels are different outside a large industrial city and a small rural city.

- Payload success criteria

The payload success criterion consists of the following primary objectives:

- Successful integration into the rocket airframe
- Successful initiation of the ozone sensor system upon apogee
- Successful storage of data during descent
- Successful retrieval of data post-flight

- Experimental logic, approach, and method of investigation

The Krueger SLI team will analyze the recovered data to investigate the different concentrations of ozone at various altitudes as well as various locations. The team's hypothesis is "If we fly a rocket one mile high to measure ozone concentrations then as the rocket descends the ozone levels should increase." The independent variable in this investigation is the altitude and the dependant variable is the ozone concentration level measured by the ozone sensor. The team will use the same rocket and ozone sensor package for each flight. Ozone readings at ground level will be taken by a separate ozone sensor before, during and after the rocket flight.

The Krueger SLI team will be testing the difference in ozone levels in at least three different places. Tentatively these locations are:

- Krueger Middle School in San Antonio, Texas
- Meeks Ranch in Kerrville, Texas
- The Marshall Flight Center in Huntsville, Alabama.

Safety and Environment (Payload)

- Safety Officer for the Krueger SLI team is Kirsten (KC) Casteel
- Preliminary analysis of the failure modes of the proposed design of the rocket, payload integration and launch operations, including proposed and completed mitigations.

“How the rocket/payload can fail”

- motor fails – the rocket could crash and potentially hurt someone
- Altimeter doesn’t deploy; parachute fails – the rocket could crash and potentially hurt someone
- Altimeter may not read – no altitude readings, our experiment is a failure
- Ozone sensor doesn’t work – no information, our experiment fails
- GPS/telemetry package doesn’t transmit to laptop –we potentially cannot recover the rocket
- Bad battery – none of the equipment is functional and the rocket fails

Many things can happen that could stop the design or building of our rocket.

The ozone sensor could be delivered late (orange)	This could cause a schedule problem	We will order the ozone sensor early so it will arrive on time, we will also make sure that they are in stock
The ozone sensor may not work (blue)	This would be a technical and schedule problem	We will order the sensor early so when it arrives we can send it back an get a new one if necessary
The ozone sensor could dysfunction while in the air and our data could be lost (yellow)	This would be a technical and cost problem	

IV) Activity Plan

Show status of activities and schedule

- Budget plan
We are going to buy another Ozone sensor which will increase the payload budget by \$532.00.

- Timeline
There are no changes at this time to our timeline.

- Outreach summary
We have contacted a local astronaut, John Blaha, to come and speak to our students on March 14th. He will speak approximately 45 minutes about all the opportunities that will be available in the next 50 years and what the students can do to take advantage of the opportunities. We have created a form letter and are in the process of sending them to local businesses. We have received \$1,750 in donations so far. We have sent letters to over 40 of our district's elementary schools asking to participate in their Science Days/Nights. Our students were involved in this last year and exposed over 100 students to the basics of rocketry. We hope to go to more schools this year. Our school newspaper is writing update articles in every edition they put out. We have submitted a public relations office to our district and have the San Antonio Express News following our progress. Our local Challenger Learning Center is finding ways for our students to participate in student missions and help with seasonal camps. All of our students have been on the missions and are excited about teaching younger students.

V) Conclusion

Overall, we seem to be on track with our budget, timeline, and outreach. We have purchased our rocket parts and have started construction. We are involving the local community and getting donations.