

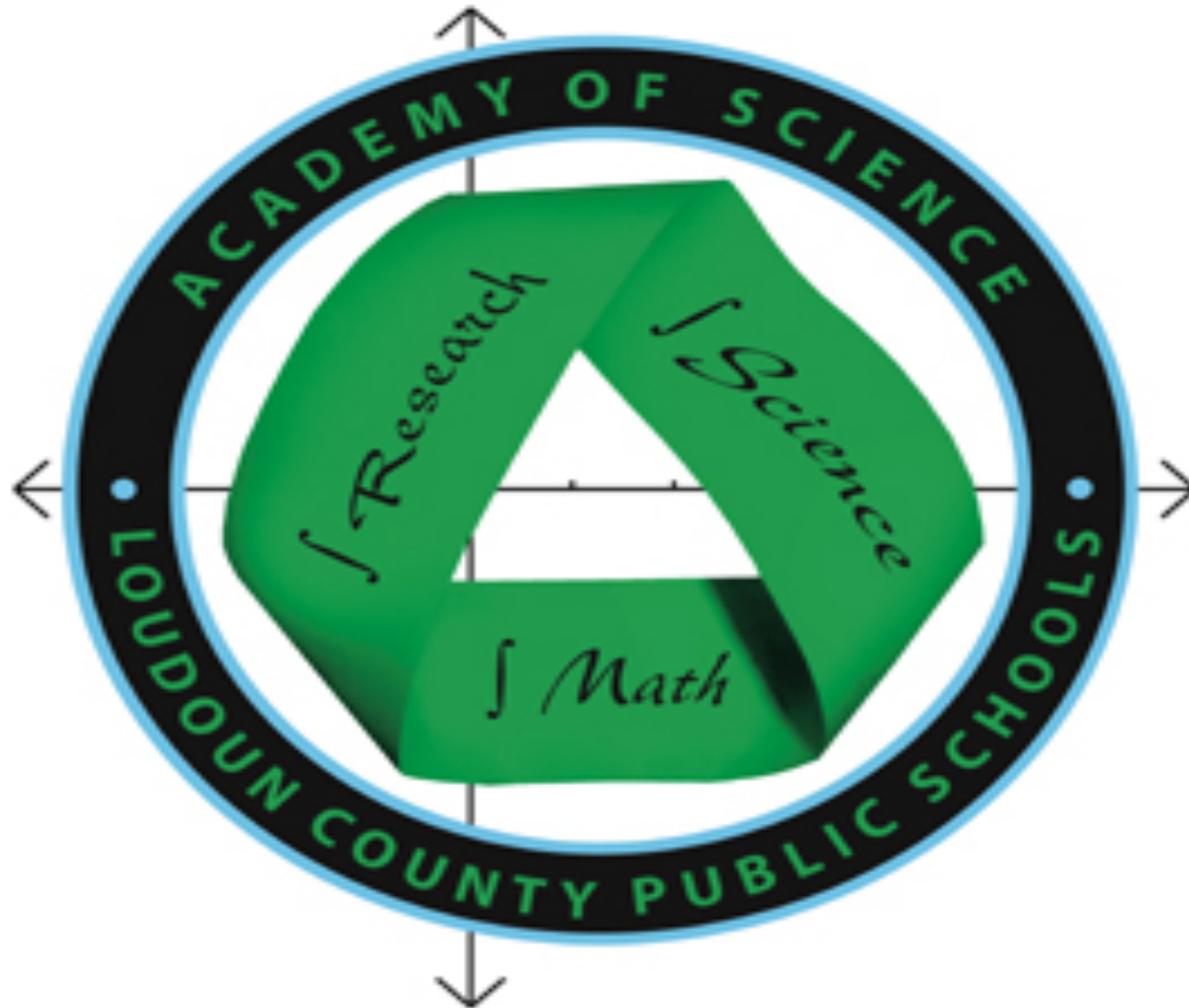
Student Research in Collaboration with Scientists

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AOS- A Brief History



The Curriculum: In Brief

- Students come to us every other day (district is block scheduled)
- In 9th and 10th grade students are given a double blocked integrated, inquiry based physical science course- no lab-book provided
- In 10th grade students finish this course as well as “Introduction to Research”
- In 11th grade take a project based course in Biology
- Throughout all three years, students take modeling-based math culminating in Multivariable Calculus.
- Independent Research is a scheduled course in 11th and 12th grade. Students assigned to a faculty mentor.

Why Research as the Capstone?

- What do we want our students to have when they leave us?
- Is there a tension between content and skill sets?
- Can a student learn sophisticated content without memorizing a thicker book?

Independent Research

- Asking the answerable question
- Designing a way to answer that question
- Mastering content as they progress from novice to “expert”

Best Of All Worlds

- Continuity and Sequence
- Depth
- Content
- Mathematical Analysis
- Communication

Models of Research Partnerships

1. Farming-Out Model

2. Teacher as the PI

3. Student as Independent
Researcher

Farming Out Model

- Someone in the school is the “Research Director”
- Places yearly telephone calls to various “lab angels” who are willing to take a student into their lab.
- Students works 1-4 years in lab, part time.
- Minuses
 - Student may not do much science
 - Maximum impact on Scientist or graduate student
- Pluses
 - Student gets lab experience and may actually get his/her name on a paper.
 - Low impact on school, budget, teacher time.

Teacher as PI

- Teacher goes in for summer work. Picks up lab techniques and model organism(s).
- Students work under the mentorship of teacher.
- Students ask the experimental question...centered on the organism/field that teacher has become trained in.
- Similarity to the “real world” of research.
 - Minuses
 - Field of research is limited by the teacher
 - Scientist is source of info and possibly supplies for teacher.
 - Pluses
 - Less time commitment by scientist
 - Scientist is source of info and possibly supplies for teacher.
 - Research question is student driven

Student as Independent Researcher

Step One-sophomore year

- Finding the passion
 - Science News
 - 3 articles/week starting in January
 - Something you think is “cool”
 - Entry on a class blog-open to comments (comments required)
- We refer to this as getting into a “river”.

- **Step 2**

- Umbrella Day

- Mid-February
- Every faculty member comes to the 10th grade science classes.
- Each faculty member next year will have at least 12 projects assigned to them in their research section.
- Faculty discusses their “research umbrella”
 - Cell lady
 - Engineering guy
 - Environmental scientist
 - Nano-spinner
 - Math-modeling

Step 3-Refining the question

- Back to the lab-notebook...finding the passion
- Reading journals from published authors
- Faculty interviews from March to May
 - No fishing allowed!!!!
 - Faculty begin the mentoring process by helping the students move from a river to a stream.
 - Proposals are rarely practical, often naïve, but almost always of interest to the student.

Seeking Out A Partnership

My name is _____ ; I believe Dr. Mayer sent you my previous message regarding my interest in studying Onychophorans. I have hoped to do a research project on the slime threads of either Peripatus or Peripatopsis, with the goal of assessing the similarities to spider silks.

As far as I can tell, the creatures are banned from the US, and it is my hope to eventually obtain the permits necessary to raise them for scientific purposes. Dr. Mayer had mentioned that my proposals are similar to the work you are doing, as I also am interested in the slime's properties and potential applications. One of my ideas is to perform various tests on the slime including tensile strength, viscosity, etc. We have a large nanospinning contingent in the school, and I thus have also considered the possibility of creating nanofibers of it for engineering purposes. This, however, raises the question of whether the slime can be shipped in a still-usable state, or whether it is possible to reconstitute it without compromising any of its properties. I would be happy to work with the slime for now, with the hope of working with live organisms sometime in the future.

*****Note- over 75% of our mail gets answered**

Why Partnerships?

- These kids get really good really quickly!!!!

- **Step 4- Project Proposal and Background Research**

- Final exam for sophomore research is a detailed project proposal which includes a background research as well as the start of a feasibility study.
- Over the summer these proposals are used to assign each student to a faculty mentor.

The Next Two Years

- Juniors are expected to be “wet” by January.
- As they solidify their project, they must requisition material:
 - First approval-Faculty mentor
 - Second Approval- Chemist
 - Final Approval-AOS director
- Students pay first \$100.00 of their cost (when possible)
- There are both juniors and seniors in each research section
- Monthly lab meetings are held for students to report progress
- Everyone participates in our yearly Symposium

- **Minuses**

- Each faculty member can have up to 24 projects to mentor (max 12 per class)
- Equipment and Chemicals can get expensive.
 - Part of the partnership idea can be to find local industry/universities.

- **Pluses**

- Finds and taps into a student's passions.
- Student ownership-they ask the question.
- Teacher and student learn together. Teacher relinquishes the "sage on the stage" role.
- Low impact on partner.
- Partner as collaborator can be a win-win.

Year 5-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
- International Research Collaborations
 - Hwa Chong Institution in Singapore
 - Daegu Science High School in South Korea

High Smile Index 😊



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