MHS Science Presentation

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WHY ARE WE HERE?

Philosophical Approach
Pragmatic Approach

An Outline of Tonight's Presentation:

- An Overview of our Science Program
- Why Physics First?
- What does instruction look like in the Physics classroom?
- Highlight new aspects of the physics program being implemented in 2014-2015

NJ State Requirements

NJ HIGH SCHOOL
GRADUATION REQUIREMENTS

Science	**15 credits** ▪ 5 credits in laboratory Biology/Life Science or the content equivalent ▪ Lab Chemistry and/or Physics and/or Environmental Science ▪ One additional laboratory/inquiry-based science course

The Traditional HS Science Course Sequence

Grade 9

Biology

or

Environmental Science

Grade 10

Biology

or

Chemistry

Grade 11

Chemistry

or

Physics

or

Environmental Science

Grade 12

No Science

or

Science Elective

or

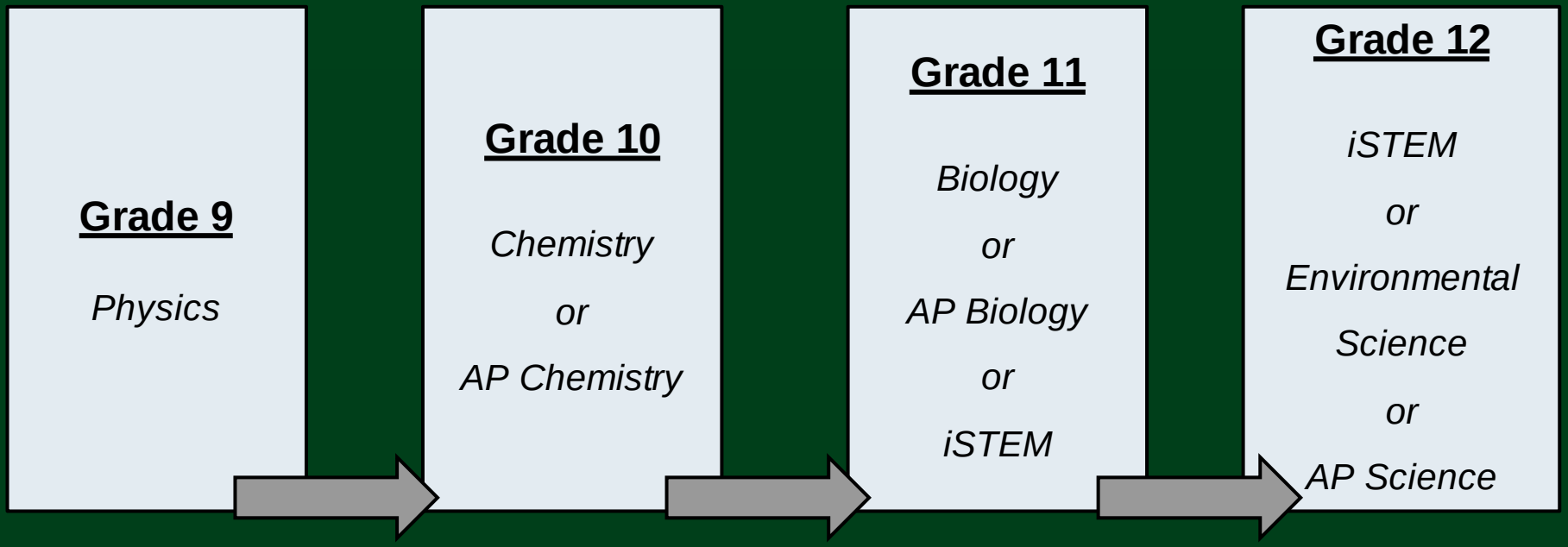
Physics

or

Environmental Science

Originated in 1894!

The MHS Science Course Sequence (since '02)



- 100% of MHS students take Physics

Why Physics First...*or rather…*
Why Biology Last?

- The Future of STEM in the U.S
- % of BAs in STEM Fields

"We are not producing, in this country, in America, enough young people going into science, technology, and engineering - the fields that are going to be essential for entrepreneurship and innovation in the 21st Century"

-- Thomas Friedman, *The World is Flat*

Why Physics First...*or rather…*
Why Biology Last?

- The Ghost of Physics Past
- Laying the Intellectual Foundation
- Physics and Math
- What about other districts?
- Never-ending Curricular Work

MHS Science Program History

- 2001-2002
  - Course Revision (half year classes)
- 2002-2003
  - First year of 9th grade full-year physics
- 2004-2005
  - Modeling Instruction Introduced
- Central Jersey Modeling Institutes
  - Physics (2009,2010)
  - Chemistry (2010,2011)

MHS Science Program Growth

Year	MHS Population
2002-03	911
2007-08	1675
2012-13	1740
2014-15	1715

MHS Science Program Growth

Year	MHS Population	AP Enrollment
2002-03	911	66
2007-08	1675	190
2012-13	1740	436
2014-15	1715	443

MHS Science Program vs. Other Districts

Comparisons

AP Science Enrollment 2012-13

School	Total Enrollment	# of Students Taking AP Science	Percent of AP Science
MONTGOMERY	**1740**	**436**	**25.1%**
Hunterdon Central	2946	249	8.4%
Bridgewater-Raritan	2794	328	11.7%
Princeton	1445	146	10.1%
WWP-S	1599	178	11.1%
WWP-N	1610	207	12.9%
Hopewell	1209	115	9.5%
Milburn	1522	137	9.0%

MHS Science Program Sequence

Physics	- 4 levels
Chemistry	- 4 levels
Biology	- 4 levels
Environmental Science	- 2 levels
iSTEM (63)	- 1 level

Levels

General College Prep

Honors AP

What is Science Instruction?

- *there are "those who see what they believe and those who believe what they see."*
  Owen H. Wangensteen

- *"Science is a way of thinking much more than it is a body of knowledge."* Carl Sagan

An Introduction to Modeling

- WNET News Article on Modeling Instruction

  In this video Seth Guiñals-Kupperman, a Physics teacher in the High School for Math, Science and Engineering in NY, explains how he uses Modeling Instruction to make the course content more coherent and meaningful for his students.

Physics First & Modeling Instruction

- ***Construct and use*** **scientific models**
- **Use multiple representations to construct scientific model.**
- **Small set of core content models enhancing coherence within and among courses**
- **Build models through evidenced-based claims**
- **Modeling as the *procedural core* of scientific & mathematical knowledge**

MHS Constructivist vs. Traditional

cooperative inquiry	**vs**	**lecture/demonstration**
student-centered	**vs**	**teacher-centered**
active engagement	**vs**	**passive reception**
student activity	**vs**	**teacher demonstration**
student articulation	**vs**	**teacher presentation**
evidence based labs	**vs**	**textbook information**
conceptual	**vs**	**mathematical**

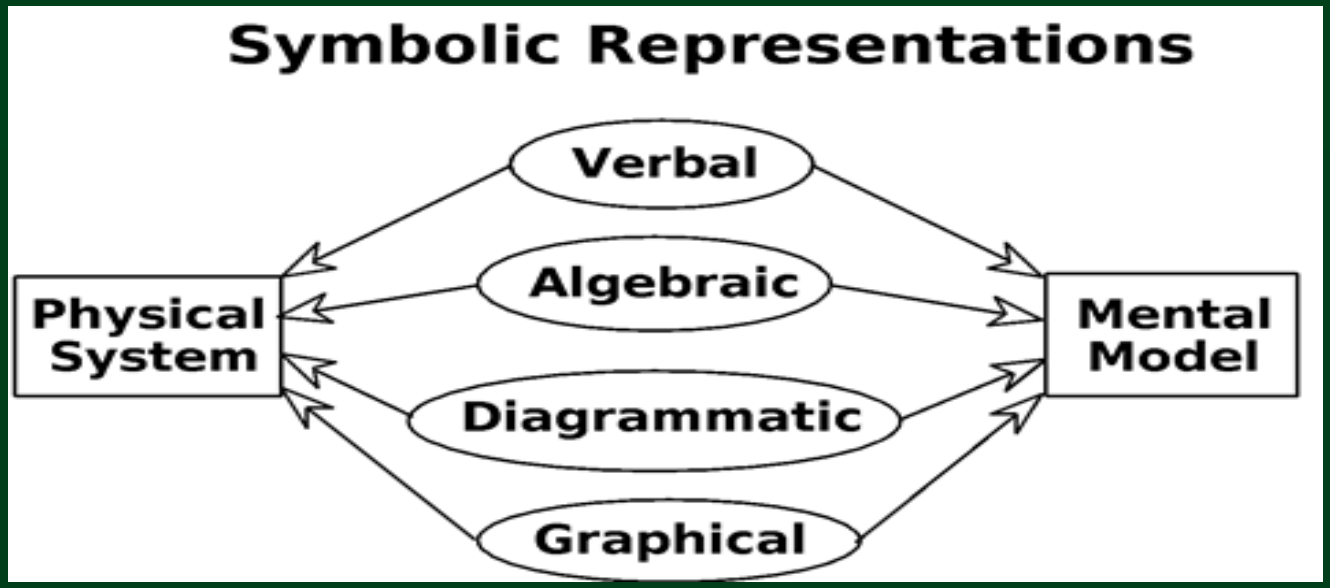
Models vs Problems

- The problem with problem-solving
  - Students come to see problems and their answers as the units of knowledge.
  - Students fail to see common elements in novel problems.

"But we never did a problem like this!"

- Models as basic units of knowledge
  - A few basic models are used again and again with only minor modifications.
  - Students identify or create a model and make inferences from the model to produce a solution.

What Do We Mean by Model?



- with explicit statements of the relationships between these representations

Models vs Problems

- **Objectives:**
  - to improve the quality of scientific discourse.
  - move toward progressive deepening of student understanding of models and modeling with each pass through the modeling cycle.
  - get students to see models everywhere!
- **Ultimate Objective:**
  - autonomous scientific thinkers fluent in all aspects of conceptual and mathematical modeling.

Parent-Student-Teacher Communication

- Six Parent Forums Hosted: Spring 2014
- UMS PTA Sponsored Modeling Workshop

February 19th , 2015

6:30-8:00PM in UMS Media Center

- Student Advisory Group - 8th Gr. Transition
- Student STEM Board
- 24/7 Access to Genesis Gradebooks
- Digital Resources & email blasts

Shared Resources

- Science Department Website
- After School Assistance
  - Tuesday, Wednesday and Thursday
- Study Hall
  - Small Group Sessions
- S.O.A.R. summer preview courses
- MHS Guidance

Ongoing Professional Collaboration and Training

- *How Students Learn in the Science Classroom.*
- *Next Generation Science Standards*

  The vision represented in the Framework is new in that students must be engaged at the nexus of the three dimensions:

  1. Science and Engineering Practices,
  2. Crosscutting Concepts, and
  3. Disciplinary Core Ideas.

Ongoing Professional Collaboration and Training

- University/ College Partnerships
  - Princeton University
  - Rider University
  - Raritan Valley Community College
  - Arizona State University
  - Rutgers University
  - Columbia University - Teachers' College
- Professional Organizations
  - American Modeling Teachers' Association
  - American Association of Physics Teachers
  - STEMTeachersNYC

Building a Common Experience

- Enhancing consistency
- Establishment of Collaborative Learning Teams
  - Development of common assessments
  - Sharing of instructional strategies
  - Analyzing areas of strength and weakness
- Regular conversations are happening
- Progress being assessed

Assessment

- Increasing quantity of assessments in physics
  - Necessary transition from 2 assessments/ marking period
  - Teachers have increased both the number of assessments and types of assessments
  - Continue working on developing quality assessments that demonstrate student mastery of physics content
- This increase aligns with our SEL goals

Ongoing Professional Collaboration and Training

- S.O.A.R. Course Previews: HS Team Teaching
  - Mastering the art of modeling instruction
- S.O.A.R. *Responsive Teaching in Science* Workshop and Student Course
  - Exploring the benefits of modeling instruction to engage learner in grades 2-8

Positive Points

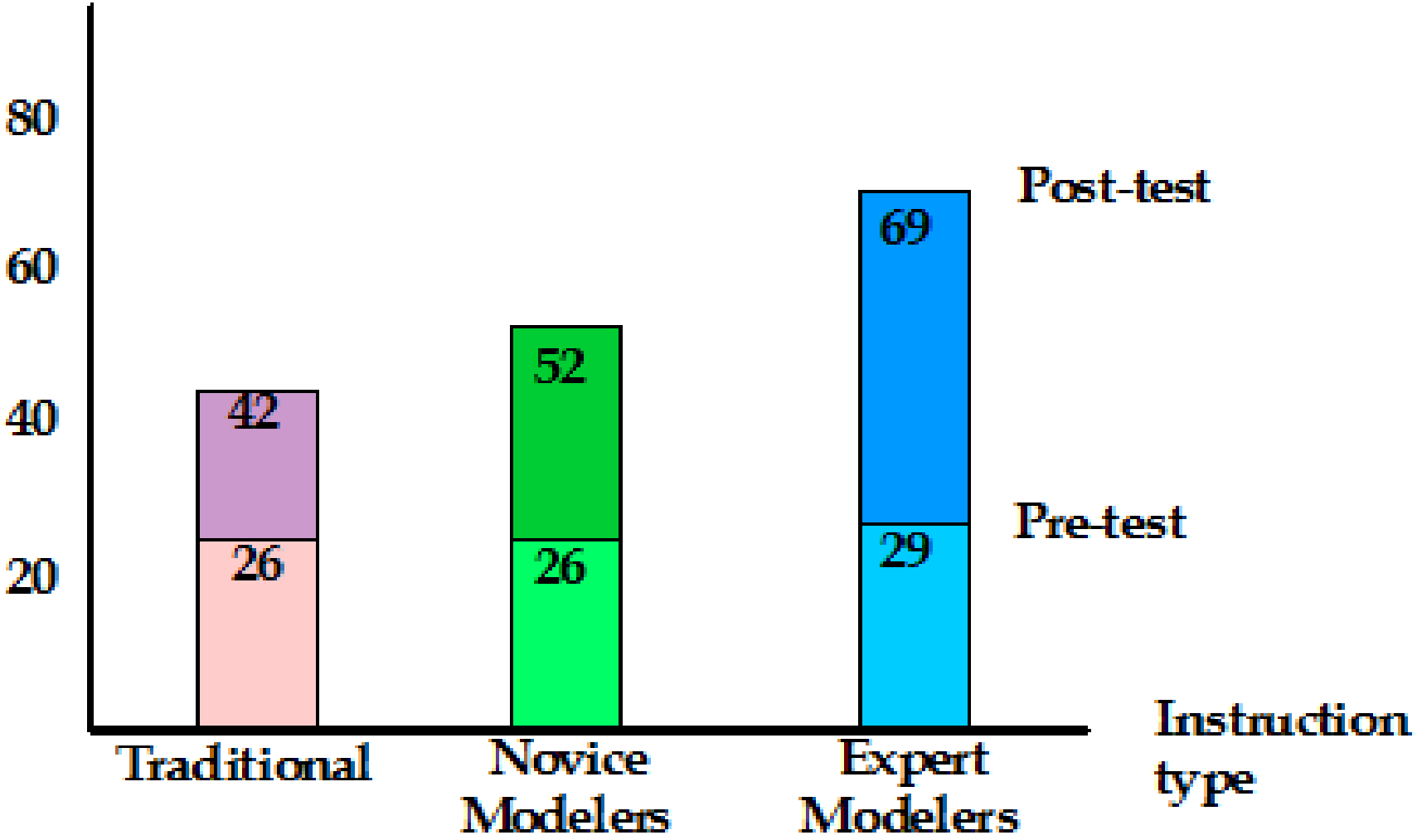
- Students getting into great schools
  - •Student Advisory expressed positive changes in Physics this year
  - •Students engaged in science co-curriculars
  - •Pre/Post assessment data are incredible
  - •AP Physics scores are outstanding

MHS Science-related Extra-Curricular Clubs

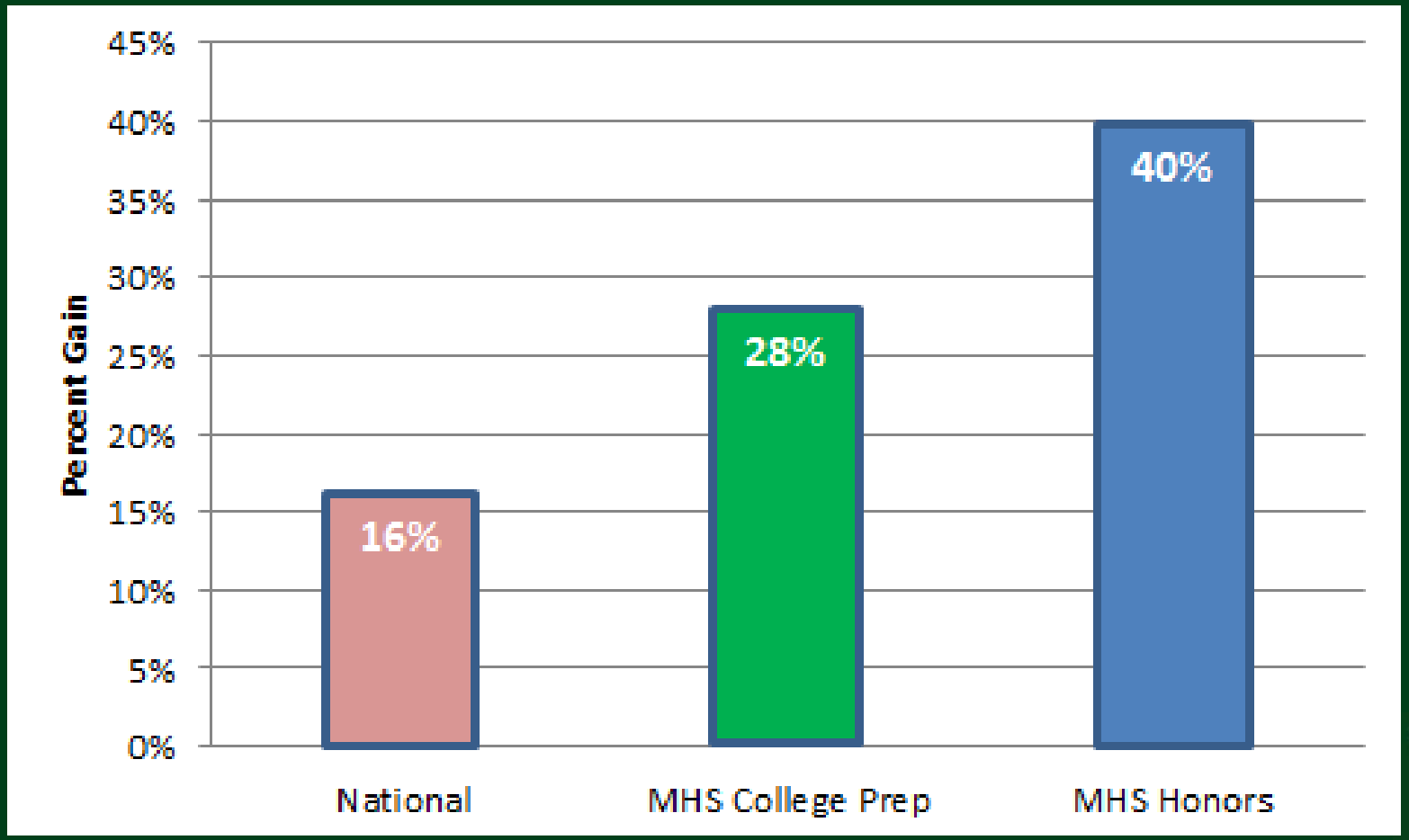
Opportunities (400 students)

-Science League
-MSEA
-Science Bowl
-Volunteer Science Club
-iGEM
-Technology Student Association
-Red Cross Club
-Gamers' Guild
-Physics Olympiad
-Princeton Physics Competition
-Science Olympiad
-Academic League
- Engineering Club
-Inventeam
-Doctors of Tomorrow
-Earthwatchers
-STEM Board
- American Chemical Society
-Chemistry Olympiad
-Biology Olympiad

Nationally Normed Diagnostic Assessment Gains

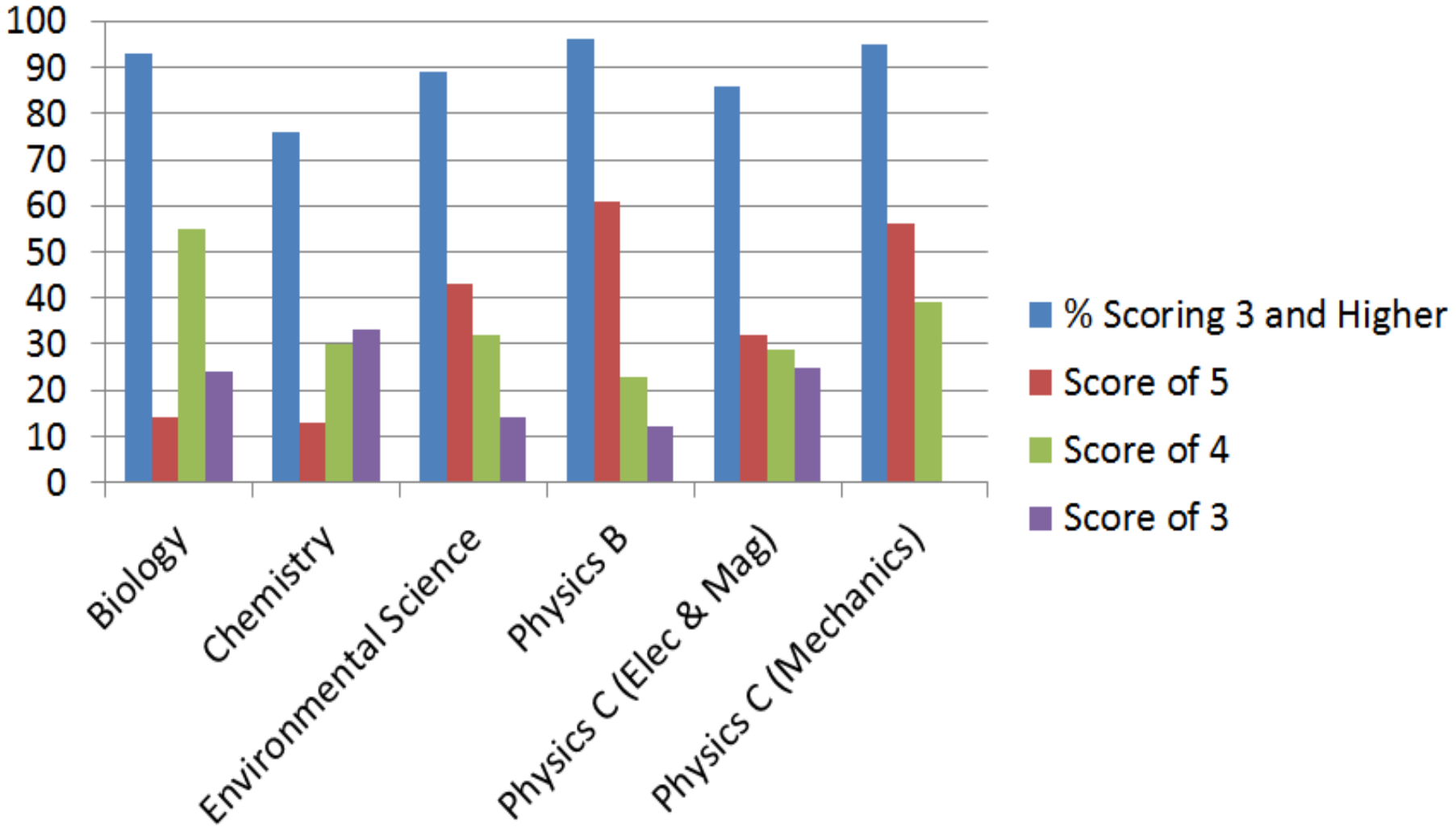


Nationally Normed Diagnostic Assessment Gains 2013-14



MHS Science AP Scores 2014

Compare MHS to National Averages



Looking Ahead

- We are doing well and will continue evaluating and making improvements
- Continued work on:
  - Communication
  - Assessments
  - Instructional strategies
  - Shared resources
- Increased Collaboration:
  - Teacher to teacher
  - Teacher to Dept., Bldg., and Central Office Admin.

The Future of MHS Science Program

Things we never thought about or didn't think we'd ever need – ***until we did***

* Student Management Software
* Smart Boards and projectors
* Lesson Planners
* Webinars and remote PD
* Automated forms; record keeping from the server
* Desk tops to lap tops to tablets
* Online classes
* Global Connect
* School web sites
* Parent portals
* Teacher websites
* YouTube
* All those not mentioned and all those yet to come
* Security cameras
* Google Docs
* BYOD applications
* Blogs
* Flipped classrooms
* Digital texts

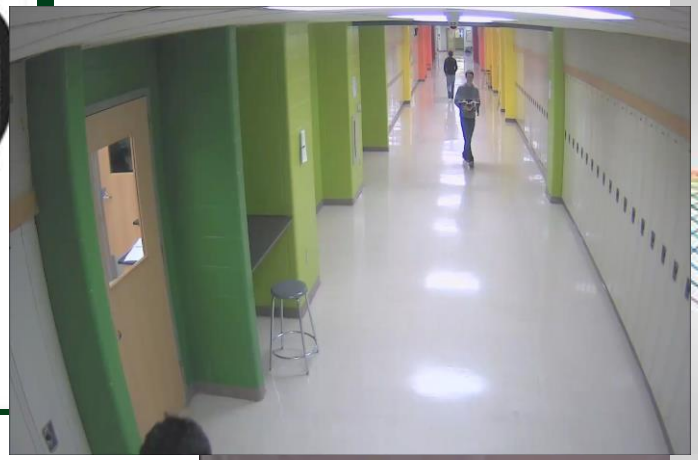
Mark J. Raivetz, Ed.D.

MAKER SPACE

STEM

iGEM

Synthetic Biology
based on standard parts



Identified
TECHNOLOGIES

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