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Re: Summer 2023 Curriculum Projects in Science & Technology

Grade 4 Science Revision

Purpose of the Project

The last revision of the 4th Grade Science program occurred in the summer of 2016 following the NJDOE adoption of the Next Generation Science Standards (NGSS) in 2013. The NGSS were restructured into the NJSLS-Science ahead of a tiered implementation: grades 6-12 were to align by September 2016 with grades K-5 having been required to align by September 2017. The curriculum implemented in 2016 relied upon the support of science resource kits from Knowing Science. A K-5 Science Program Evaluation was concluded in the summer of 2020. The results of this evaluation concluded that the supporting materials for Knowing Science did not equip the teachers with the necessary support in content to provide students with opportunities for an enhanced, enriching experience. The program was bolstered with online resources from Mystery Science. The 5 Year Curriculum Revision Cycle was disrupted by COVID 19 and an updated plan to revise the K-5 Science Program was scheduled with Grades 4 and 5 occurring in the summer of 2023, grades 2 and 3 scheduled for the summer of 2024, and grades K and 1 scheduled for the summer of 2025. This project, alongside the Grade 5 Science Revision, are the first phase of this updated curriculum revision cycle aimed at ensuring:

- The Science Curriculum in the BTSD is aligned to the NJSLS-Science
- The scope and sequence of the program fits within the constraints of the elementary schedule where, in Grade 4, Science, Social Studies, and Health must share the 'content block.'
- The resources used to implement the Science Curriculum in the BTSD:
 - Provide the teachers with content support necessary to provide an enriching, inquiry-based experience in science
 - Include assessments that align to the SBRC approach in Bernards Township
 - Support teachers with materials to engage all students and provide access to extension opportunities when necessary/ appropriate

- Are cost effective with an efficient process to complete the annual supply restocking order

Summary of the Project

Prior to the start of the project, a multitude of science resources from an array of vendors were provided to teachers to test within classrooms. Given the deliverables noted above, the teachers determined that continuing to leverage Mystery Science by sustaining the online access as well as expanding the program by purchasing the activity accompaniments, Mystery Packs, would be the best option for meeting all of the needs of the Grade 4 Science program. The team of teachers considered the ‘shared content time’ dynamic of Health, Science and Social Studies, and outlined core activities that all teachers will conduct. These core activities align the experience of the Grade 4 students in science across all four elementary buildings and include common assessments used to report student performance on the SBRC. The science units in Grade 4 include:

- Unit 1: Earth Science Unit: “The Birth of Rocks”
- Unit 2: Physical Science Unit: “Energizing Everything”
- Unit 3: Physical Science Unit: “Waves of Sound”
- Unit 4: Life Science Unit: “Human Machine”

Beyond the core activities, every unit has additional activities which teachers may draw upon to provide extension and enrichment opportunities to the students. These resources are cultivated in a Grade 4 shared Google Drive to ensure all staff have access to instructional materials. Over the summer, the supervisor coordinated with building administration in all four elementary schools to confirm section numbers and ensure that the correct number of resources were acquired to outfit all Grade 4 classrooms across the district. Compared to previous kits, which carried an initial cost of approximately \$3,500 per teacher with annual restocking costs in excess of \$500 per instructor, the cost of Mystery Science Mystery Packs is considerably lower with no upfront kits to acquire. The annual cost is \$350-\$500 per classroom for consumables.

Implementation and next steps

Throughout this first year of implementation, K-5 department time will be used for 4th grade teachers to report out on their experiences with the new science program. This information will be used to revise which activities remain “common/ mandatory” and which remain “for enrichment.” A driving factor in this process is the manner in which the elementary content block is shared by Health, Science and Social Studies.

Grade 5 Science Revision

Purpose of the Project

Similarly to the Grade 4 Science Project, the 5th Grade Science Program was last revised in 2016 and also leveraged Knowing Science. In addition to the revisions to the NJSLS-Science, the 5th grade instructional model has evolved and students now change teachers and receive science content for 50 minutes daily all year long. This project was therefore necessary to both align to the NJSLS-Science as well as update the scope and sequence to align with our current elementary instructional model.

Summary of the Project

The 5th Grade curriculum team had all of the same considerations outlined in the Grade 4 project when it came to identifying needs and determining a science kit/ package to support those needs. Unlike Grade 4, which shares content time between Health, Science, and Social Studies, the Grade 5 program has far more content time during the school year as well as fewer teachers charged with science instruction. Therefore, the team identified a need for a more robust program than Mystery Science could provide. Ultimately, the team elected to support the Grade 5 Science curriculum with Smithsonian Science- a program from Carolina Biological Supply. The program includes access to online resources to foster student learning as well as support teachers with the content. Like Grade 4, the Grade 5 team identified common activities within each unit as well as enrichment exercises should time/ student need allow for additional activities. The units in Grade 5 Science include:

- Unit 1: Matter & Its Interactions (Physical Science)
- Unit 2: Ecosystems (Life Science)
- Unit 3: Earth's Surface Processes (Earth Science)
- Unit 4: Earth's Place in the Universe (Earth Science)

While the cost of the annual supply restock will be comparable to that of Knowing Science, with fewer teachers delivering science content there was a much lower initial cost as fewer kits were required. In 2016, at approximately \$3,500 per kit, the district needed 22 kits in Grade 5. With the restructure in instructional approach to have a few teachers dedicated to science instruction, the number of kits, and, subsequently the cost, are significantly lower. This program is not only far better at addressing both the NJSLS-Science and the instructional needs of the teachers, but it is also far more cost effective to implement and maintain.

Implementation and next steps

The new kits were ordered over the summer and are in various stages of receipt and unboxing. This initial setup always impacts the first year of a new science kit implementation and revisions to years 2+ will be necessary once the teachers familiarize themselves with the equipment and the various activity setups. The most common revisions include shifts between which activities are core/ required and which are supplemental/ used for enrichment.

9th Grade Biology Revision

Purpose of the Project

All RHS science curricula were revised for the implementation of the NGSS/ NJSLS-Science ahead of the September 2016 adoption mandate under the supervision of a previous science supervisor. Prior to COVID 19 resulting in a overhaul of the 5 year curriculum revision cycle, the science department had swapped scheduled projects to prioritize the chemistry program amidst concerns about the curriculum and its alignment to the SAT II Subject Test (these tests have since been abandoned by The College Board). Consequently, the RHS science curriculum revision cycle fell “out of sequence” and was no longer being revised in a sequential manner that allowed changes to ‘walk up’ with an incoming graduating class. The last revision of the Biology curriculum was in 2019 and,

following the impacts of COVID upon the 5 year curriculum cycle, there was an opportunity to reset the sequential approach to revising science curricula. With revisions to the NJSLS-Science, the abandonment of the SAT II Subject Tests (to which Honors Biology, Honors Chemistry, and Honors Physics once aligned), and the implementation of the Rotating Drop Schedule (RDS) at RHS, there were multiple needs for revision within the 9th grade science program.

Summary of the Project

There are three different levels of 9th Grade Biology:

- 120C CP Biology (5 credit; CP weighting)
- 120M Enriched Biology (6 credit; CP weighting)
- 120H Honors Biology (6 credit; Honors weighting)

During the 2019 revision project, a shift in approach to levels in science was implemented. Instead of creating three separate curricula- one for each level- all three appear within a single document. Through this approach, there is better horizontal alignment across these levels with regards to course objectives and curricular expectations. This summer, the Biology team restructured their scope and sequence into the following units:

- Unit 1: Levels of Organization
- Unit 2: Energy & Matter Transfer
- Unit 3: DNA, Protein Synthesis & Cell Division
- Unit 4: Genetics & Heredity
- Unit 5: Evolution

Like in Grades 4 and 5, the Biolog team identified core activities within each unit that will be common across all teachers of the course. This ensures the consistent delivery of high quality instruction for all students. Given the catalog of electronic resources available to BTSD teachers and students, the Biology team elected to keep their current texts as they continue to be accurate resources for the scope of the program's three levels. This decision produced considerable savings to the district. Overall, while the cost of consumable materials continues to rise, supply needs have been streamlined with the implementation of the core activities within each unit and the supply cost per section has therefore been reduced. This, coupled with slightly lower enrollment, has resulted in a slight reduction in the annual operating cost of 9th Grade Biology.

Implementation and next steps

Following the first year of implementation, the teachers will leverage their notes and other reflective documents from their PLCs to update and revise their pacing as well as fine tune the core activities conducted across all teachers of the course.

AP Physics Revision

Purpose of the Project

There are three levels of AP Physics:

- AP Physics 1 (algebra based; predominantly taken by 11th grade students at RHS and this is historically the most popular AP science course at RHS).
- AP Physics 2 (algebra based; predominantly taken by 12th grade students at RHS who completed either Honors Physics or AP Physics 1 in 11th grade)

- AP Physics C (calculus based; predominantly taken by 12th graders at RHS who completed AP Physics 1 in 11th grade).

Physics can be grouped into two categories: ‘Mechanics’ and ‘Electricity & Magnetism (E&M).’ Students in AP Physics C cover both categories at RHS and qualify to take the two exams for AP Physics C. AP Physics 1 and AP Physics 2 each cover selected topics from the two categories of physics and periodically The College Board updates the scope of each course. With the overlap between the three courses, they are always scheduled to be revised at the same time to ensure that AP Physics 1 continues to provide the foundation necessary for success in AP Physics 2 and AP Physics C. This revision did come on the heels of a 2021 revision that aligned with the 5 year curriculum cycle (prior revision was 2016). The disruption to the 5 year cycle from the impacts of COVID 19 caused an overall restructuring of the course revision schedule in science, and, with newly announced course updates from The College Board taking effect in AP Physics in the 24-25 school year, it was logistically more viable to revise the AP Physics program this year to align to the new scope and requirements.

Summary of the Project

As was noted in the purpose, all three levels of AP Physics were revised given upcoming changes to scopes of the courses imposed by The College Board. An overview of all three curricula below outlines how AP Physics 1 provides the foundation for success in either AP Physics 2 or AP Physics C. It also points out how the topics in the two algebra-based courses, AP Physics 1 and AP Physics 2, are covered in greater depth in the calculus-based AP Physics C course.

- AP Physics 1
 - Unit 1: 1D Kinematics
 - Unit 2: Newton’s Laws
 - Unit 3: 2D Kinematics & Forces
 - Unit 4: Applications of Newton’s Laws
 - Unit 5: Circular Motion
 - Unit 6: Energy
 - Unit 7: Momentum
 - Unit 8: Rotational Motion
 - Unit 9: Vibrational Motion
 - Unit 10: Fluids (24-25 implementation)
 - Unit 11: AP Review
 - Unit 12: Electrostatics
 - Unit 13: Electric Circuits
- AP Physics 2
 - Unit 1: Fluids
 - Unit 2: Thermodynamics
 - Unit 3: Electric Force, Field & Potential
 - Unit 4: Electric Circuits
 - Unit 5: Magnetism & Electromagnetic Induction
 - Unit 6: Geometric & Physical Optics
 - Unit 7: Quantum, Atomic & Nuclear Physics

- AP Physics C- RHS students enrolled in this course are eligible to take two different exams:
 - AP Physics C: Mechanics
 - Unit 1: Kinematics
 - Unit 2: Newton's Laws
 - Unit 3: Work, Energy & Power
 - Unit 4: Systems of Particles & Linear Movement
 - Unit 5: Rotation
 - Unit 6: Oscillations
 - Unit 7: Gravitation
 - AP Physics C: Electricity & Magnetism (E&M)
 - Unit 1: Electrostatics
 - Unit 2: Conductors, Capacitors & Dielectrics
 - Unit 3: Electric Circuits
 - Unit 4: Magnetic Fields
 - Unit 5: Electromagnetism

With regards to providing access to AP Science courses, students who take Honors Physics in 11 grade have the opportunity to qualify for either AP Physics 2 or AP Physics C (but there is too much overlap between Honors Physics and AP Physics 1 for students who have completed Honors Physics to take and receive credit for AP Physics 1). Similarly, students who take Enriched Physics in 11th grade can qualify for any of the three AP Physics courses (noting that, with less overlap, students who complete Enriched Physics may take AP Physics 1 for credit). It is worth noting that, given the foundation that AP Physics 1 provides for both AP Physics 2 and AP Physics C, students who completed Enriched Physics are strongly advised, but not required, to take AP Physics 1 if pursuing an AP Physics course.

AP Physics 1 and AP Physics 2 use the same text as the two courses combine to cover both subdivisions of physics- Mechanics and Electricity & Magnetism. As was the case with the 9th Grade Biology project, the teachers found that the text is still a viable resource to support the course. Further, as it passes the AP Audit process, the text is approved by The College Board for use in the course. Given the enrollment in these two courses, the ability to keep the existing texts produces considerable savings for the district.

AP Physics C did identify a need to provide students with access to a new text. That text was presented to the BOECC already and is scheduled for approval at an upcoming Board of Education meeting.

Implementation and next steps

As is the case with 9th Grade Biology, all three levels of AP Physics will adjust scope, sequence, and pacing following the first year of implementation. With AP courses, the data from student AP exams is leveraged to aid in this process and identify areas of the program in need of fine tuning.