Carroll High School Physics with High-Powered Rocketry

Rocket Science 101!!!

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Rocket Science 101

- Why?
- Benefits
- Peer Mentoring
- Concerns
- Websites
- Future Goals
- Cost Estimates
- Lessons Learned
- Plan of Attack
- To Do List

Why High-Powered Rocketry?

- Great application of:
  - Newton's Laws of Motion
  - Kinematics
  - Work-Kinetic Energy Theorem
  - Conservation of Energy
  - Impulse-Momentum Theory
  - Fluid Dynamics

Why High-Powered Rocketry?

- True Rocket Science
- Learn cause-and-effect analysis
- Real-life data vs. predicted
- Improves technical reading skills
- Valuable Excel spreadsheet training
- Community involvement with Rocket Rally

Main Menu

Benefits of High-Powered Rocketry

- Gives meaning to Physics topics
- Develops problem-solving skills
- Students are excited and motivated!!!
- Hands-on learning and building
- Work to achieve a goal not just a grade
- Tremendous pride in their work

Benefits of High-Powered Rocketry

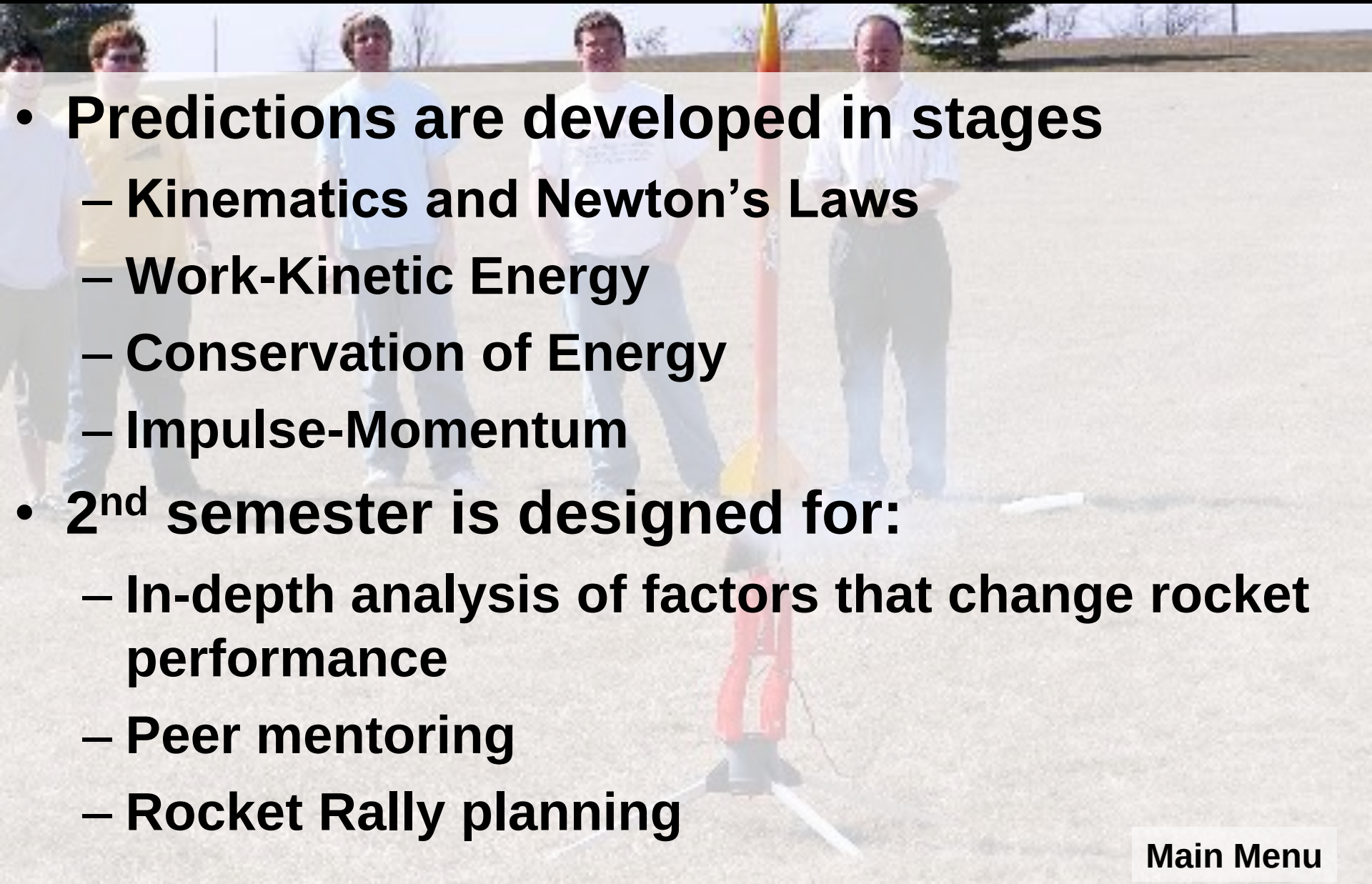
- Competition breeds innovation
- Helps develop leaders
- Builds confidence
- Encourages independent learning
- Young students excited about science
- Physics is the “talk” around school

Main Menu

Rocket Science 101- Plan of Attack

- Split into 2 semesters:
  - 1st: Estes rocket for familiarization
  - 2nd: Aerotech High power rocket
- Every Friday is for Rocket Science
- Worksheets guide students through the explorations
- In-class examples are focused on rockets
- Emphasize graphical analysis in curriculum
- All lab reports are completed using Excel

Rocket Science 101- Plan of Attack



- Predictions are developed in stages
  - Kinematics and Newton's Laws
  - Work-Kinetic Energy
  - Conservation of Energy
  - Impulse-Momentum
- 2nd semester is designed for:
  - In-depth analysis of factors that change rocket performance
  - Peer mentoring
  - Rocket Rally planning

Main Menu

"Rocket Scientist's" To Do List

1st Semester:

- Build a Skill Level 2 Estes Rocket
- Use Kinematics and Newton's Laws to create a spreadsheet that predicts the rockets drag, acceleration, velocity and altitude
- Develop launch, recovery, and data retrieval plan
- Launch and recover rocket

"Rocket Scientist's" To Do List

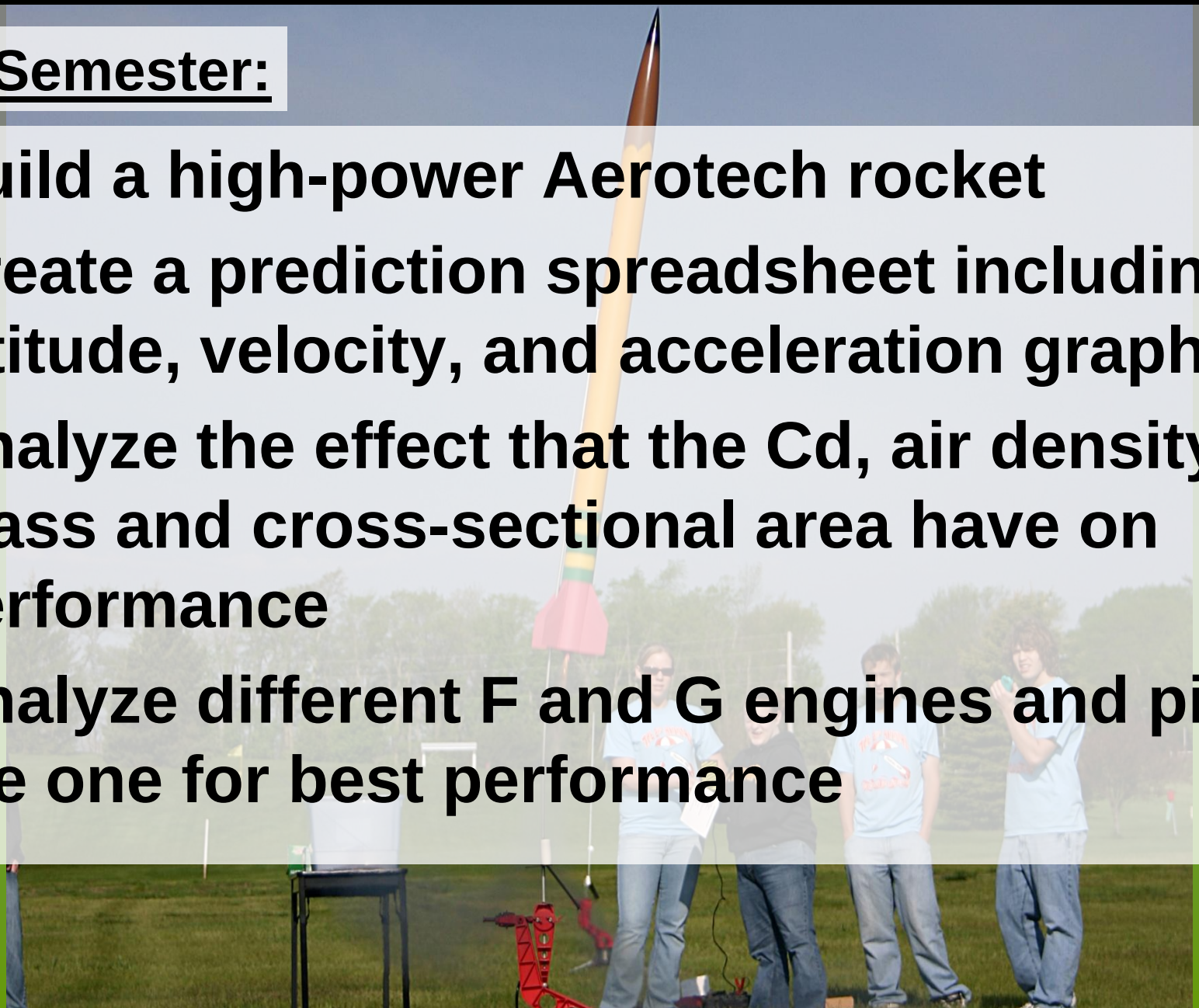
1st Semester:

- Obtain actual flight data using an Estes Altitrak and stop watch
- Post-flight analysis of data
- Lessons learned report
- Work-Kinetic Energy theorem model
- Conservation of Energy model
- Impulse-Momentum model

“Rocket Scientist’s” To Do List

2nd Semester:

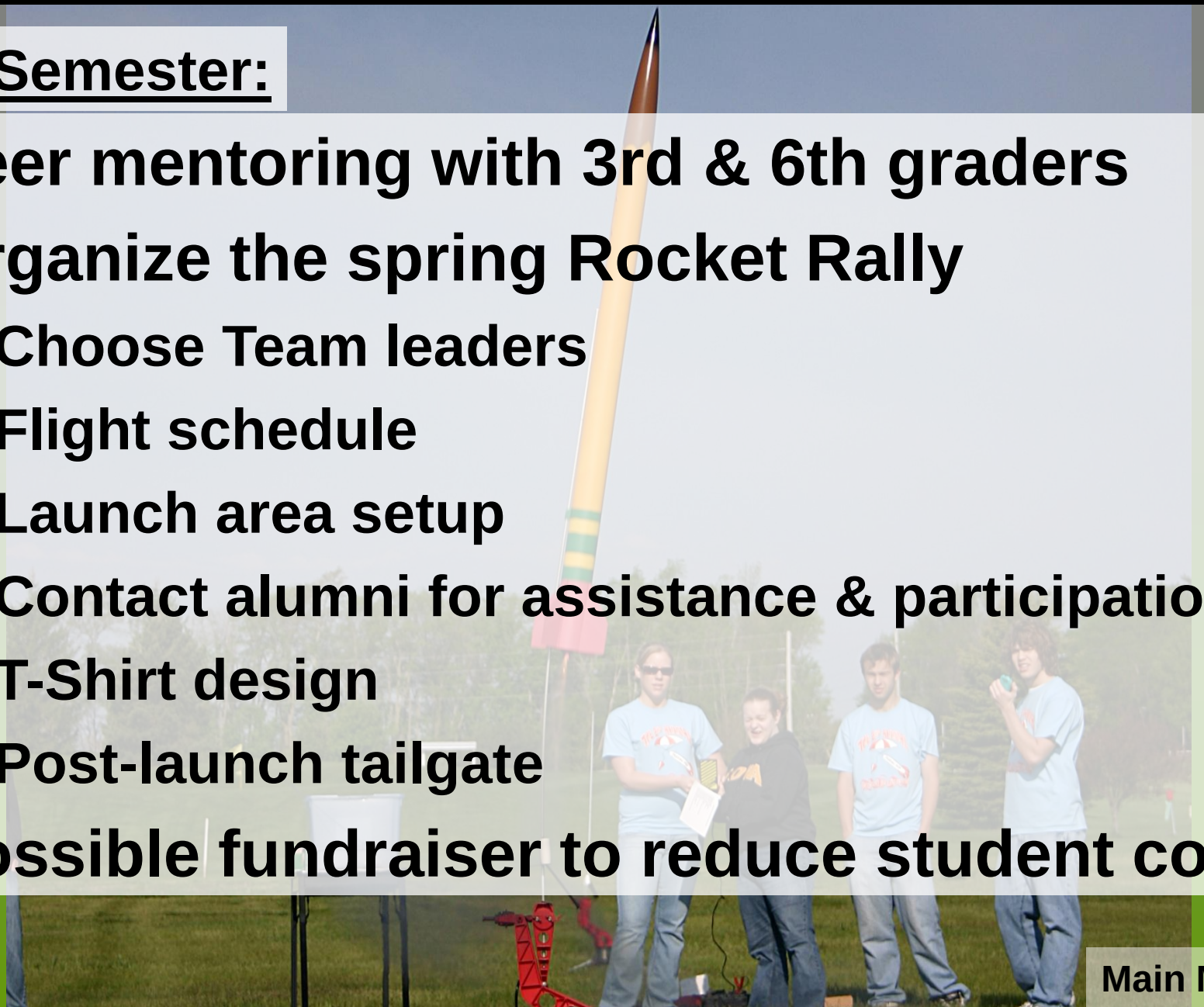
- **Build a high-power Aerotech rocket**
- **Create a prediction spreadsheet including altitude, velocity, and acceleration graphs**
- **Analyze the effect that the Cd, air density, mass and cross-sectional area have on performance**
- **Analyze different F and G engines and pick the one for best performance**



“Rocket Scientist’s” To Do List

2nd Semester:

- Peer mentoring with 3rd & 6th graders
- Organize the spring Rocket Rally
  - Choose Team leaders
  - Flight schedule
  - Launch area setup
  - Contact alumni for assistance & participation
  - T-Shirt design
  - Post-launch tailgate
- Possible fundraiser to reduce student cost



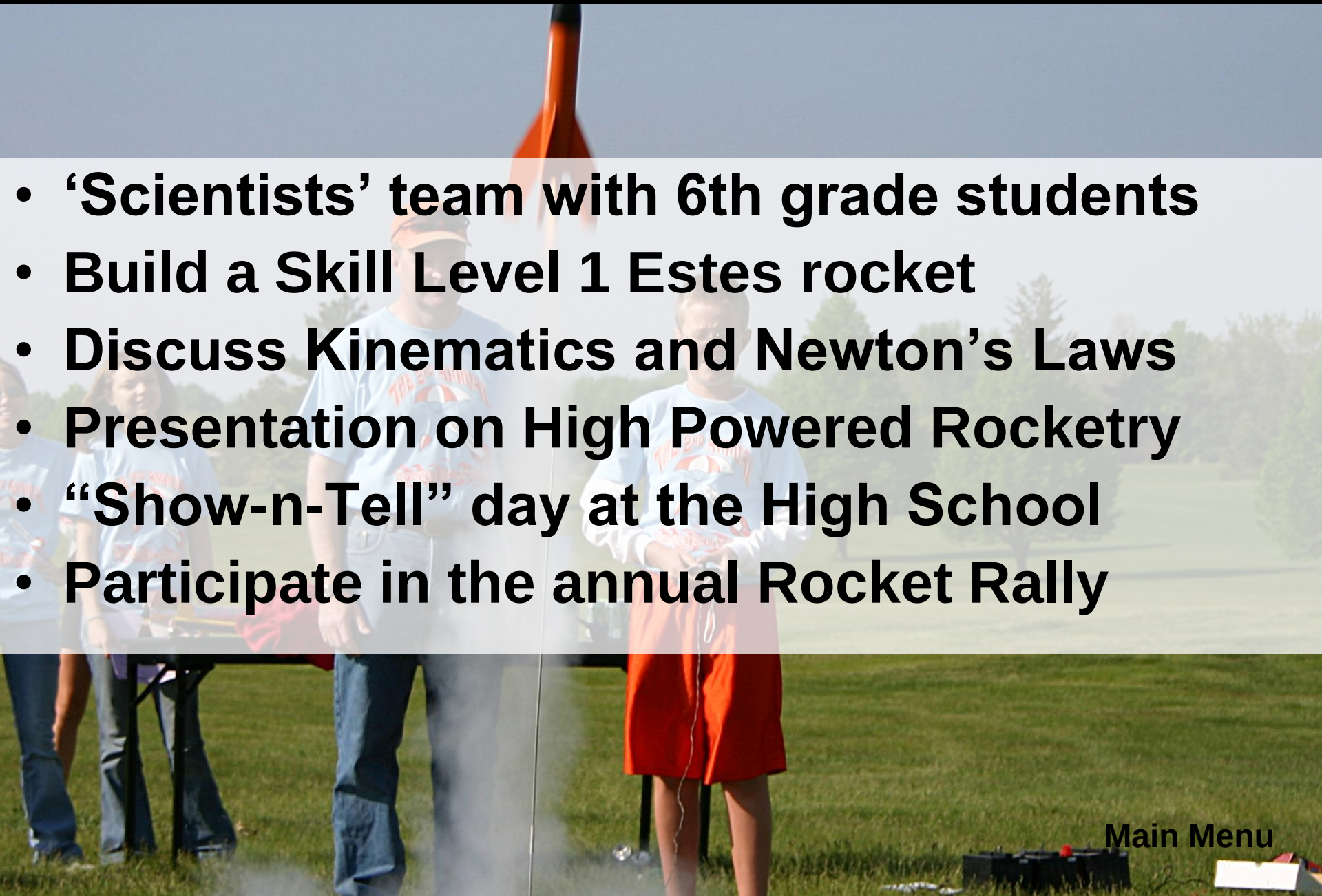
Main Menu

High Powered Rocketry Concerns

- Loss of other Physics content areas
- May lose some students due to lack of interest in the project
- Student cost for the project
  - ~$60 for year, 2 rockets and t-shirt
- School budget for altimeters & launch pads
- Coordination with FAA and local airport
- Weather can cause delays in the project
- Suitable launch area

Main Menu

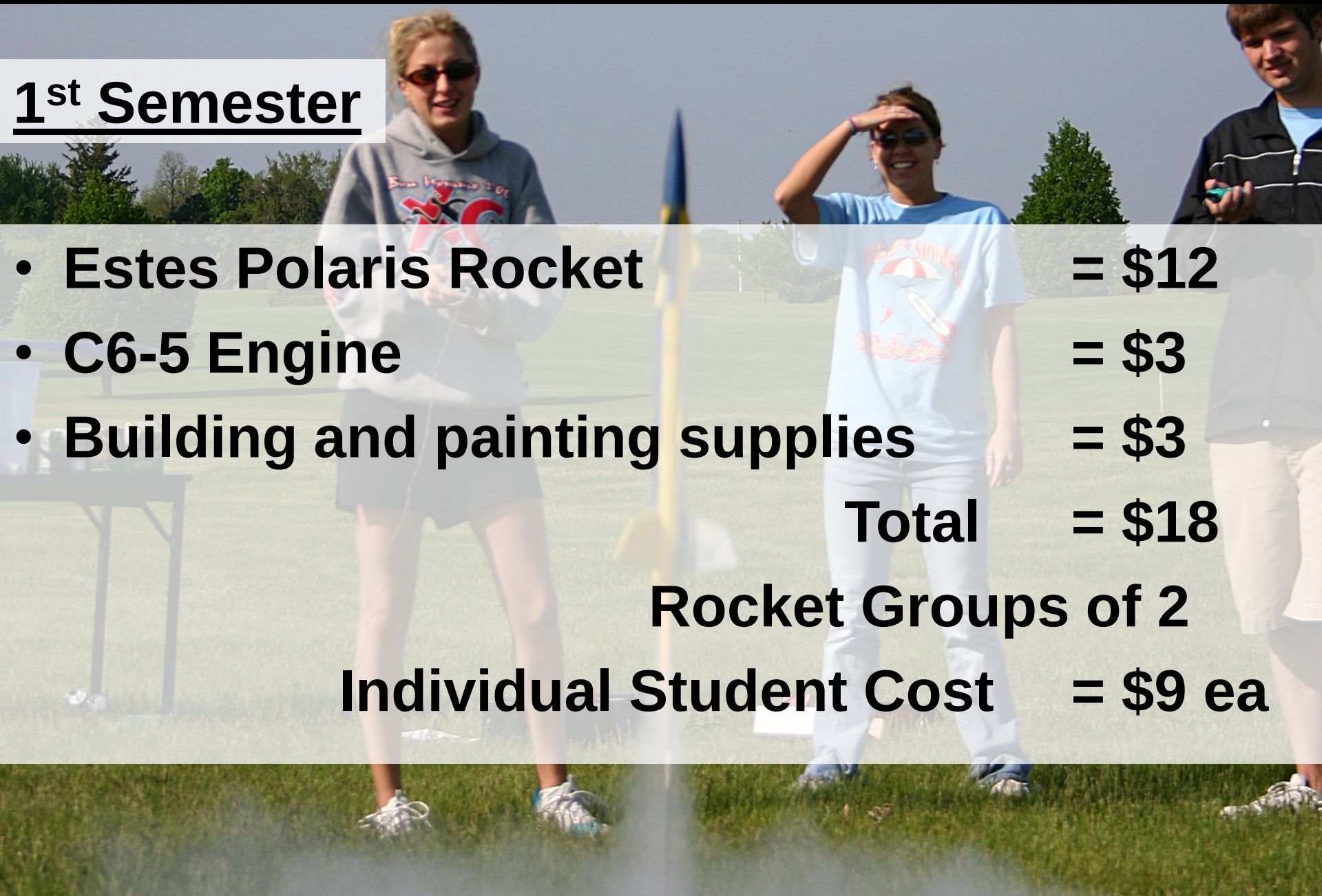
Peer Mentoring Program



- ‘Scientists’ team with 6th grade students
- Build a Skill Level 1 Estes rocket
- Discuss Kinematics and Newton’s Laws
- Presentation on High Powered Rocketry
- “Show-n-Tell” day at the High School
- Participate in the annual Rocket Rally

Main Menu

Rocket Project Cost Estimates



1st Semester

- Estes Polaris Rocket = $12
- C6-5 Engine = $3
- Building and painting supplies = $3

Total = $18

Rocket Groups of 2

Individual Student Cost = $9 ea

Rocket Project Cost Estimates

2nd Semester

- Aerotech Arcas Rocket = $70
- F50-7 or G40-7 Engine = $25
- Building and painting supplies = $3
- T-Shirt = $10
- Tailgate party = $3

Total = $111

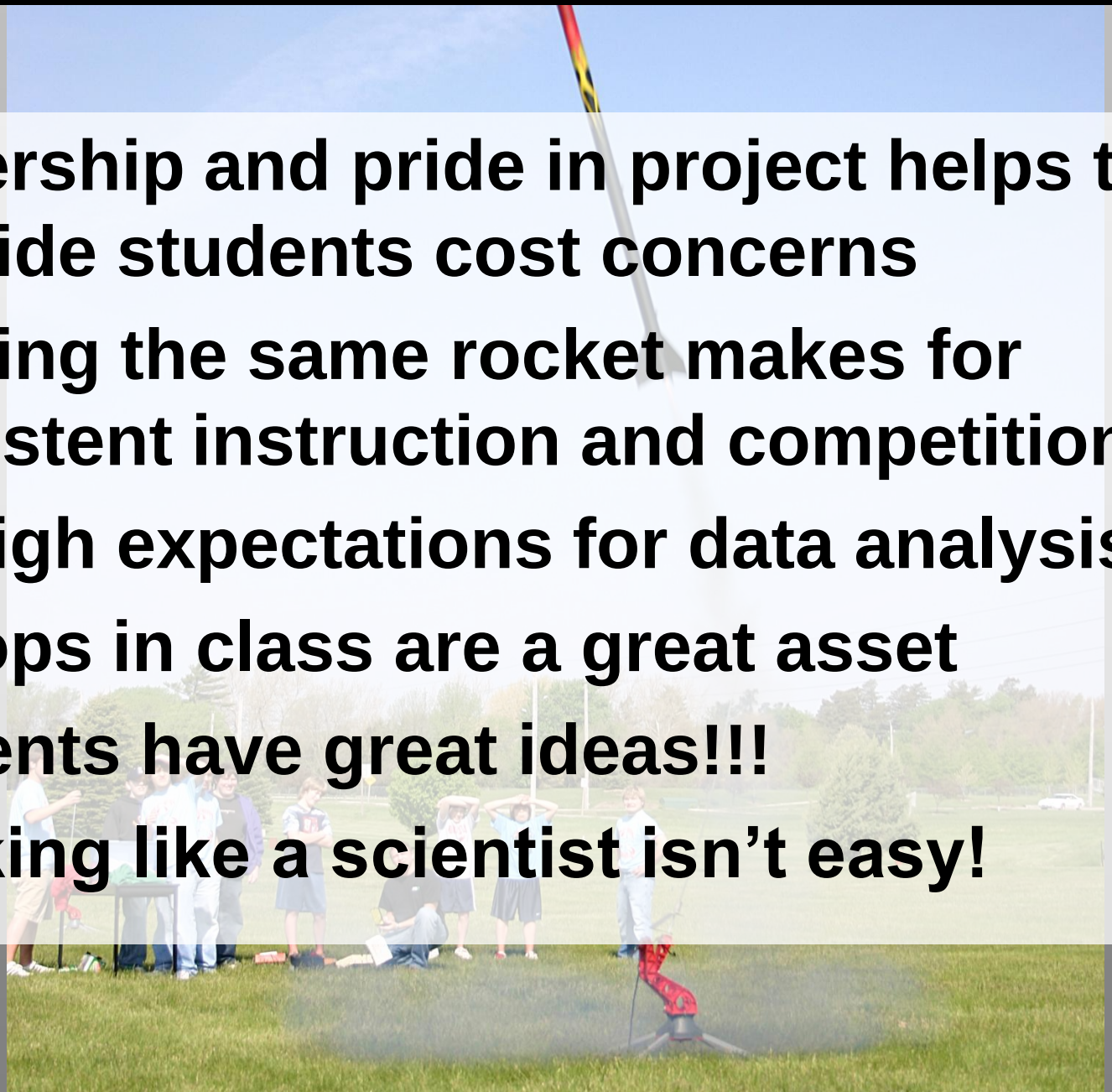
Rocket Groups of 3

Individual Student Cost = $37 ea

Main Menu


Perfect launch and recovery
PRICELESS!

Lessons Learned



- Ownership and pride in project helps to override students cost concerns
- Building the same rocket makes for consistent instruction and competition
- Set high expectations for data analysis
- Laptops in class are a great asset
- Students have great ideas!!!
- Thinking like a scientist isn’t easy!

Lessons Learned

- Student out of pocket expenses are high
- School must make an educational and financial commitment to the project
- People needed for the Rocket Rally
  - Recovery Team Leader
  - Video Coordinator
  - Range Safety Leader
  - Ground Control Leader
- 2 Launch pads and 2 altimeters are ideal

Main Menu

Future Goals

- Develop a mentoring program with the Middle School
- Fundraiser to reduce student costs
- Alumni return for launch and assistance
- Research sounding rockets
- Design/build own rocket instead of a kit
- Rocket group web pages

Future Goals

- Student presentations to local businesses
- Aerodyne Wind Tunnel usage
- Increase usage of RockSim computer software
- Extra practice launches
- Field Trip to Iowa State Wind Tunnel
- Model Rocketry Club

Main Menu

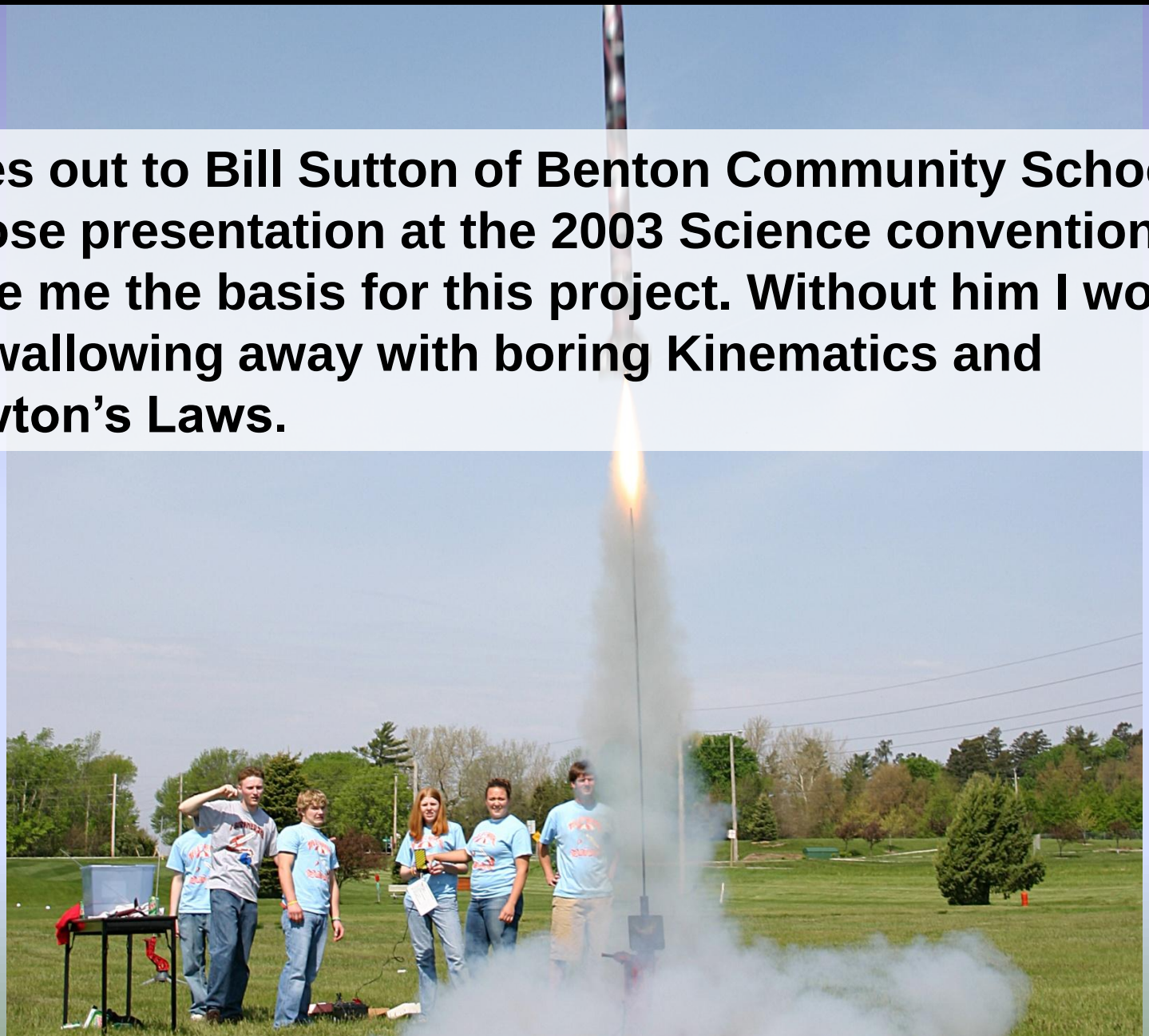
Rocketry Websites

- **Carroll High School Rocketry**
  - http://server-8.carroll.k12.ia.us/~duhrkopfscott/physics/rockets/rockets.htm
- **Aerotech**
  - http://www.aerotech-rocketry.com/
- **A to Z Hobbies**
  - http://www.a2zhobbies.com/
- **Commonwealth Displays**
  - http://www.commonwealth.net/rocketstore/rocketryframes.html
- **Blacksky**
  - https://secure.websitepros.com/blacksky.com/538886.html
- **Apogee**
  - http://www.apogeerockets.com/
- **Thrust Curve Data**
  - http://www.thrustcurve.com/
- **Rocketry Online**
  - http://www.rocketryonline.com/
- **Essence's Model Rocket Reviews**
  - http://www.rocketreviews.com/

Main Menu

Special Thanks

Goes out to Bill Sutton of Benton Community Schools whose presentation at the 2003 Science convention gave me the basis for this project. Without him I would be wallowing away with boring Kinematics and Newton's Laws.



Please feel free to email me with any questions.

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***This presentation can be found on the Carroll High Rocketry webpage. I can also email the PowerPoint file to you or send it to you on a CD.