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
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?
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...
Collaborative

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

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...

Motivated

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

Invested in Self and Community

- Healthy
- Body awareness
- Globally impacting
- Asset to learning community
- Hunger for knowledge
- Passionate
Academy of Engineering graduates will be able to appropriately communicate their ideas, written and verbal, in a variety of settings. They will be able to work in with other students, staff and business partners to accomplish a shared goal. They will be 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

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>Females</th>
<th>Males</th>
<th>AA</th>
<th>Asian</th>
<th>Hisp</th>
<th>White</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>100%</td>
<td>43%</td>
<td>57%</td>
<td>26%</td>
<td>10%</td>
<td>55%</td>
<td>9%</td>
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<td></td>
<td>1336</td>
<td>572</td>
<td>764</td>
<td>363</td>
<td>146</td>
<td>779</td>
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<th></th>
<th>SpEd</th>
<th>ESOL</th>
<th>Now/Ever ESOL</th>
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<th>Now/Ever FARMS</th>
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<td></td>
<td>12%</td>
<td>16%</td>
<td>55%</td>
<td>61%</td>
<td>82.5%</td>
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<tr>
<td></td>
<td>Total</td>
<td>Male</td>
<td>Female</td>
<td>Asian</td>
<td>Black</td>
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<tr>
<td>Eng App</td>
<td>45</td>
<td>32</td>
<td>13</td>
<td>9</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(71%)</td>
<td>(29%)</td>
<td>(20%)</td>
<td>(29%)</td>
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<tr>
<td>Eng Academy</td>
<td>265</td>
<td>225</td>
<td>40</td>
<td>35</td>
<td>71</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(85%)</td>
<td>(15%)</td>
<td>(13%)</td>
<td>(27%)</td>
</tr>
<tr>
<td>Biomed App</td>
<td>46</td>
<td>10</td>
<td>36</td>
<td>13</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(22%)</td>
<td>(78%)</td>
<td>(28%)</td>
<td>(37%)</td>
</tr>
<tr>
<td>Bioscience Academy</td>
<td>234</td>
<td>65</td>
<td>169</td>
<td>31</td>
<td>66</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(28%)</td>
<td>(72%)</td>
<td>(13%)</td>
<td>(28%)</td>
</tr>
<tr>
<td>Information Technology</td>
<td>111</td>
<td>89</td>
<td>22</td>
<td>11</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(80%)</td>
<td>(20%)</td>
<td>(10%)</td>
<td>(26%)</td>
</tr>
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</table>

701
Program Participants Representative of School

Demographics

Percent of Population

- White
- Hispanic
- Black/Afr. Am.
- Asian/Pac. Isl.

Wheaton 2012: 60% White, 35% Hispanic, 25% Black/Afr. Am., 10% Asian/Pac. Isl.
Engineering 2012: 60% White, 27% Hispanic, 10% Black/Afr. Am., 10% Asian/Pac. Isl.
Wheaton 2013: 60% White, 33% Hispanic, 23% Black/Afr. Am., 8% Asian/Pac. Isl.
BioScience 2013: 53% White, 33% Hispanic, 8% Black/Afr. Am., 7% Asian/Pac. Isl.
Engineering 2013: 61% White, 14% Hispanic, 9% Black/Afr. Am., 11% Asian/Pac. Isl.
Wheaton 2014: 55% White, 26% Hispanic, 14% Black/Afr. Am., 9% Asian/Pac. Isl.
BioScience 2014: 45% White, 39% Hispanic, 26% Black/Afr. Am., 11% Asian/Pac. Isl.
Engineering 2014: 42% White, 27% Hispanic, 26% Black/Afr. Am., 11% Asian/Pac. Isl.
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?
### Performance of Students on STEM related AP exams

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of Participants</th>
<th>Percentage % scored 3 or above</th>
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<tbody>
<tr>
<td>2008</td>
<td>0</td>
<td>0</td>
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<tr>
<td>2009</td>
<td>5</td>
<td>5</td>
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<td>2010</td>
<td>10</td>
<td>10</td>
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<tr>
<td>2011</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>2012</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>2013</td>
<td>25</td>
<td>25</td>
</tr>
</tbody>
</table>

**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

### Participants in STEM Based AP Courses

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of Participants</th>
<th>Percentage 3+</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>10</td>
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<td>2011</td>
<td>15</td>
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<tr>
<td>2012</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>2014</td>
<td>35</td>
<td></td>
</tr>
</tbody>
</table>

**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

Percentage of Seniors passing Biology HSA

Percentage of Seniors passing Math HSA
### Graduation Rate and Money Earned for College

#### Program Completers

<table>
<thead>
<tr>
<th>Graduation Year</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BioScience</strong></td>
<td>41</td>
<td>40</td>
<td>44</td>
</tr>
<tr>
<td><strong>Engineering</strong></td>
<td>61</td>
<td>41</td>
<td>55</td>
</tr>
</tbody>
</table>

#### Notable Institutions that students now attend

- **PLTW Biomedical**
  - Boston University
  - University of Wisconsin, UMD
  - Ohio State University
  - Bucknell
  - Colby College, UMD
  - Colgate, Brown, UMD (8), UMBC
  - Morehouse College, UMD, BYU, UMES

- **PLTW Engineering**
  - UMD (5), UMBC (2), Bucknell
  - George Mason, Tufts University
  - UMD (7), UMBC (3), Embry-Riddle, George Mason, Purdue

#### Money Earned for College

- 2012: 2.3 million
- 2013: 2.7 million
- 2014: 6.3 million

- 2012: 1.1 million
- 2013: 1.3 million
- 2014: 1.1 million
<table>
<thead>
<tr>
<th>Year</th>
<th>Program Completers</th>
<th>Money Awarded for College</th>
<th>Notable Institutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>31 (21 completed internship)</td>
<td>667,000</td>
<td>UMBC Meyerhoff Scholar, UMCP</td>
</tr>
<tr>
<td>2013</td>
<td>8</td>
<td>868,866</td>
<td>John Hopkins, UMD (3), Colgate U, Tufts U</td>
</tr>
<tr>
<td>2014</td>
<td>11</td>
<td>900,000</td>
<td>MIT, UMCP</td>
</tr>
</tbody>
</table>
Graduation Rate and Money Earned for College

Students Earning College Credit

- BioScience
- Engineering

Scholarship Dollars Earned

Number of Students

Students Earning College Credit

- BioScience
- Engineering

Dollars (in millions)

FARMS Rate

- WHS
- BioScience
- Engineering

Percentage

Year:
- 2012
- 2013
- 2014
Project Lead the Way (PLTW) Pre-Engineering program (2004, 2010)

Philosophy
- Engineering design process
- Problem based learning
- Hands-on experiences
- Teamwork
- Communication
- Documentation
5 full year courses: 3 foundations, 1 elective, 1 capstone

- **IED**
- **POE**
- **DE**

**Foundations**

- **AE**
- **CEA**

**Electives**

- **EDD**

**Capstone**

- **MC**
- **UMCP**

**Early College**

*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

**10th Grade**

Applications of math and physics to engineering problems

Principles of Engineering (POE)
A survey of site planning and building design for residential and commercial building structures.

Software: Autodesk Revit

11th Grade

Aerospace Engineering (AE)

The study of aerodynamics, the design of vehicles for use in the atmosphere and space, and other related topics
11th Grade

Foundations of sequential and combinational logic design

Software: National Instruments Multisim, Xilinx

12th Grade

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

9th grade
The Principles of the Biomedical Sciences

10th grade
Human Body Systems

11th grade
Medical Interventions

12th grade
Biomedical Innovations capstone course
The Bioscience Academy Student

Career Oriented

Creative

Engaged

Collaborative

Diverse
<table>
<thead>
<tr>
<th>The Principles of the Biomedical Sciences</th>
<th>Human Body Systems</th>
<th>Medical Interventions</th>
<th>Biomedical Innovations</th>
</tr>
</thead>
<tbody>
<tr>
<td>The problem? What led to the death of a fictional person, and how they might have prolonged it?</td>
<td>The problem? Real world cases &amp; solving medical mysteries</td>
<td>The problem? “How-To” maintain overall health and homeostasis in the body while following the life of a fictitious family.</td>
<td>The problem? Challenging open-ended problems on clinical medicine, physiology, biomedical engineering, &amp; public health</td>
</tr>
</tbody>
</table>
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
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

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**

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.
**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.
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**Graduation Rate** –

- 4 Year Cohort – 79.47%
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**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.

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**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.
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?
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
Gains in the Education of Math and Science

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

<table>
<thead>
<tr>
<th>Nick Gardner</th>
<th>Dr. Migdalia Goba</th>
<th>Dr. Hyung Park</th>
<th>Dr. Carla Easter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Civil Engineer</td>
<td>Clinical Research</td>
<td>Robotics</td>
<td>Genomic Research</td>
</tr>
<tr>
<td>VDOT</td>
<td>NIH</td>
<td>NIH</td>
<td>NIH</td>
</tr>
</tbody>
</table>
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
To increase the number of culturally responsible Black engineers who excel academically, succeed professionally, positively impact the community.
How will we capture the progress of STEM Academy 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.)

<table>
<thead>
<tr>
<th>Please answer the following questions:</th>
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<tbody>
<tr>
<td>1. What are the program goals?</td>
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<tr>
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<tr>
<td>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.</td>
</tr>
<tr>
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<tr>
<td>3. Please provide the data your school used to determine the program’s impact on student achievement.</td>
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<tr>
<td>4. Describe the most significant impact the program has had on your school.</td>
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</tr>
<tr>
<td>5. Describe the Capstone project.</td>
</tr>
</tbody>
</table>
## 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  $
“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)
<table>
<thead>
<tr>
<th>Focus on Significant Content</th>
<th>Develop 21st Century Skills</th>
<th>Engage Students in In-depth inquiry</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Critical friends</td>
<td>• collaboration</td>
<td>• risk taking</td>
</tr>
<tr>
<td>Tasks organized around a driving question</td>
<td>Established Need to Know</td>
<td>Voice and Choice is Encouraged</td>
</tr>
<tr>
<td>• risk taking</td>
<td>• risk taking</td>
<td>• risk taking</td>
</tr>
<tr>
<td>• collaboration</td>
<td>• collaboration</td>
<td></td>
</tr>
<tr>
<td>Incorporate Revision and reflection</td>
<td>Include a Public Audience</td>
<td>Red – students Blue - Teachers</td>
</tr>
<tr>
<td>• critical friends</td>
<td>• risk taking</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• risk taking</td>
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</tr>
</tbody>
</table>
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
Questions? Anything else you would like to hear about...