

# So, You Want to Start A STEM School? 😊



# Today's Presentation

1. Introductions
2. A Brief look at the history of the formation of the AOS
3. The curricular goals and their implementation
4. Where are we now?

# The AOS- A Brief History

- 2002 - LCPS School Board commits to a magnet school model .
- 2003 - HHMI approaches LCPS with a funding opportunity
- 2003-2004 - study of existing programs begin
- 2005 - First class begins in September

# Existing models of STEM Schools-where do we fall?

*The workshop identified four types of selective STEM schools:*

*(1) state residential schools*

*(2) stand-alone schools*

*(3) schools-within-a-school,*

*(4) regional centers with half-day courses*

*-From the NRC report*



# Planning

- Strategic plan for an academy program began in 2001 during the planning for a new high school
- High school was built with extra capacity (250 seats, opened in 2003-04)
- Discussion focused on a Biotechnology program (HHMI connection)
- Academy program was initially set to open in 2004-05

# Lessons Learned

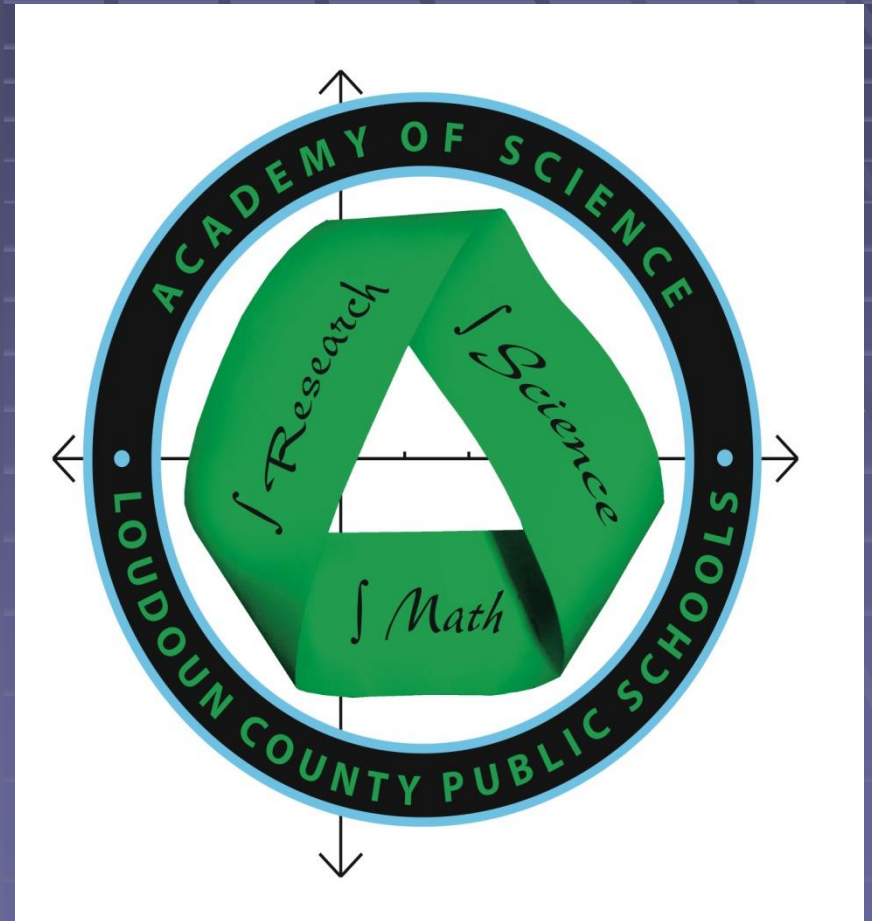
- People matter
- Use the resources you have
- Funding is important
- Place and space
- Ownership of students
- Unintended consequences

# Lessons Learned

- Managing change
- Admissions, keeping diversity
- Taking the top science math students
- Extending programs to home schools
- Long term planning
- Research, research, research

# MISSION STATEMENT

The mission of the Academy of Science (AOS) is to provide an academic environment where students are encouraged to develop creative scientific endeavors of their own design, while having the opportunity to pursue a rich, well-rounded high school experience.



# A student at the Academy of Science will acquire skills to:

- Ask sophisticated scientific questions and conduct research and experimentation
- Read, write and communicate at a level that is required of university students
- Integrate personal scientific and academic background into a broad (holistic) view of the world.

# Cornerstones of AOS Mission

Nurturing

Inquiry

Integration





# Recruiting Faculty

- The selection of the AOS faculty was based on their academic achievement in math and science, their interest in inquiry-based teaching, and their willingness to work with unique students...*from AOS info sessions*
- What I mean....
  - Do you have expertise in your field?
  - Are you willing to stretch yourself?
  - Do you love teaching?
  - Are you good at it?

# Developing Faculty

- *In any discipline, effective professional development should:*
  - *focus on developing teachers' capabilities and knowledge to teach content and subject matter,*
  - *address teachers' classroom work and the problems they encounter in their school settings*
  - *provide multiple and sustained opportunities for teacher learning over a substantial time interval.*

*-From the NRC report*

# Professional Learning Communities

- All teams are multidisciplinary in teacher background
- Teams meet once/week
- Faculty (11 teachers and 2 admin) meets weekly

# Nurturing-Creating a Culture of Science



*Do a few things greatly...*

- *“Research suggests that although teacher qualifications matter, the school context—its culture and conditions—matters just as much, if not more.”*

*-From the NRC report*

# AOS ADVISORY

- Because of our commitment to nurture as well as instruct, each teacher is assigned an Advisory Group
- Advisory teachers start with students when they enter the academy and stay with them until graduation.
- Faculty advisors will visit each family during the summer before the student's first year at the academy.



# International Programs





# Instructional Program



# Inquiry



# Curriculum

*“Effective instruction capitalizes on students’ early interest and experiences, identifies and builds on what they know, and provides them with experiences to engage them in the practices of science and sustain their interest.”*

*-From the NRC Report*

# Freshman/Sophomore Science

- The Integrated Science curriculum covers physics, earth science and chemistry in a three-credit sequence of courses taken during the first two years at the AOS.
- Freshmen are enrolled in Integrated Science 1 & 2; sophomores are enrolled in Integrated Science 3.
- In addition to IS3, students take “Introduction to Research”



# Inquiry

- The freedom to fail
- Students design their own lab experiences by responding to guided questions from faculty. (for example-day 1)
- There is no lab textbook
- After designing lab activities, students write reports, following an AOS rubric



# Integration-An Example

- 9<sup>th</sup> grade Course begins with classical mechanics and dynamics
- Upon completing friction, we move into:
  - weathering and erosion.
  - Basic structure *of the atom*
  - Ions and ionization
  - Disassociation
  - Acid/Base Chemistry
  - Soils, Glaciers, Rivers and Streams, Mapping
- From the study of the Earth itself, we move to the study of the Earth as a solar system entity
- History of Astronomy to a mathematical look at Kepler and Newton.

# Science-Years 3 and 4

- 11<sup>th</sup> graders all take AOS Biology, a project based course
- Each student is also enrolled in an independent research section
- 12<sup>th</sup> graders all take an AP Science as well as Independent research

# The Capstone-Independent Research

*“In particular, students who had research experiences in high school, who undertook an apprenticed mentorship or internship, and whose teachers connected the content across different STEM courses were more likely to complete a STEM major than their peers who did not report these experiences.”*

*-From the NRC report*

# Research & Mentorship

- AOS research coursework begins in the sophomore year.
- In 10<sup>th</sup> grade, a portion of each science class is dedicated to “Introduction to Research.”
- Sophomore research curriculum is designed for students to develop the research skills required for developing their own research.

# Some Examples of Mini-Projects

- Blandy Farms-ongoing succession study
- Science Show: Taking science on the Road!
- Engineering competition
- Radon Map of Loudoun County Using GIS
- Goldenrod gall analysis

# Picking a Research Project

- The most difficult part of research is coming up with an answerable question.
- Finding a passion-Science news
- Umbrella Day
- Faculty Interviews
- Choosing a “doable” project is crucial
- Project Proposal and Background research due by late May.



# Math

- AOS students are enrolled in one Math course yearly
- The cornerstone of math instruction throughout the program is a unique math/science integration that accentuates the understanding of math principles rather than repetition of rote process.
- All 9<sup>th</sup> graders take AOS Analytic Geometry, Functions, and Trigonometry with Transformations. At the end of the year, freshmen take the EOC SOL test to complete math verified credit requirements for graduation.
- By 11<sup>th</sup> grade all students are enrolled in either Calculus AB or BC and by senior year, BC or multivariable calculus.
- A concentration of modeling/statistics is incorporated at all levels, including science courses.

# AOS 4 Year Math Progression

Analytic Geometry,  
Functions, and  
Trigonometry with  
Transformations

AOS PRE-BIO  
SCIENCES  
ANALYSIS

AOS PRE-  
PHYSICAL SCIENCES  
ANALYSIS

AOS AB  
CALCULUS AP  
WITH  
STATISTICS

AOS BC  
CALCULUS AP  
WITH  
STATISTICS

AOS AB  
CALCULUS AP  
WITH  
STATISTICS

AOS BC  
CALCULUS AP  
WITH  
STATISTICS

AOS BC  
CALCULUS WITH  
STATISTICS

MULTIVARIABLE  
CALCULUS

AOS BC  
CALCULUS AP  
WITH  
STATISTICS

MULTIVARIABLE  
CALCULUS

Integrating Mathematics and  
Statistics Instruction  
at  
the Academy of Science

# The “Early Modeling” Paradigm

- Experimental Design
- Looking for Patterns
- Making Predictions
- Testing Predictions and Refining the Model
- Interpreting, Articulating and Making Connections

Day #1

The “Noble” Lie

My Grandmother’s Clock

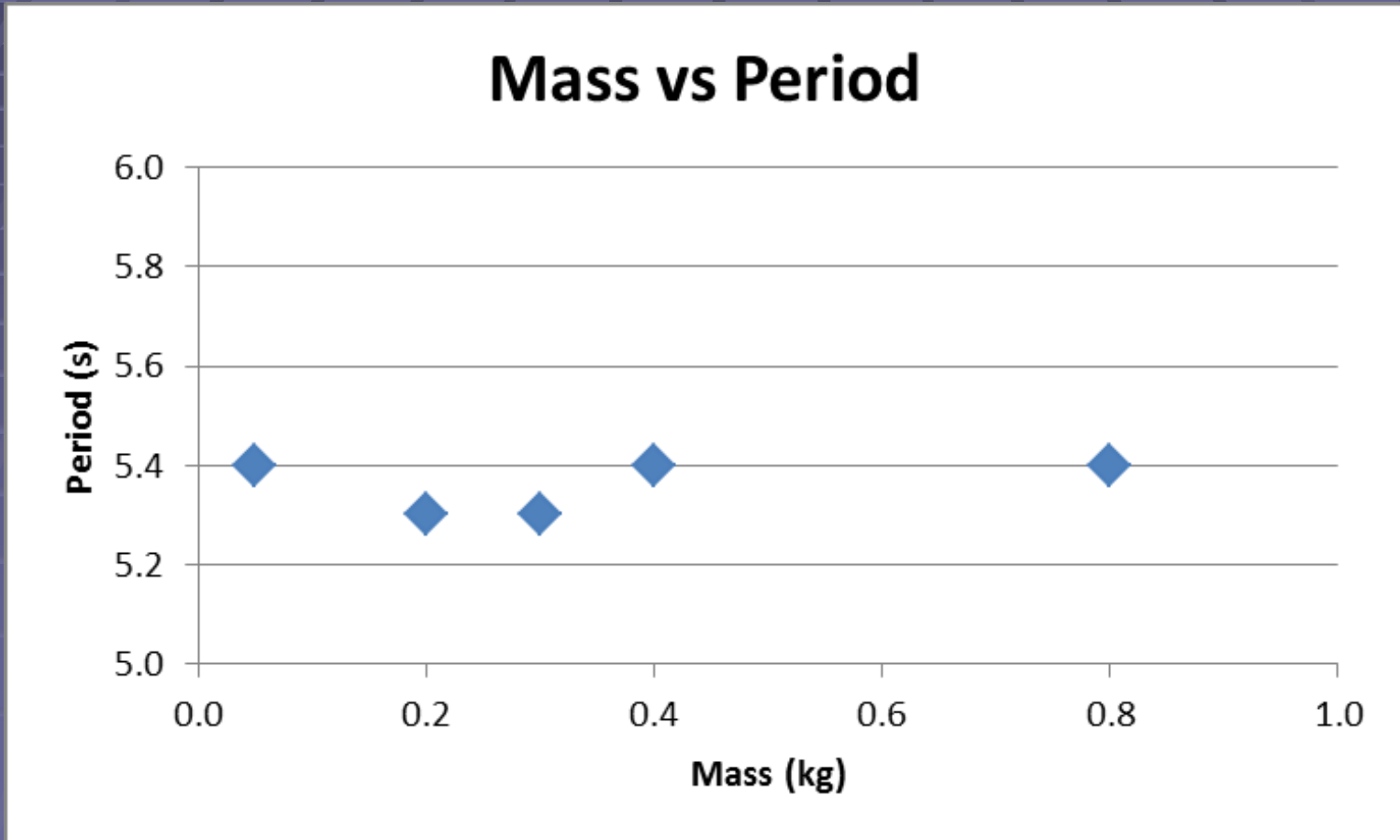
The First Model

# What Factors Might Influence the Period of a Pendulum

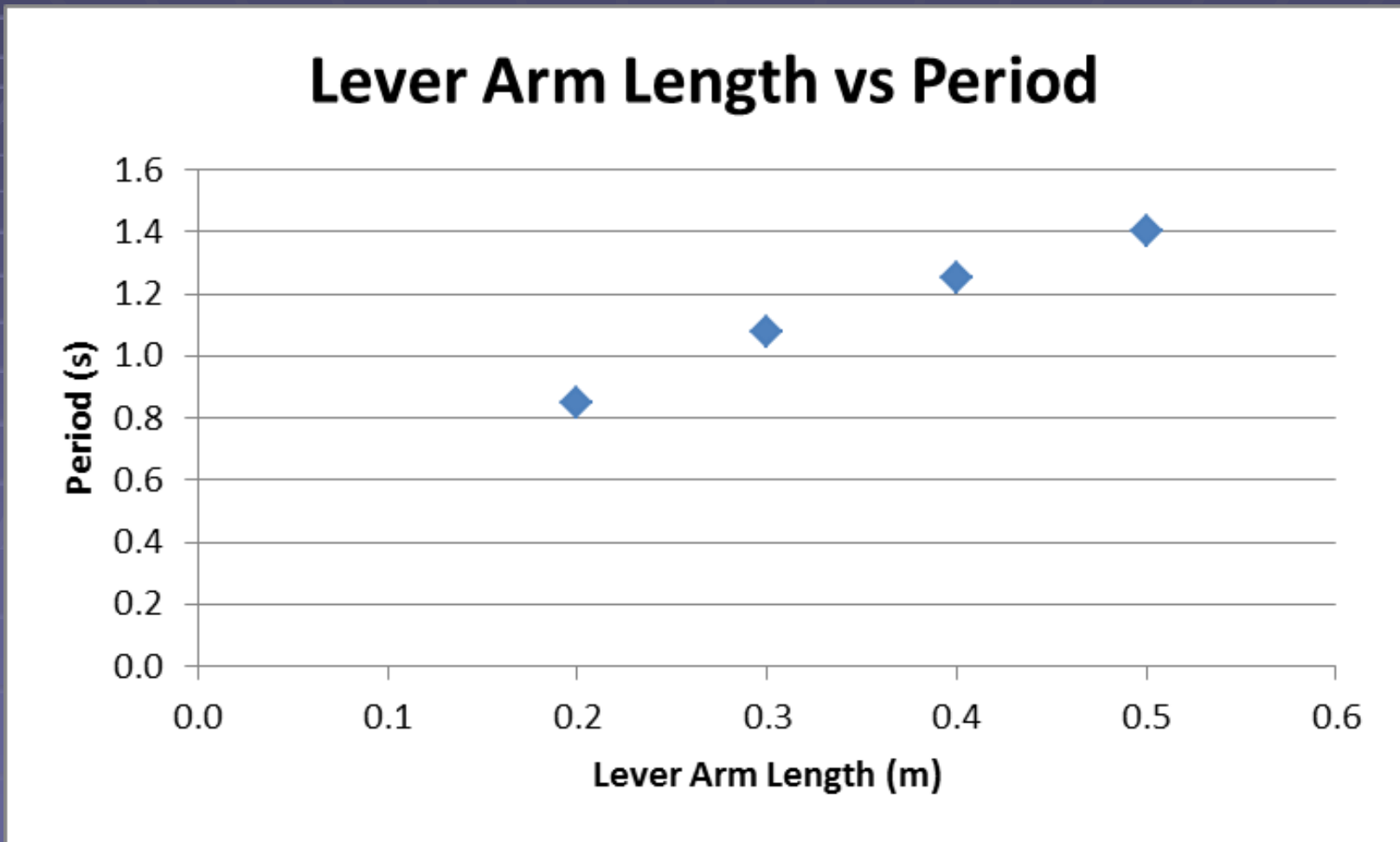
- Experimental Design
  - Looking for Culprits - Variables
    - Mass of the Bob
    - Length of the Lever Arm
    - Angular Displacement



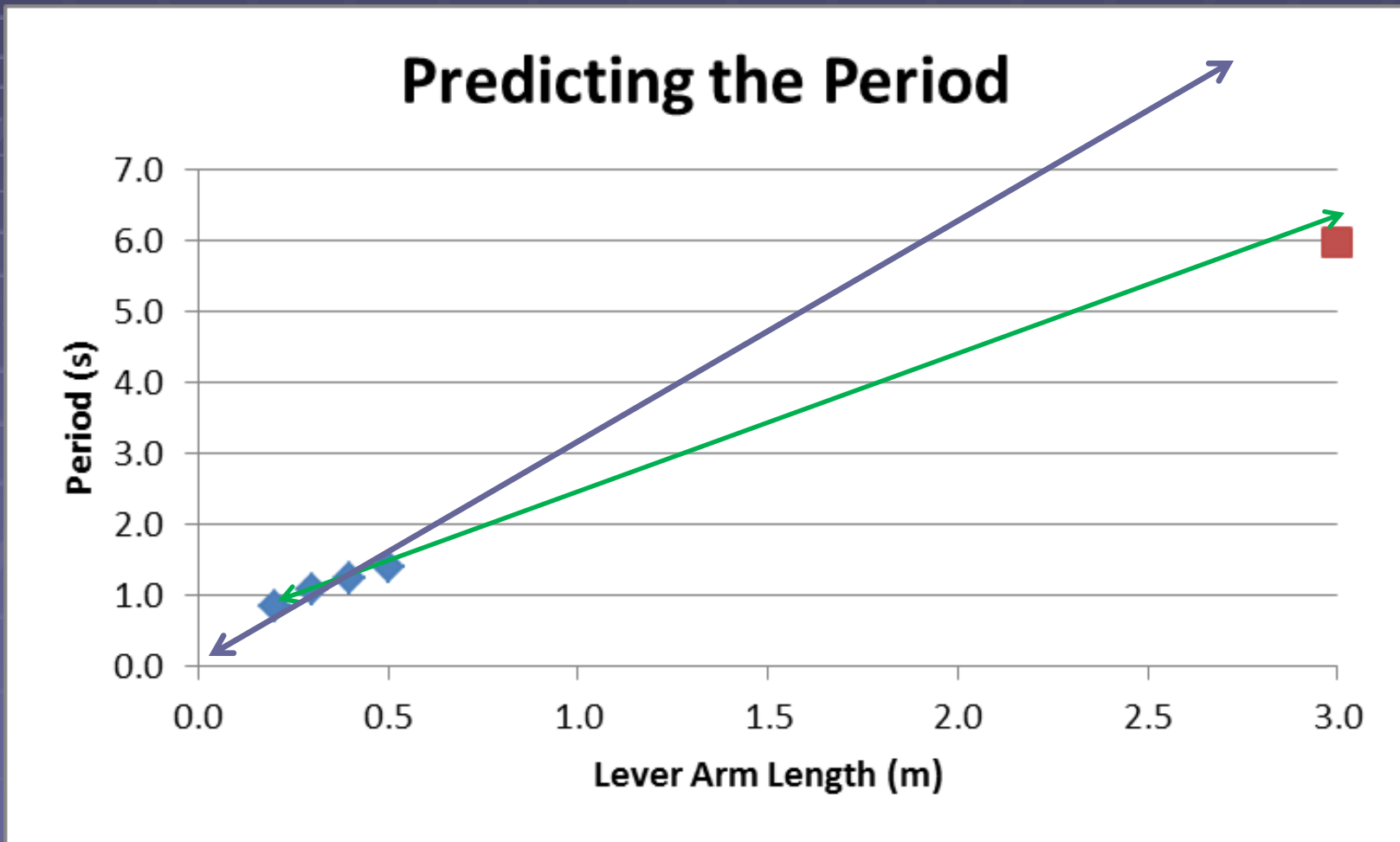
- Looking for and Interpreting Patterns



- Looking for and Interpreting Patterns



- Looking for and Interpreting Patterns



# Factors Influencing the Period of a Pendulum

- Interpreting the Prediction and ...
- Articulating Meaning in the Prediction ...  
... without math?

Edgar Allen Poe  
*(The Pit and the Pendulum)*

and

What do we tell Grandma?

# Creating Math Models



# Modeling the Pendulum

... WITH Math!

# Using Data to Develop Models

## 1<sup>st</sup> Semester

- Best Fit Lines, Residuals and Least Squares – Introducing Regression
- Statements of Proportionality

# Making Connections

## Extending the Pendulum Model

From Linear Kinematics and Dynamics  
to Circular Motion and Astronomy

# Year 8-Is It Working?

- Many of our students walk into research positions during their freshman year, in fact, some are recruited by partner scientists.
- High success in competitions
  - Last year we had an Intel Young Scientist Awardee
  - Consistent high placing in the Russia Space Olympics
  - Last year AOS students took 6 first place awards out of the 12 offered at the Virginia State Science Fair
- College Acceptances
- STEM careers

# High Smile Index 😊



George Wolfe, [george.wolfe@lcps.org](mailto:george.wolfe@lcps.org)  
Odette Scovel, [odette.scovel@lcps.org](mailto:odette.scovel@lcps.org)  
Duke Writer, [duke.writer@lcps.org](mailto:duke.writer@lcps.org)