Creating Successful STEM Academies

Heather Carias, Academy and Application Programs Coordinator

Andrea Robertson, Engineering and Information Technology Academy Coordinator

Introductions

Heather Carias, M.Ed.

- National Board Certified – AYA Science
- Certified in Science
- PLTW Certified in PBS, HBS, MI, and BI
- Academy Coordinator for 4 years
- Bioscience Head for 5 years

Andrea Robertson – Nottingham, M. E.

- National Board Certified – AYA Career & Technical Ed.
- Certified in Math and Career Tech Ed.
- PLTW Certified in POE, DE, Aerospace, IED
- Academy of Engineering, Lead for 4 years
- Academy of Information Technology Lead for 1 year

Prior Knowledge of Group

- Your high school has been tasked with creating an Academy program. What elements will you ensure are present in this program?

Driving Questions to Guide the Creation of a STEM Academy

Driving Questions…

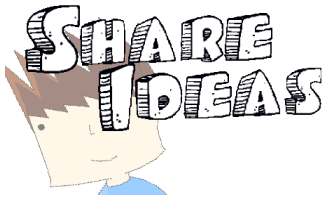
- *capture and communicate our purpose*
- *guide our work*
- *answer the question: "Why are we doing this?"*

Our questions…

- 1) How will we demonstrate our STEM Academy vision through our work?
- 2) How will we positively impact our school with our Academy model?
- 3) How will we differentiate program opportunities for students?
- 4) How will we evaluate our programs?

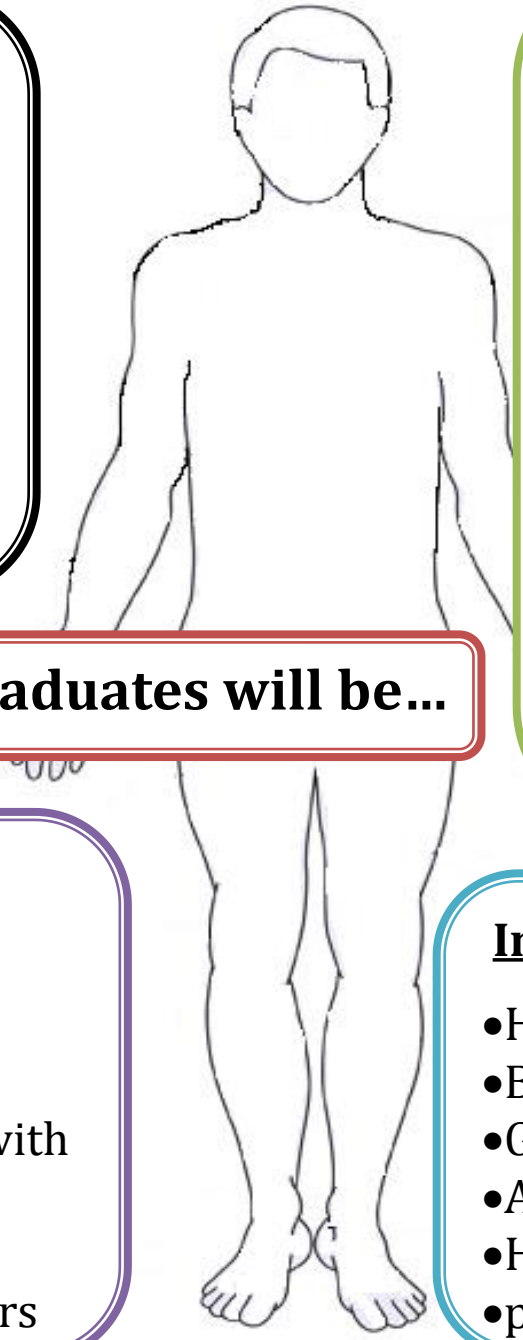
1) How will we demonstrate our Academy vision through our work?

- What is the vision of a STEM Academy?
  - Which stakeholders care about our program graduates?
  - What do we want those stakeholders to say about our graduates?
    - Write descriptors on post-it notes and attach to the body.
    - Group similar responses together to devise a list of those key characteristics that we want to see in our graduates.
    - Couple like characteristics and create a title for the category.
- Share out responses…



Motivated

- Driven
- Persistent
- Hard working
- Excited about the future
- Willing to take on challenges
- Innovative
- Creative



College Ready

- Competent
- Strong knowledge base
- Scientifically literate
- Organized
- Empowered to achieve more than is expected of them
- Critical thinkers that solve medically related problems
- Advanced laboratory techniques
- Computer savvy
- Earned college credit

Bioscience Academy Graduates will be…

Collaborative

- Team player
- Respectful of others and environment
- Comfortable interacting with a variety of medical professionals
- Connect learning to careers

Invested in Self and Community

- Healthy
- Body awareness
- Globally impacting
- Asset to learning community
- Hunger for knowledge
- passionate

Academy of Engineering graduates will be …

college eligible and career ready with the required content knowledge, practical experience and workplace skills

able to appropriately communicate their ideas, written and verbal, in a variety of settings

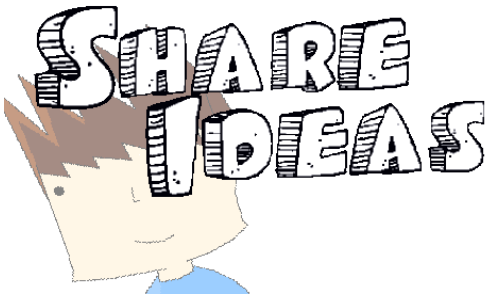
able to work in with other students, staff and business partners to accomplish a shared goal

able to take reasonable risks, persevere through challenges, reflect on performance and develop original ideas

2) How will we positively impact our school with our Academy model?

- What indicators do we want to impact through our Academy programs?

- How will the Academy programs impact those indicators?



2) How will we positively impact our school with our Academy model?

- What indicators do we want to impact through our Academy programs?

Organizational and Performance Results

By June 2014, students will demonstrate academic achievement as measured by the following goals:

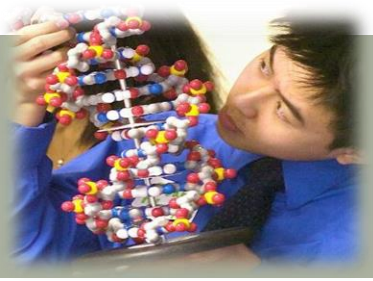
- **SAT/ACT-** Grade 12 SAT/ACT/Accuplacer participation at/above 80%. Grade 12 SAT performance at least 1410 or ACT of 22.
- **Honors/AP/College Courses -**50% of students earning a 3 or better on an AP test and 77% of students enrolled in at least one Honors/AP class.

Honor Roll - 35% of ALL Wheaton HS students will qualify for the Honor Roll each quarter.

HSA – English – 86.2% of all graduating seniors
Algebra – 91.2% of all graduating seniors
Biology – 85.1% of all graduating seniors

Eligibility - 80% of students in all subgroups will be eligible each quarter (2.0 minimum GPA)

Graduation Rate –
4 Year Cohort – 79.47% and 5 Year Cohort – 84.26%

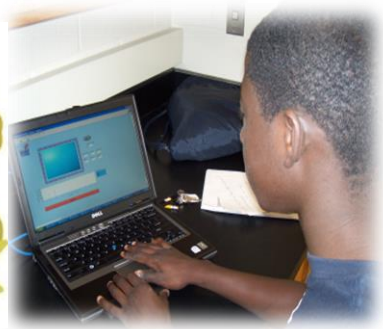


Who are the WHS Knights?

- Video http://www.montgomeryschoolsmd.org/schools/wheatonhs/academies/
- Demographics

Total	Females	Males	AA	Asian	Hisp	White
100%	43%	57%	26%	10%	55%	9%
1336	572	764	363	146	779	108

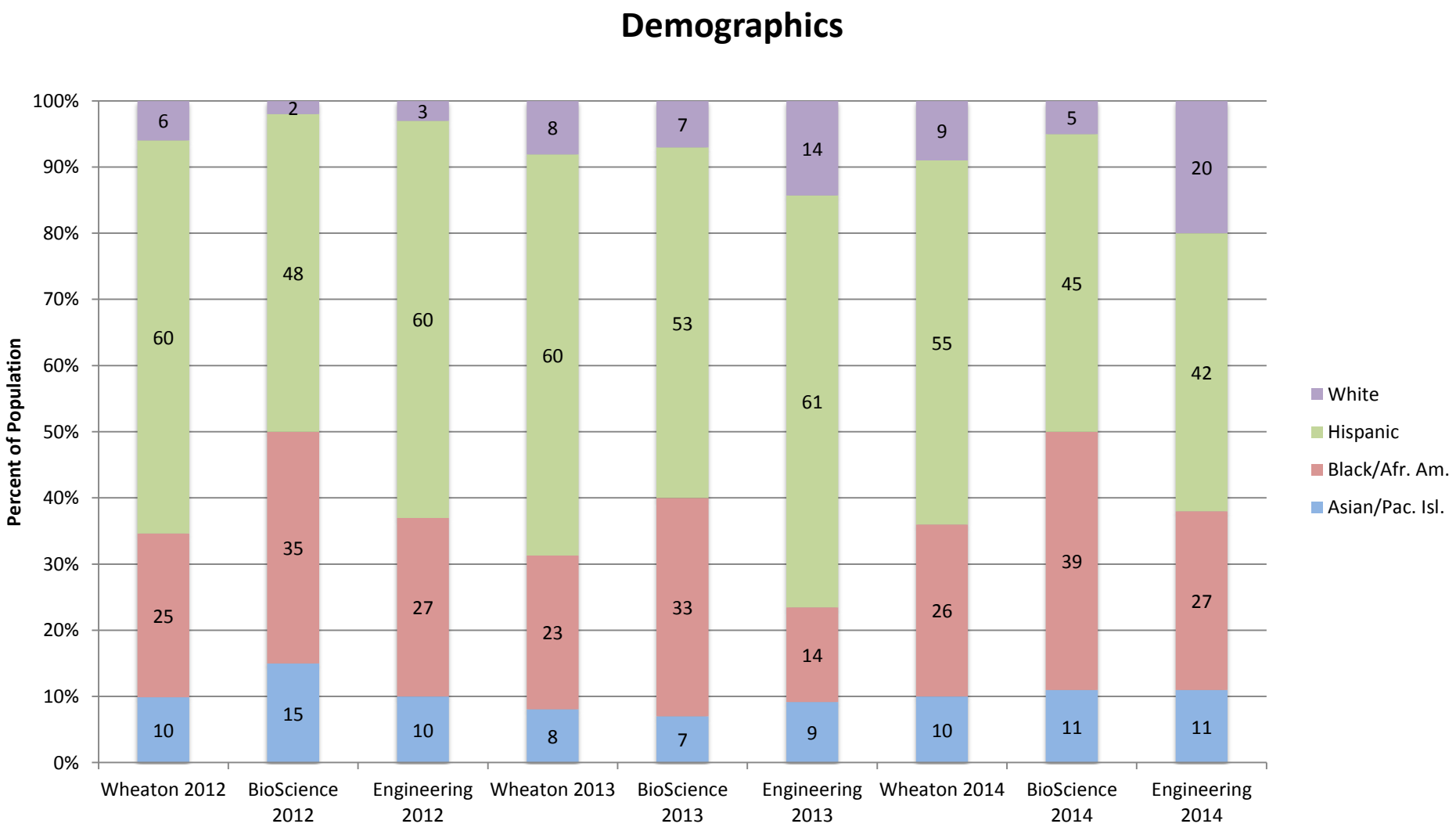
SpEd	ESOL	Now/Ever ESOL	FARMS	Now/Ever FARMS
12%	16%	55%	61%	82.5%



Wheaton High School Program Demographics

	Total	Male	Female	Asian	Black	Hispanic	White	Multiple
Eng App	45	32 (71%)	13 (29%)	9 (20%)	13 (29%)	5 (11%)	16 (36%)	2 (4%)
Eng Academy	265	225 (85%)	40 (15%)	35 (13%)	71 (27%)	111 (42%)	39 (15%)	8 (3%)
Biomed App	46	10 (22%)	36 (78%)	13 (28%)	17 (37%)	8 (17%)	5 (11%)	3 (7%)
Bioscience Academy	234	65 (28%)	169 (72%)	31 (13%)	66 (28%)	119 (51%)	14 (16%)	4 (2%)
Information Technology	111	89 (80%)	22 (20%)	11 (10%)	29 (26%)	58 (52%)	9 (8%)	4 (4%)

Program Participants Representative of School

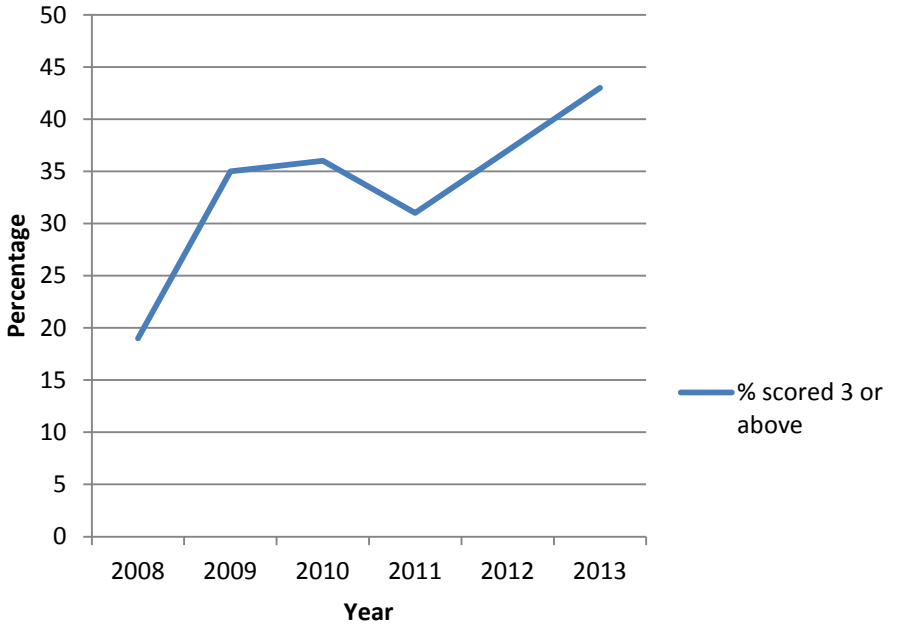


2) How will we positively impact our school with our Academy model?

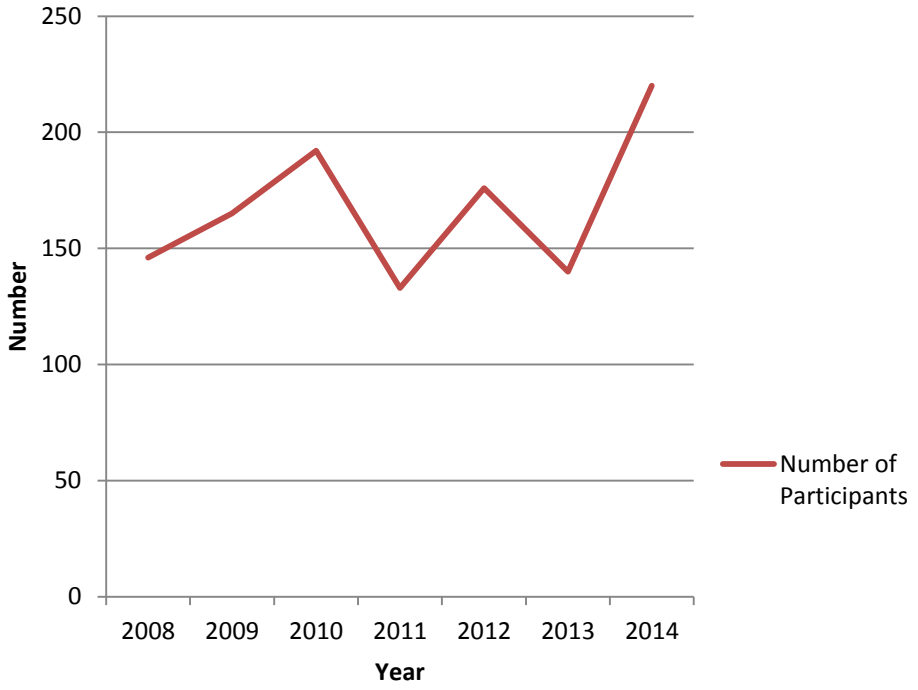
- How will the Academy programs impact those indicators?
  - Does having STEM based Academies at WHS impact…
    - the participation and performance on STEM based AP tests?
    - performance of students on Biology and Math High School Assessments?
    - rate of graduation and money earned for college?
    - Number of college credits earned by students prior to graduation?

AP Participation and Performance

Performance of Students on STEM related AP exams

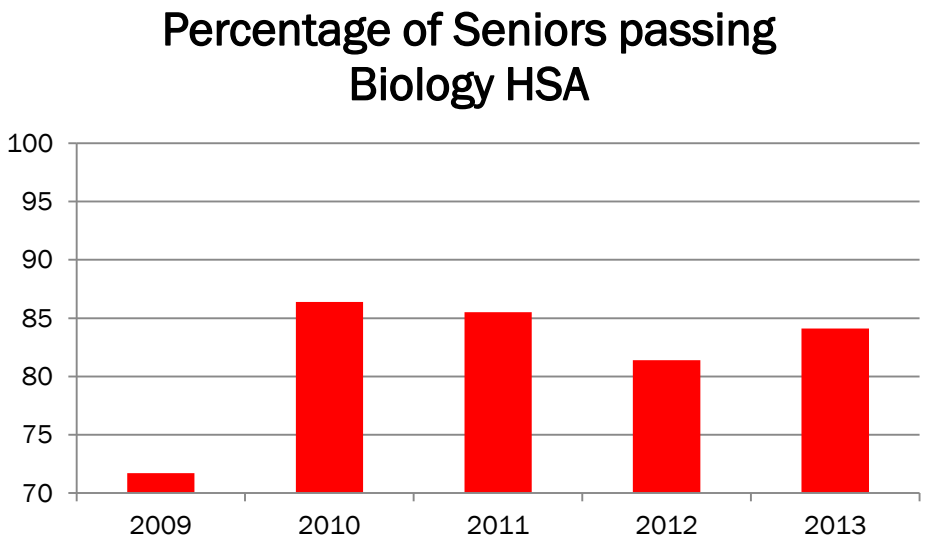


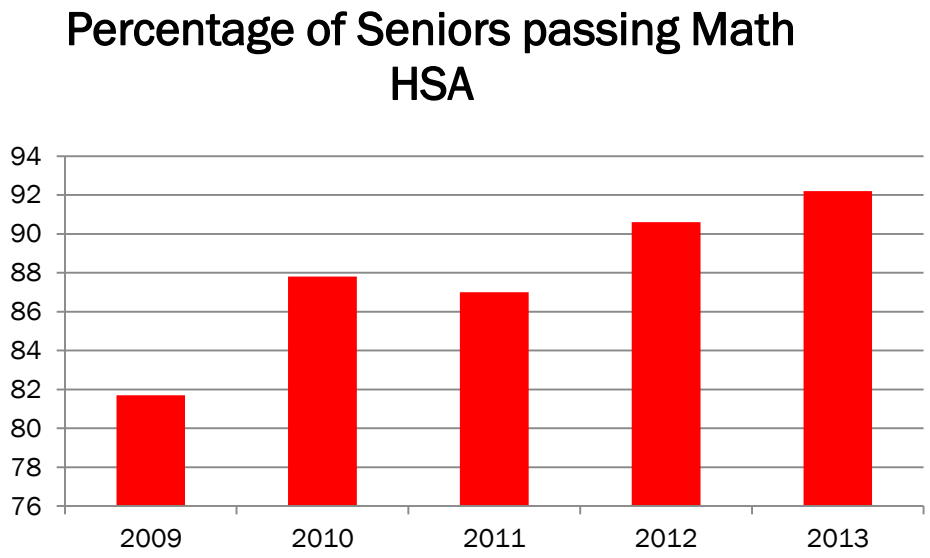
Participants in STEM Based AP Courses



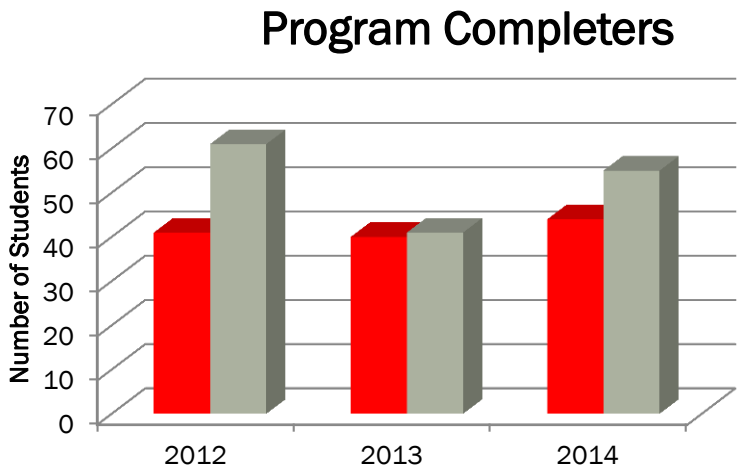
TOTAL: STEM	146	19% Pass 3+	165	35% Pass 3+	192	36% Pass 3+	133	31% Pass 3+	176	37% Pass 3+	140	43% Pass 3+	220
TOTAL: SCHOOL	293	42% Pass 3+	357	39% Pass 3+	334	40% Pass 3+	352	38% Pass 3+	399	45.40%	376	48%	751

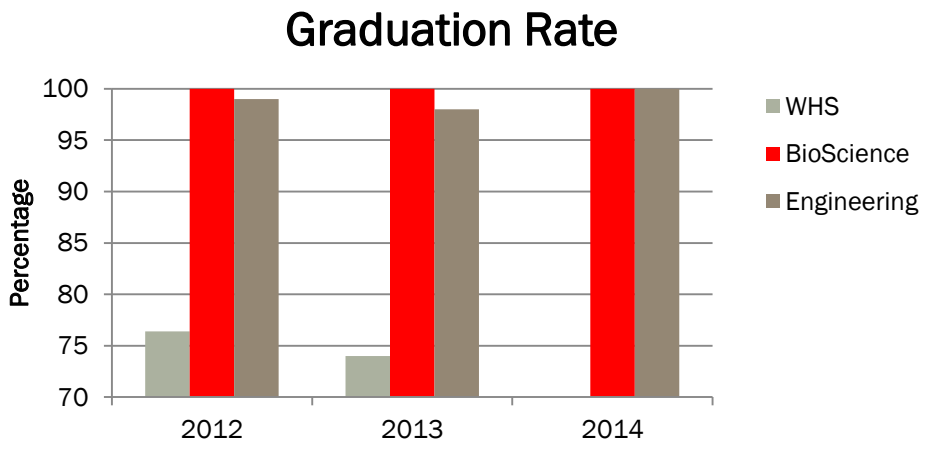
High School Assessment Data





Graduation Rate and Money Earned for College



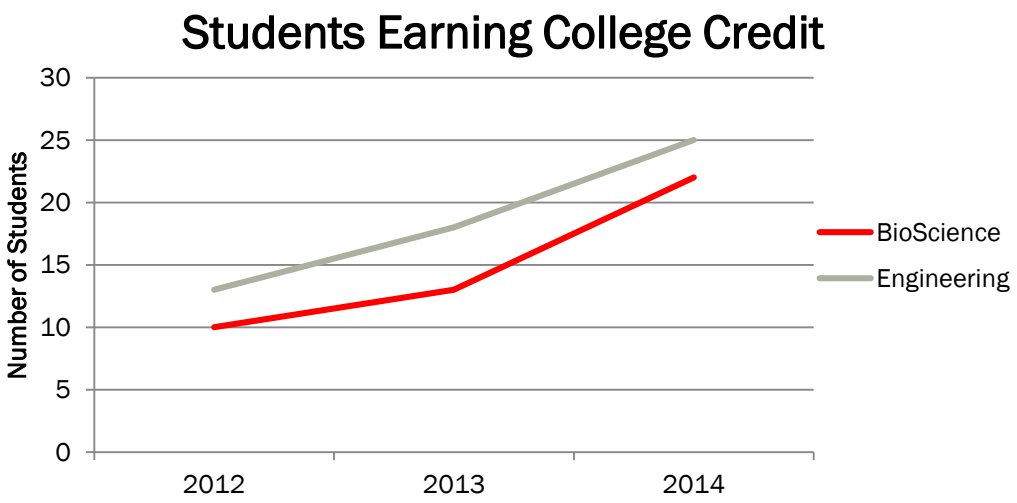


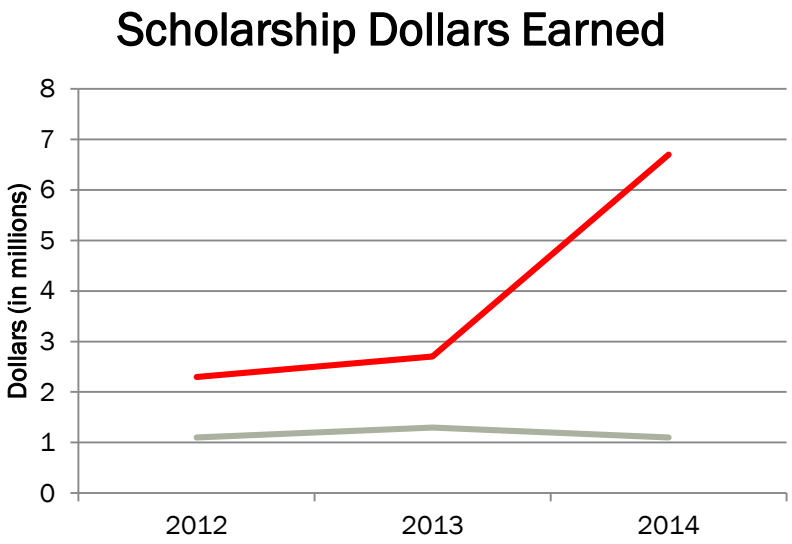
	PLTW Biomedical			PLTW Engineering		
Graduation Year	2012	2013	2014	2012	2013	2014
Program Completers	41	40	44	61	41	55
Notable Institutions that students now attend	Boston University, University of Wisconsin, UMD	Ohio State University, Bucknell, Colby College, UMD	Colgate, Brown, UMD (8), UMBC	Morehouse College, UMD, BYU, UMES	UMD (5), UMBC (2), Bucknell, George Mason, Tufts University	UMD(7), UMBC(3), Embry-Riddle, George Mason, Purdue
Money Earned for College	2.3 million	2.7 million	6.3 million	1.1 million	1.3 million	1.1 million

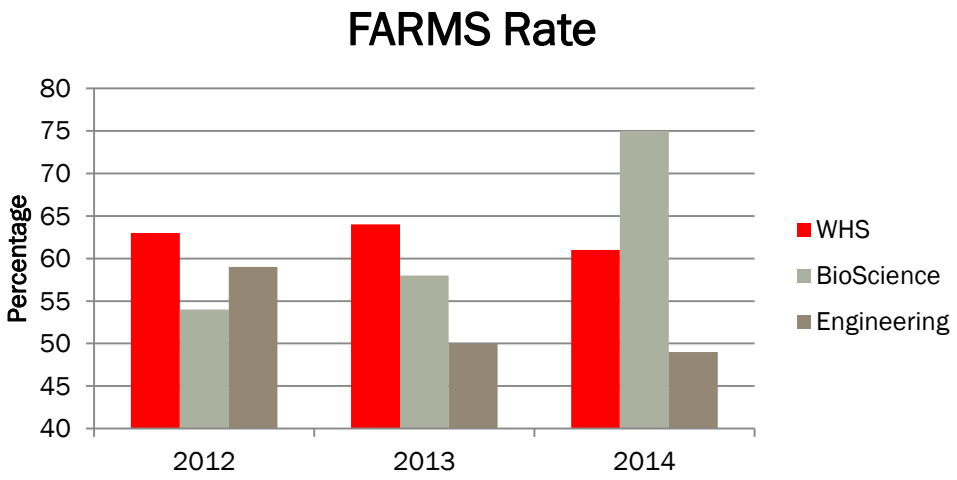
Graduation Rate and Money Earned for College

Academy of Information Technology			
Year	**Program Completers**	**Money Awarded for College**	**Notable Institutions**
2012	31 (21 completed internship)	667,000	UMBC Meyerhoff Scholar, UMCP
2013	8	868,866	John Hopkins, UMD (3), Colgate U, Tufts U
2014	11	900, 000	MIT, UMCP

Graduation Rate and Money Earned for College







Overview of PLTW Engineering

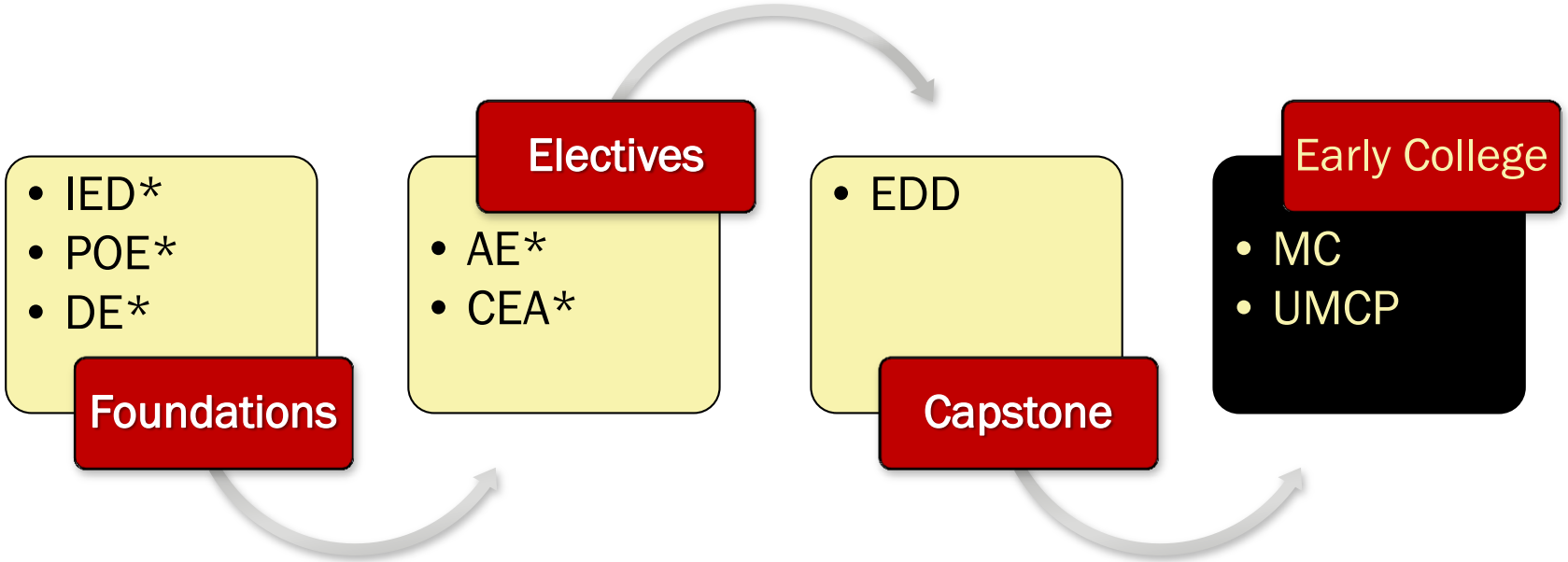
Project Lead the Way (PLTW)
Pre - Engineering program
(2004, 2010)

Philosophy

- Engineering design process
- Problem based learning
- Hands-on experiences
- Teamwork
- Communication
- Documentation

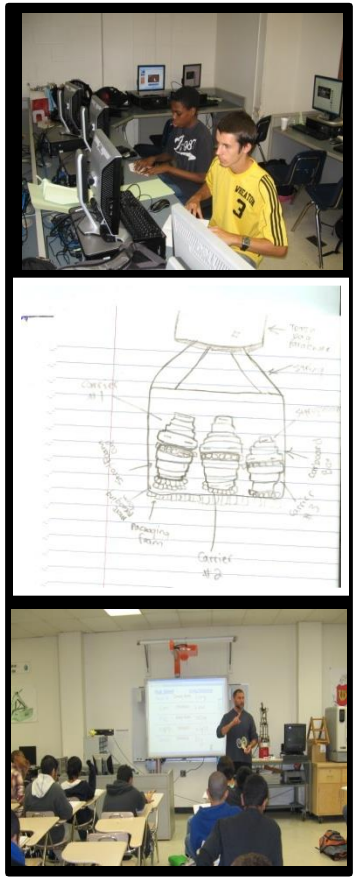
Engineering Program of Study

5 full year courses: 3 foundations, 1 elective, 1 capstone



*Students who maintain an 85+ average each quarter and pass the final exam with a 70+ are eligible, for a fee, for college credit through RIT

Introduction to Engineering Design (IED)

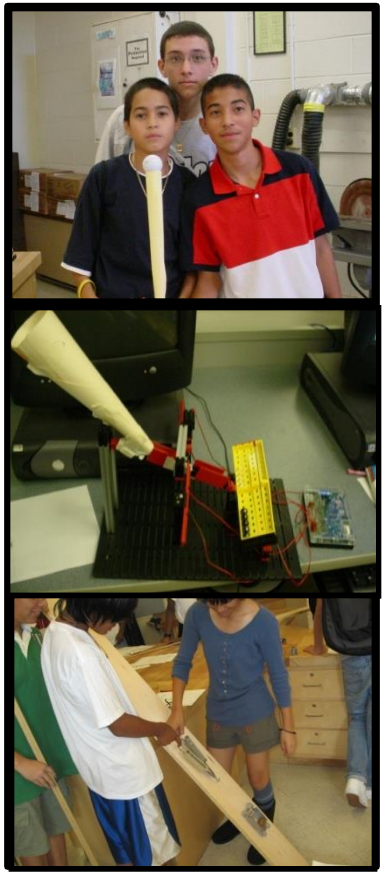


9th Grade or Middle School

Applications of the design process and 3D solid modeling

Software: Autodesk Inventor

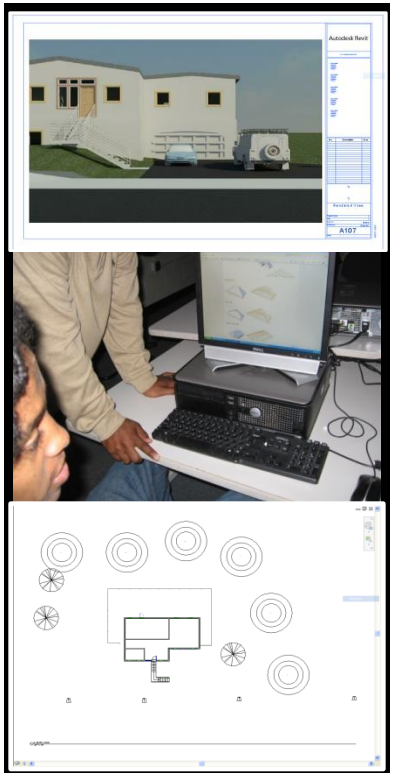
Principles of Engineering (POE)



10th Grade

Applications of math and physics to engineering problems

Civil Engineering and Architecture (CEA)



11th Grade

A survey of site planning and building design for residential and commercial building structures.

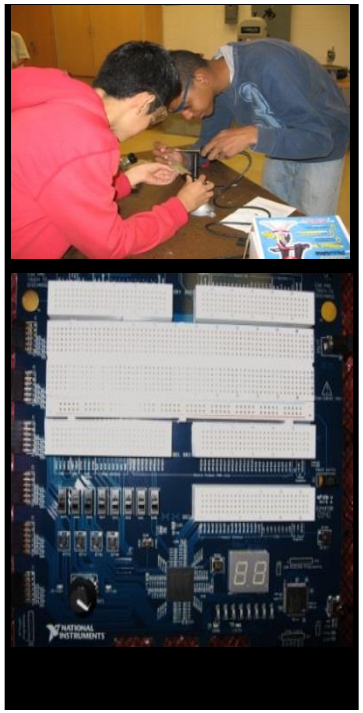
Software: Autodesk Revit

Aerospace Engineering (AE)

11th Grade

The study of aerodynamics, the design of vehicles for use in the atmosphere and space, and, other related topics

Digital Electronics (DE)

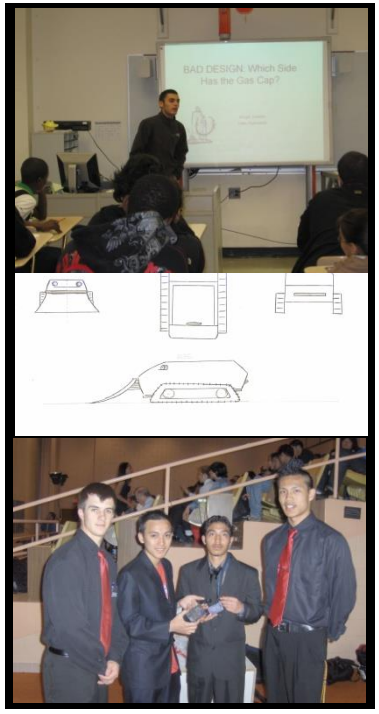


11th Grade

Foundations of sequential and combinational logic design

Software: National Instruments Multisim, Xilinx

Engineering Design and Development (EDD)



12th Grade

In small teams, students follow the design process to develop a solution to a real-world problem

PROJECT LEAD THE WAY PLTW &

Wheaton High School
HOME OF THE KNIGHTS
MCPS CTE Student Excellence Award - 2010
PLTW National Model School 2008 - 2009

Bioscience Academy

9th grade	10th grade	11th grade	12th grade
The Principles of the Biomedical Sciences	Human Body Systems	Medical Interventions	Biomedical Innovations *capstone course*

Career Oriented

Creative

The Bioscience Academy Student

Engaged

Collaborative

Diverse

A hands-on, real-world problem-solving approach to learning

The Principles of the Biomedical Sciences

Investigate health conditions including heart disease, diabetes, sickle-cell disease, hypercholesterolemia, & infectious diseases.

The problem?
What led to the death of a fictional person, and how they might have prolonged it?

Human Body Systems

Interactions of human systems in identity, power, movement, protection, and homeostasis.

The problem?
Real world cases & solving medical mysteries

Medical Interventions

Explore interventions involved in the prevention, diagnosis & treatment of disease

The problem?
"How-To" maintain overall health and homeostasis in the body while following the life of a fictitious family.

Biomedical Innovations

Design innovative solutions for the health challenges of the 21st century.

The problem?
Challenging open-ended problems on clinical medicine, physiology, biomedical engineering, & public health

A community of motivated and supported students and well trained teachers

- Classrooms are equipped with tools for learning STEM.
  - Laptops, Vernier software & probes, Anatomy in clay manikins
- Academy courses help connect biology and chemistry classes to real and interesting topics.
- All teachers go through rigorous 80 hour training at Stevenson University current through a virtual academy.

Students feel supported through opportunities to learn outside of class. Take-Action, field-trips, and internships.

2) How did we positively impact our school with our Academy model?

- Incorporation of new courses focused on career exploration, problem solving, mastery of varied skill sets
  - PLTW Teacher Training and Collaboration of Teachers as a PLC
  - Strengthened teacher practice impacting wide range of students and teachers
    - PLTW Biomedical Trained Teachers Teach – AP Biology, Biology, Matter and Energy
    - PLTW Engineering Trained Teachers Teach – Calculus BC, H. Algebra II
- Partnerships with Professionals
- Creation of Small Learning Communities
  - Administrative (scheduling) and Counselling Support
- Connection with the School Improvement Plan

Leadership

VISION: The diverse community of WHS will develop responsible, global citizens in a positive, safe and caring environment of academic excellence where students, staff, parents and community are proud to belong.

MISSION: Wheaton High School will provide every student a quality education that will give them the opportunity to go to college and be career ready.

Student/Stakeholder Focus

As a result of the root cause analysis, it as revealed that students need:

Frequent opportunities in:

- Literacy Strategies in
  - Reading comprehension
- Being actively engaged in their learning
  - Project-Based Learning

Faculty and Staff Focus

Ongoing staff development through staff meetings, department meetings and PLCs will be given in the areas of project-based learning, student engagement and literacy instruction.

Teachers will experiment with PBL and share their goals and processes. Staff will provide feedback.

PLC time will be used to:

- Collaborate and plan instruction
- analyze formative and summative data
- develop/monitor SMART goals
- Share best practices

Process Management

Instructional Council and departments and PLCs will explore how to experiment with PBL through the content as well as define literacy within their content area.

PLC/content teams will design, implement and monitor action plans related to the department focus using SMART goals. PLCs will regularly post their agenda and action minutes to their folder on tshared.

Strategic Planning

As a result of the root cause analysis, it was determined that through the increase of **student engagement**, we will meet the individual **literacy** needs of students using *comprehension strategies* while also experimenting with *project based learning* to increase academic achievement.

Measurement, Analysis, and Knowledge Management

Student engagement will be measured through walkthrough data based on the following criteria: students on task, percentage of student discourse/talk, questions asked of students.

Our efforts with **PBL and Student Engagement** will be monitored through our PLC SMART goals and action plans.

Our efforts will also be measured through observations, classroom visits, student voice, and surveys.

Organizational and Performance Results

By June 2014, students will demonstrate academic achievement as measured by the following goals:

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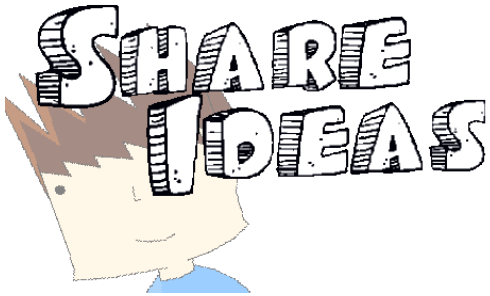
Graduation Rate –
4 Year Cohort – 79.47%
5 Year Cohort – 84.26%

3) How will we differentiate program opportunities for students?

- What avenues have you explored/implemented to extend learning beyond the classroom. What avenues have you explored/implemented to support students that are not meeting content mastery expectations?

- What were the successes and struggles that you encountered with these academic extensions and supports?



Saturday School Mentoring

- Video clip – student reflections
- Who: All AP Biology students, self selected chemistry students, teacher selected Academy students
- What: Students are mentored by USUHS medical school students or by Howard University Chemistry PhD students

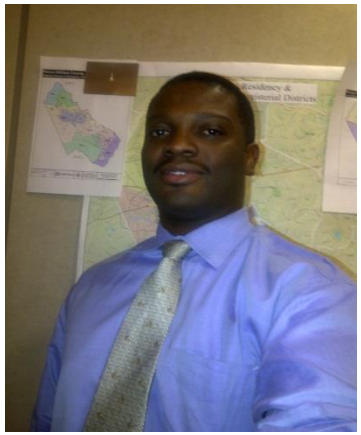
GEMS

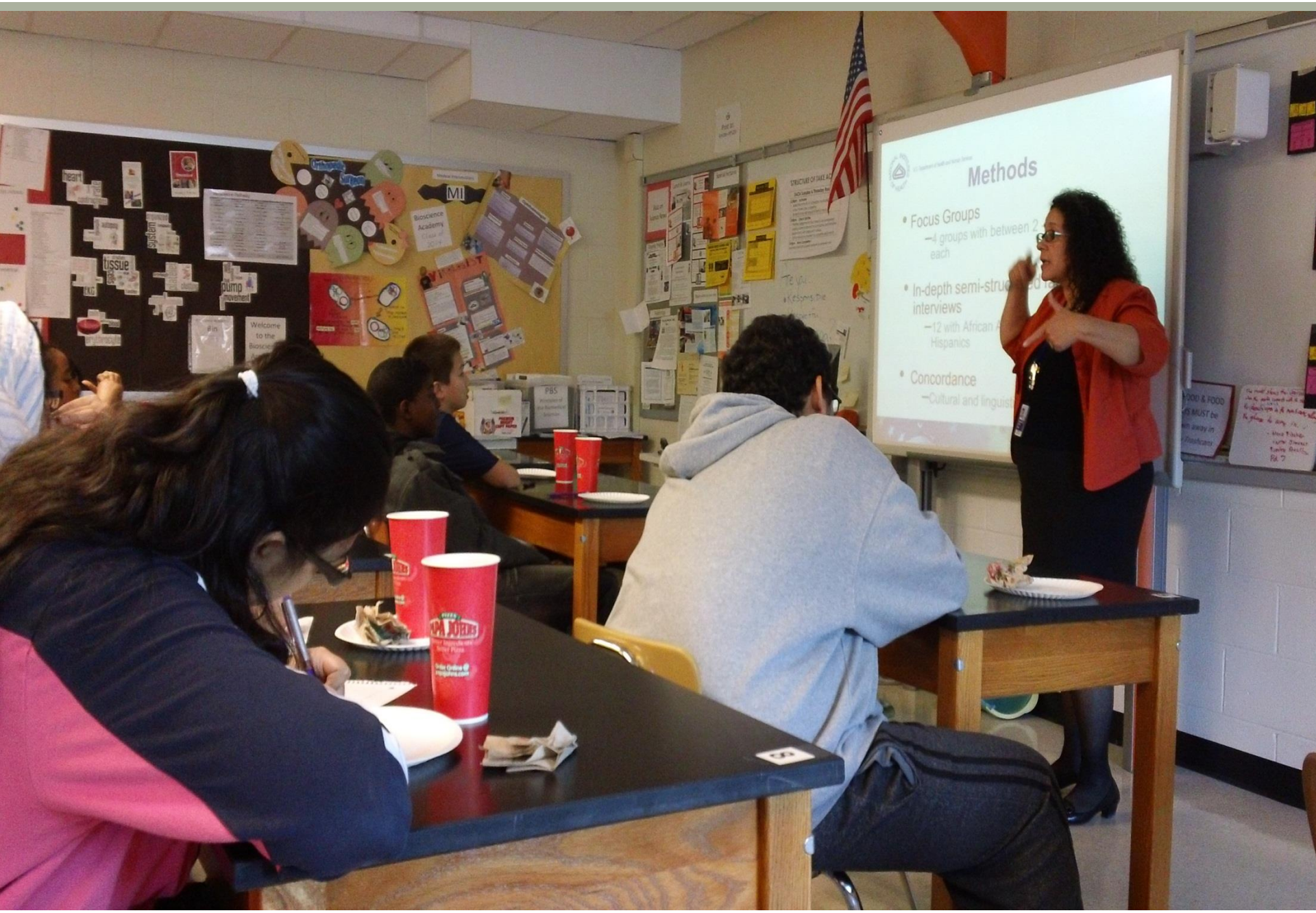
Gains in the Education of Math and Science

100+ Participants in 2012-2013; projected 60 participants for 2014

Thinking Like a Scientist or Engineer

- students are exposed to the types of critical thinking skills demonstrated by scientists and engineers in the work place.
- 1st meeting – professionals' background and discussion with students of a situation/problem typical to the profession
- 2nd meeting - exchange of ideas between the students and the NIH investigator as to how to solve the problem

Nick Gardner Civil Engineer VDOT	Dr. Migdalia Goba Clinical Research NIH	Dr. Hyung Park Robotics NIH	Dr. Carla Easter Genomic Research NIH
			


Methods
Focus Groups
4 groups with between 2
each
In-depth semi-stru
interviews
12 with African
Hispanics
Concordance
Cultural and linguis
Bioscience
Academy
MI
Welcome
to the
Biosci
PBS
CPA POKERS

JEWELL RESEARCH LAB

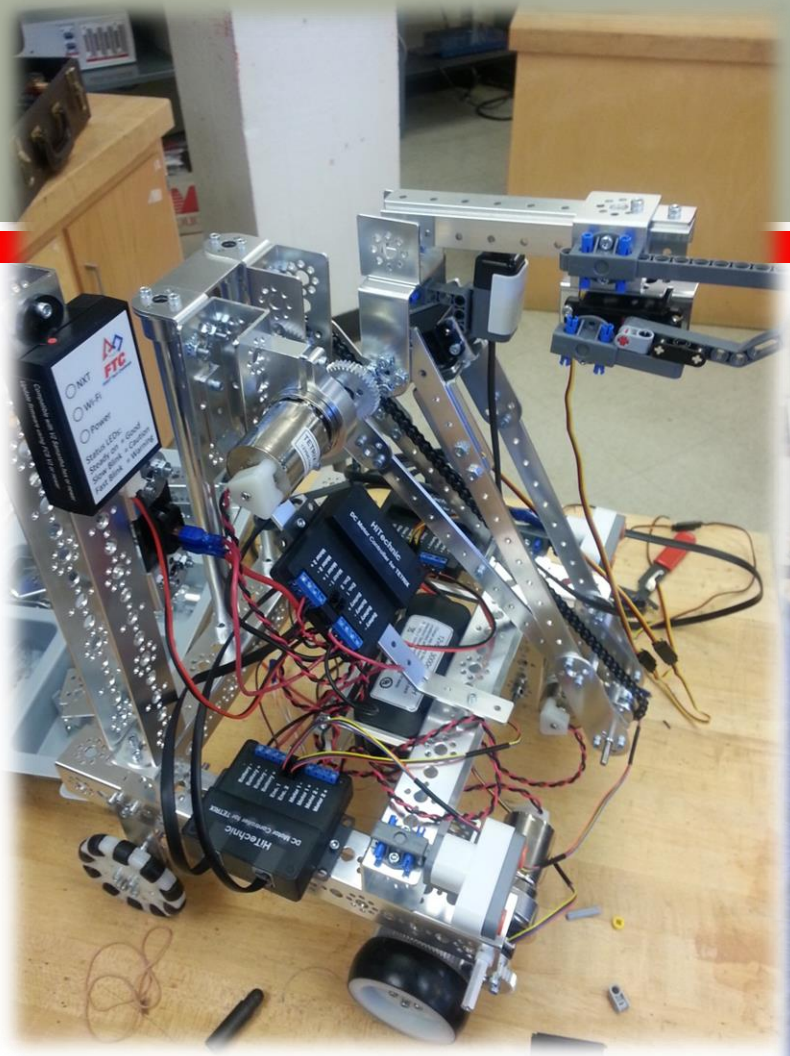
FISCHELL DEPARTMENT OF BIOENGINEERING

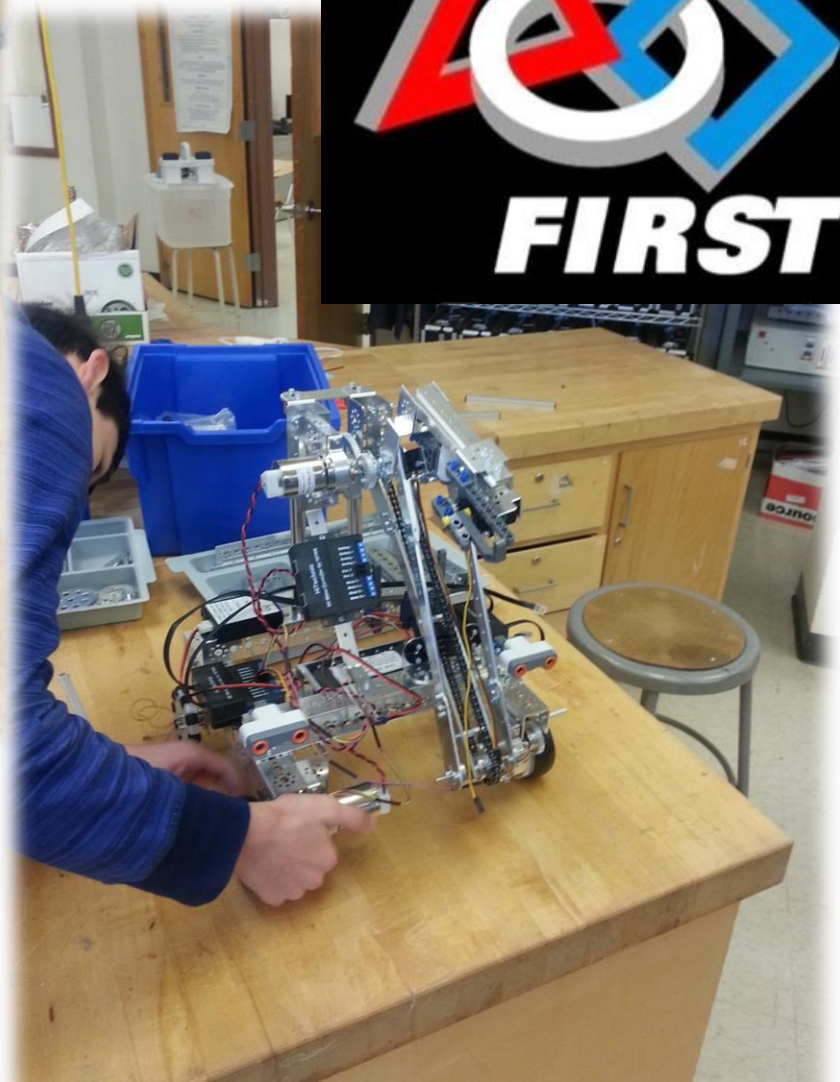
UNIVERSITY OF MARYLAND - COLLEGE PARK

- Students select and research a biotechnology topic.
- Students will prepare and present a research poster around their topic during a poster session and reception at the Univ. of Maryland in the Spring.
- The project will be facilitated by a series of lectures, workshops, assignments, and mentoring by Bioengineering faculty and researchers from the Univ. of Maryland.

Electric Vehicle Club

Robotics Club





MENTOR PROGRA

TECTURE • CONSTRUCTIO

Academic Extensions

sciLIFE Conference

Speakers

WHEATON KNIGHTS

Crime and Punishment Museum

Career Day

Maryland Science Center

Maryland Robotics Day

Friday, Oct. 25

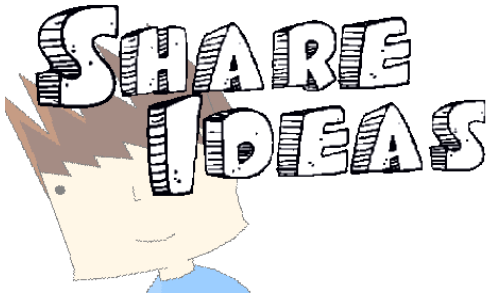
NSBE Jr.



To increase the number of culturally responsible Black engineers who excel academically, succeed professionally, positively impact the community

4) How will we evaluate our programs?

- How will we capture the progress of STEM Academy programs?



4) How will we evaluate our programs?

- How will you capture the progress of STEM Academy programs?
  - Data driven benchmarks
  - Student testimonies
  - Community response
  - Culture shift in the school
  - Instructional shift in the school

4) How will we evaluate our programs?

Program Evaluation and Measures (Please have your principal provide the following information.)

Please answer the following questions:
1. What are the program goals?
2. How do you measure the program's progress toward these goals? Consider the following: suspensions, attendance, eligibility, GPA, math course, AP classes/exams, etc.
3. Please provide the data your school used to determine the program's impact on student achievement.
4. Describe the most significant impact the program has had on your school.
5. Describe the Capstone project.

Program Admissions

1. Does the program require a selection process? ☐ Yes ☐ No
2. What students are eligible to participate in the program?
   ☐ Local School ☐ Regional ☐ Countywide
3. If the program is a local school program, please describe your application and admissions process.

Program Funding

1. Does the program require MCPS to pay an annual affiliation fee to an outside organization? ☐ Yes ☐ No

   If yes, what is the organization's name? _____

   What is the annual cost? $ _____

2. Does the program receive additional funding? ☐ Yes ☐ No

   If yes, please select all that apply and amount for each.

   ☐ Local School $ _____ ☐ Perkins $ _____

Student testimonies

- “Because of the engineering academy, I developed critical thinking and I now understand ‘real world’ problem solving that will prepare me in the future.” –Soulihe Nida (Senior)
- “I learned how to work with others through the skills I learned in the bioscience academy.” –Tania Flores (Junior)
- “The IT academy exposed me to challenging classes that prepared me to excel in college.” –Maynor Navarro (Junior)
- “The bioscience academy has given me lots of opportunities for internships and it overall made me grow as a student and person.” –Camila Serpas (Junior)
- “I learned how to step out my comfort-zone which led to great opportunities such as internships or even studying abroad! Being an active student here at Wheaton made my four years amazing.” –Richard Torres (Senior)

Anthony 2014
Brown University
Gates Scholar

Stephanie 2012
University of Wisconsin
Posse Scholar

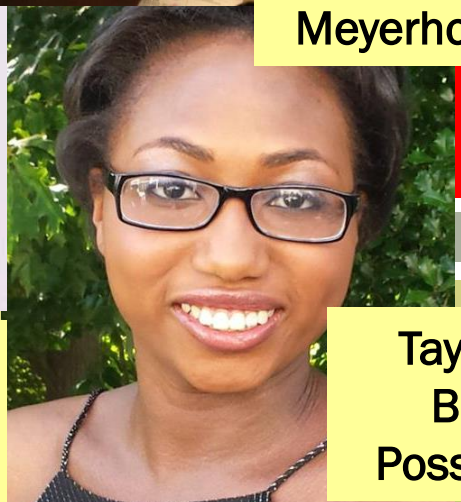
Leuk 2010
Cornell
University
Gates Scholar

Safi 2012
Boston University

Omar 2012
UMBC
Meyerhoff Scholar

Phung 2011
University of Maryland
Gates Scholar

Kenia 2011
Bucknell
Posse Scholar



Taylor 2013
Bucknell
Posse Scholar

Shift in Culture and Instructional Practice

Project Based Learning Essential Elements

Focus on Significant Content • Critical friends	Develop 21st Century Skills • collaboration	Engage Students in In-depth inquiry • risk taking
Tasks organized around a driving question • risk taking • collaboration	Established Need to Know • risk taking • collaboration	Voice and Choice is Encouraged • risk taking
Incorporate Revision and reflection • critical friends	Include a Public Audience • risk taking • risk taking	Red – students Blue - Teachers

Shift in Culture and Instructional Practice

- Culture Committee Mission: Create an atmosphere of trust to promote Project Based Learning (PBL) through risk taking, being a critical friend, and collaboration.

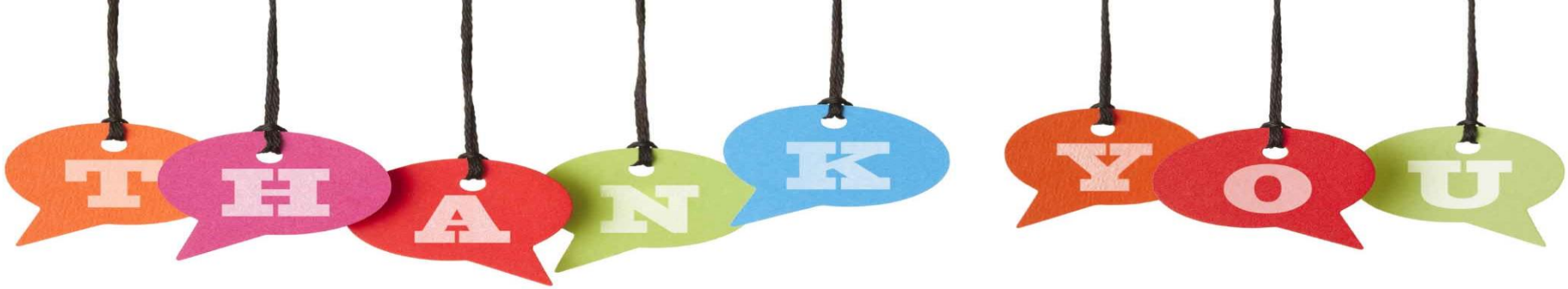
Get on-board the Knight Train

WHS culture

collaboration

risk taking

critical friends



Questions? Anything else you would like to hear about…