

PUBLIC SCHOOLS of
BROOKLINE

K-12 Science Update

February 17, 2022



Agenda



- Introduction
 - Brookline High School Science - *Focus on Physics*
 - K-8 Science
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- A decorative halftone pattern consisting of a grid of small dots, with the density of the dots increasing towards the bottom right corner of the slide.



BHS Physics

AP Physics

Merged two courses into one, due to changes in the exams, and inequity in the course selection process

Future Work

9th Grade Physics in 22 Tappan

AP Physics Exams

| BHS Course | AP Physics C | AP Physics 1&2 |
|-------------------|--|--|
| AP Exams | <ul style="list-style-type: none">• <i>AP Physics C: Mechanics</i>• <i>AP Physics C: Electricity & Magnetism</i> <p><i>Representing two collegiate semesters of calculus-based Physics for Physics and Engineering majors</i></p> | <ul style="list-style-type: none">• <i>AP Physics 1</i> <p><i>Formerly many algebra-based topics, now just algebra-based Mechanics due to pandemic. Intended to be a full year 11th grade course.</i></p> <ul style="list-style-type: none">• <i>AP Physics 2</i> <p><i>Algebra-based Electricity, Magnetism, Thermodynamics, Waves, Modern Physics. Intended to be a full year 12th grade course.</i></p> |

Timeline of BHS Physics

2001 - New Course

AP Physics B
joins with
AP Physics C

2020 - Begin to Merge AP Courses

Pandemic forces
many changes

1998

BHS Pilots 9th grade
Physics

2017 - Increase in AP Physics C Enrollment

As the AP Calculus BC
requirement was dropped

Future

Focus on eliminating
barriers, and coding

Use enrollment and
student engagement as
indicators of success

Students asked...

Which one is harder?

The one with Calculus?

“Am I good enough?”

Imposter syndrome impacts female identifying students and students of color.

Which one is more fun?

Topics imply difficulty

AP Physics C has classic physics content

AP Physics 1&2 included fluid dynamics, modern physics, and more

Which one is easier?

The one without Calculus?

These students could take AP Physics C with some support with Calculus techniques.

De Facto Levels in AP Physics

Exam Confusion

4 AP Physics Exams in 2 Courses

Students have misunderstood the difference between these two courses

College acceptance dictates inequity

Bias

A persistent perception that AP Physics C has more prestige than AP Physics 1&2, has led to systemic bias within our course selection process and homogeneity in the student populations.

This has led to unnecessary homogeneity in our student populations

Content

AP Physics C has classic physics content

AP Physics 1&2 included fluid dynamics, modern physics, and more

The results...

Who took the “harder” one?

Students who were chosen for Advanced Math at a young age

AP Physics C has had predominantly white male students despite the fact that most of the students who actually struggle in the course are white males.

Who took the “easier” one?

Students who received biased messages

Some students were encouraged to take AP Physics 1&2 thinking it is easy. But this is based on bias and imposter syndrome, not ability.

Two courses merged into one

Students can select a combination of three exams, and are learning to code and model physics

Students can get more support from each other

Teachers can support each other,
and more students
Student and Teacher
Collaboration is Key



Challenges

Curriculum Revision

Restructure the first few units of AP Physics so that the level of rigor in math content builds more gradually and intentionally

Adapt online resources to support this additional exam for AP Physics C: Electricity and Magnetism

Assessment

Retakes are good in theory, but can plateau success

Coding and College Readiness

Are BHS graduates finding the coding units helpful in college?

Are they prepared for all STEM majors?

Next Steps

***AP Physics work is
a microcosm of 9th
grade issues***

22 Tappan

Allow for the architecture of open and collaborative spaces to inspire merging sections together

Use the spaces for more experiential learning

Heterogeneous Group Instruction

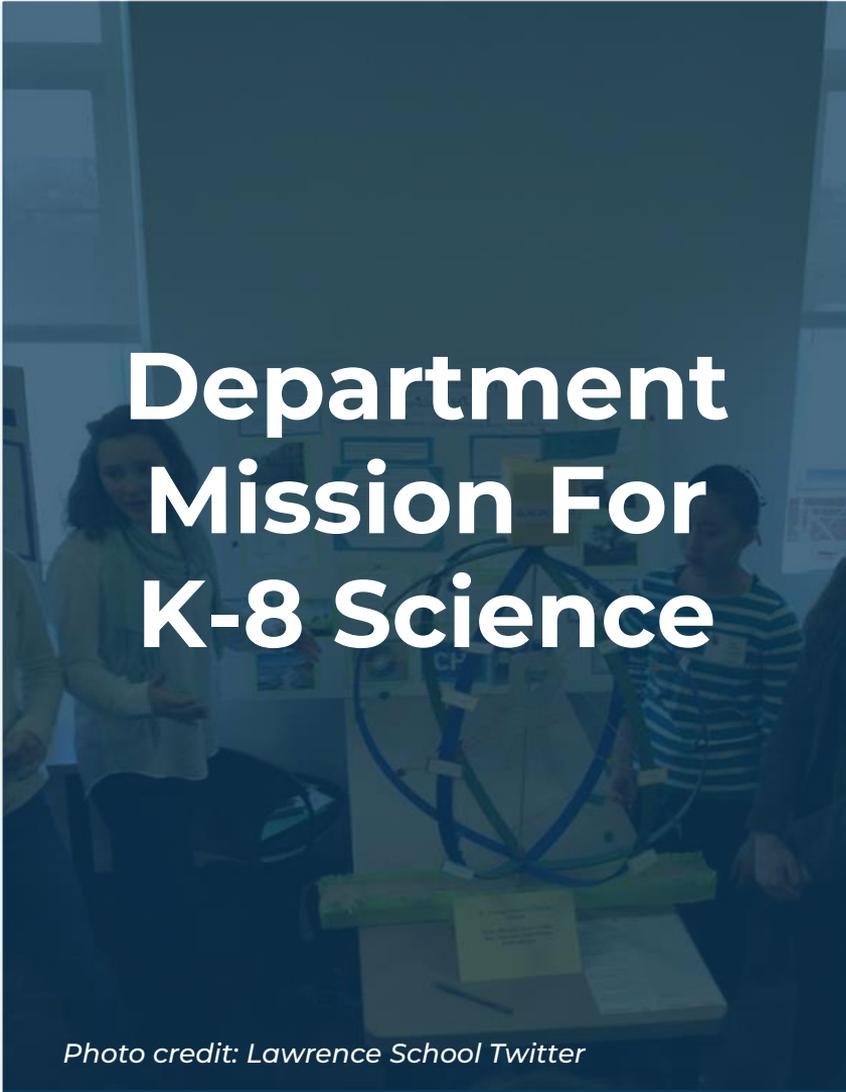
Balance the innovation with traditional assessment

Find units that can easily differentiate into advanced work

Make Collaboration the key

Common Planning Time

Simpler Bell Schedule



Department Mission For K-8 Science

The K-8 Science, Technology, and Engineering (STE) program develops and supports creative, coherent, and culturally responsive K-8 science curriculum which prepares students to be scientifically literate global citizens and provides them the foundation they need to be successful in ongoing science education and STEM careers. This program works to ensure that:

- All students have a deep, enduring understanding of how to think and work as scientists/engineers, as well as a foundation of key scientific/engineering concepts that have real world connections for them throughout their lives.
- All students are curious life-long learners, stewards of the environment, and responsible global citizens who are equipped with the skills they need to innovate and thrive in the 21st century.

WHAT WE TEACH: NGSS and MA Science Standards

In 2012, decades of research and collaboration on science education produced the a [Framework for K-12 Science Education](#).

A collaboration of 26 states released the [Next Generation Science Standards \(NGSS\)](#) in 2013 to meet the vision of the Frameworks.

[MA Science, Technology, and Engineering \(STE\) Standards](#) were updated in 2016, and are closely aligned with NGSS.

Old vs. New

Previous Standards

- Focused primarily on knowing specific content.
- Scientific method was taught as a separate linear process.
- Very unclear developmental progression for concepts over the course of K-12 schooling.

New Standards

- Focus on a combination of science practice, disciplinary core ideas and cross cutting concepts.
- Evision science and engineering as iterative processes involving 8 different practices.
- Shows clear developmental progression for concepts over the course of K-12 schooling.

Anchoring Phenomena

Students are introduced to a puzzling scientific occurrence, called a “phenomenon.”

Students generate questions and initial models in order to learn more and explain the phenomena.

Over the course of the unit, students engage in activities to answer their questions and revise and refine their models.



Brookline Alignment

Strengths

- Strong culture of using scientific notebooks in instruction.
- Students engage in scientific discourse regularly as part of science classes.
- Teachers embrace hands-on exploration of science concepts.

Areas for Growth

- K-8 science curriculum was last updated between 2010-2015 and is not well align to the new standards.
- K-5 teachers need professional development in new standards and in using phenomena.
- K-5 students need more opportunities to design investigations and analyze data.

Brookline Alignment

| Grade | Current Units | Last Revised | Alignment Notes | Future Vision w/standards |
|-------|--|--------------|---|---|
| 2 | Where does soil come from? Part 1: Life in a Rotting Log and Worm Composting | Dec. 2013 | Little alignment, missing big ideas of comparing environments and diversity of life | Plant and Animal Diversity 2LS2-3(MA), 2LS4-1 (3rd grade currently) |
| | Where does soil come from? Part 2: Changes in Earth | Dec. 2013 | Aligned, but currently rarely reached or taught (Prioritized in 20-21 school year) | Changing Landforms 2ESS2-1, 2ESS2-2, 2ESS2-3, 2ESS2-4(MA) |
| | How and Why do things move? | Dec. 2013 | No alignment to grade 2, some alignment to K and 3rd grade standards. Missing materials and their uses, and chemistry standards | Properties of Materials 2PS1-1, 2PS1-2, 2PS1-3, 2PS1-4, 2PS3-1(MA), 2K-2ETS1-3 |
| 3 | Human Made Structures | Jan. 2015 | Some alignment, mostly aligned with grade 2 standards | Forces and Motion 3PS2-1, 3PS2-3, 3PS2-4, 3.3-5ETS1-1 3.3-5ETS1-2, 3.3-5ETS1-4(MA) |
| | Living Structures: The Skeletal System | Jan. 2014 | No grade 3 alignment, some alignment to grade 4 | Weather and Climate 3ESS2-1, 3ESS2-2, 3ESS3-1 |
| | Mammal Detectives | Oct. 2010 | Some grade 3 alignment, good alignment with grade 4 | Life Cycles and Traits 3LS1-1, 3LS3-1, 3LS3-2, 3LS4-2, 3LS4-3, 3LS4-5(MA) |

Standards Key:

red = standards missing now

orange = standards partially addressed now

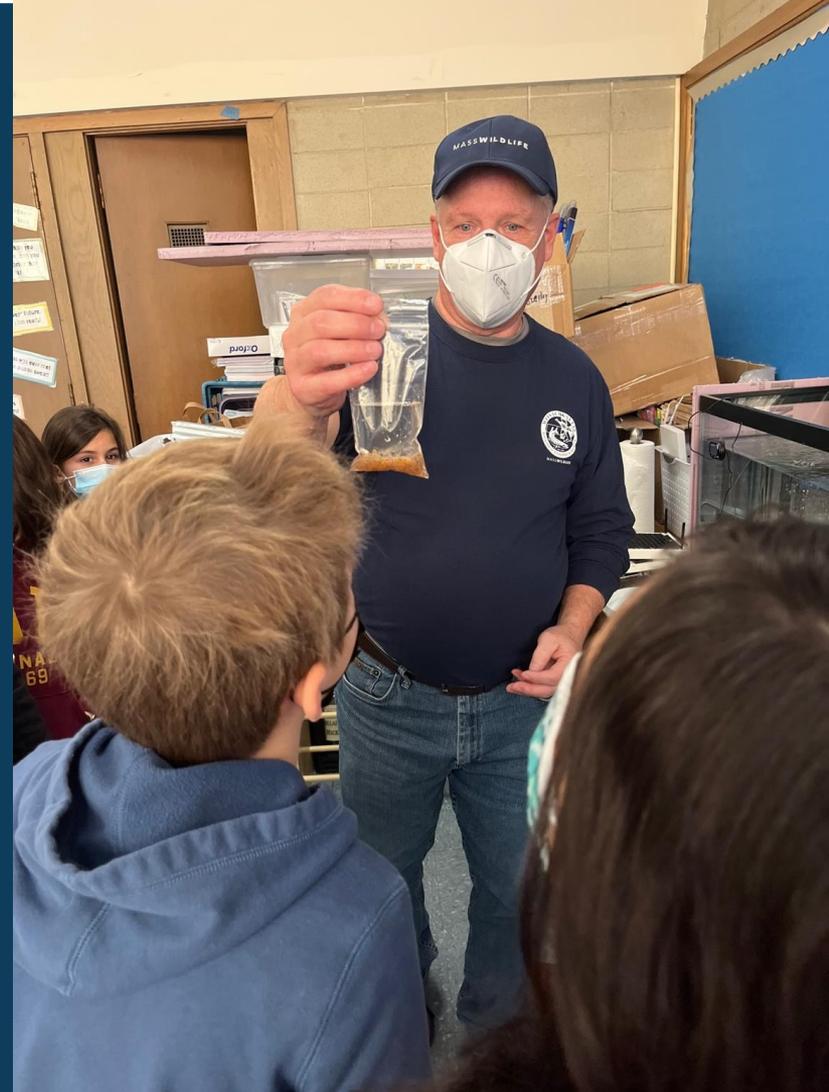
yellow = standards addressed in different grade now

Initial Pilot

Grade 3

- Weather and Climate by Amplify Science
 - Life Cycles and Traits co-written with Brookline teachers
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Trout Eggs Delivery for Life Cycles and Traits



Initial Pilot Findings

Successes

- High levels of engagement
- Integration of math and ELA skills in science lessons
- Development of strong scientific skills

Challenges

- Finding adequate time for science lessons
- Providing adequate professional learning support for teachers
- Financial implications of scaling pilot to the whole district

Draft K-5 Science Revision Timeline

SY 23

Implement revised grade 3 units

Begin piloting additional revised units at new grade levels

SY 25

Continued piloting and implementation of units in additional grade levels

SY 22

Initial pilot of two grade 3 units

SY 24

Continued piloting and implementation of units in additional grade levels

SY 26

Complete implementation of aligned units

Middle School Highlights

- BEF funded Museum of Science Institute in SY 21 focusing on using Anchoring Phenomena
 - Pilot of Open SciEd units in selected classrooms this year
 - Incorporating environmental justice and social justice lens into units
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6th grade student designed experiment to help explain a phenomenon



Going Forward

Continue to Gather Pilot Feedback

- Teacher meetings
- Looking at student work

Prepare for Grade 3 Implementation Next Year

- Refine documentation for teachers
- Develop a professional learning plan

Expand Pilots to new grades

- Run summer workshops for pilot teachers to prepare
- Ensure new units are mindful of diverse representations of scientists and scientific expertise.