D86 Science Program Update

June 9, 2021

D86 Science Departments: Collaboration with our School Board

The D86 Science Department Chairs and Teachers have a long history of collaborative engagement with our School Board. Our goal is to meet the needs of our students and our community, and much of our work has emerged from the communication and direction we have received from our school board leadership over the years.

As times change, the needs and interests of our students and community also change, and therefore so do the needs and interests of our school board. Our department members understand that to do our best work, we must engage in ongoing dialogue and change as well. Please reach out to us with your questions, concerns and ideas as you have them. We look forward to continuing to work together.

AGENDA

1. History of D86 Science Curriculum Alignment
2. Illinois State Science Standards
3. Development of the D86 Science Program
4. Program Updates and Future Work
5. Program Analysis

History of D86 Science Program Alignment

History of D86 Science Curriculum Alignment

2007-2015	Development of Science Essential Curriculum (DuPage Regional Office of Education initiative)
2014	Adoption of the Next Generation Science Standards (NGSS) as the Illinois Science Standards
2016-2018	Development of D86 Guaranteed & Viable Curriculum (CEC) -- Summary
2018-2019	Civil Rights Complaint (including re: alignment between schools) -- New items 1 2
2018-Present	BOE adoption of D86 Strategic Plan
	Dec 2018: BOE directive to D86 Chairs to propose provisional curriculum alignment plans
	March 2019: D86 Science Program Team initiated program sequence options
	May 2019: Science sequence proposal presented to teachers, parents/students for feedback
	Fall 2019: Board/community presentations: October 2019, November 11 and 13, November 2019, January 23, 2020 FAQ sheet

Hinsdale Central's Prior Program: Open Enrollment

"Open Enrollment" means that students at Hinsdale Central Science did not have a sequence for their science courses but could take them in any order based on meeting the prerequisites. Some examples of four-year plans include, **but was not limited to:**

9th grade	10th grade	11th grade	12th grade
Earth Science	Biology	Chemistry	Physics
Earth Science	Chemistry	Physics	AP Course
Biology	Chemistry	Physics	AP Course
Biology	Earth Science	Chemistry	AP Course
Chemistry	Physics	Biology	Earth Science
Chemistry	Earth Science	Physics	Biology

Hinsdale Central's Prior Program: Open Enrollment

Benefits	Drawbacks
- Allowed families to have choice - Provided flexibility based on student interest and needs - Provided a robust earth science curriculum at multiple levels	- Teachers and students did not have a vertically aligned sequence building upon skills or content from 9th to 11th grade - Courses contained students of many grade levels within the same course, at differing levels of academic maturity - Many students did not experience the four core content areas (NGSS) - Students/parents experienced confusion on choosing the "right" courses

Hinsdale South's Prior Program: PCB Sequence

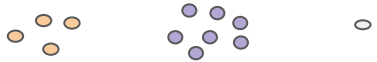
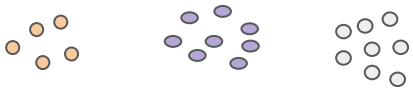
In Hinsdale South's prior program, implemented in 2008,
students took a sequence of courses from 9th grade to 11th grade,
with most AP and elective science courses offered in 11th and/or 12th grade.

9th grade	10th grade	11th grade	12th grade
Geophysics or Physics H	Chemistry or Chemistry Honors	Biology or AP Biology	AP Course/ Science Elective

Hinsdale South's Prior Program: PCB Sequence

Benefits	Drawbacks
- Teachers and students experienced vertical aligned courses year-to-year in which skills and content could be built upon - Decreased student/parent confusion on choosing the "right" courses - All students, regardless of background, took the same core science courses at the same grade level (albeit at differing skill levels -- regular vs. honors/AP)	- Earth science only integrated in regular level freshman course

Hinsdale South implemented a version of PCB more than a decade ago, which has shown a positive impact on the number of students taking and passing AP science courses.

	HSHS AP Scores during ES/B-C-P sequence (avg 2005-2009)	HSHS AP Scores during P-C-B sequence (avg 2015-2020)
AP Chemistry (3/4/5s)		
APES (3/4/5s)		
AP Physics C (3/4/5s)		
AP Biology (3/4/5s)		

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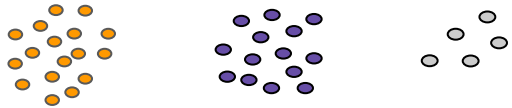
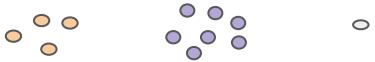
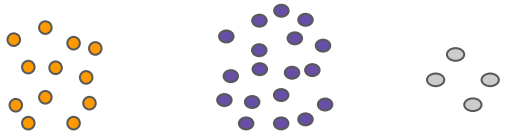
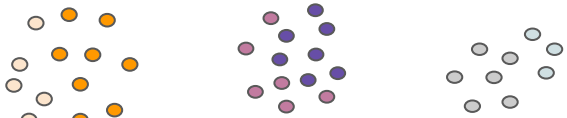
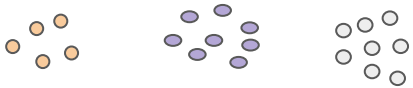
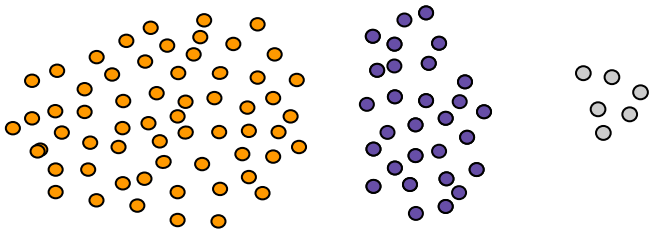
	HSHS AP Scores during ES/B-C-P sequence (avg 2005-2009)	HSHS AP Scores during P-C-B sequence (avg 2015-2020)
AP Chemistry (3/4/5s)		
APES (3/4/5s)		
AP Physics C (3/4/5s)		
AP Biology (3/4/5s)		

Illinois State Science Standards

Illinois' current science standards became effective in February 2014 and are based on the Next Generation Science Standards (NGSS). Forty-one experts, including three Illinois educators, wrote the NGSS. State-level committees in 26 states reviewed the learning benchmarks. These groups confirmed that the design and development of the NGSS were guided by the best available evidence to ensure that students who meet these standards are prepared for postsecondary education and careers in the 21st century. The NGSS can be viewed at 23 Illinois Administrative Code 1 Appendix D .

The Next Generation Science Standards (NGSS)

The NGSS are K–12 science content standards that set the expectations for what students should know and be able to do in science in order to make sense of the world around them and be ready for college, careers, and citizenship.

NEXT GENERATION SCIENCE STANDARDS
For States, By States

About the NGSS

1. **The NGSS are for ALL students and provide a science education they can use in real life.** A strong science education equips students with both an ability to make sense of the complex world around them and foundational skills that are necessary for all careers and life.

2. **The NGSS include the latest advances in science and research about how students best learn science.** The NGSS are based on the National Research Council's 2012 document *A Framework for K-12 Science Education*, which provides updated science content and reflects current research about student learning.

3. **The NGSS were developed by states and their educators.** Twenty-six lead states worked with a 40-member writing team composed of classroom teachers, working scientists, and education researchers to develop the standards. Each lead state assembled a team of educators, higher education faculty, scientists, and engineers to provide feedback on the draft standards. Additionally, two public review periods captured tens of thousands of comments during development that were used to revise each draft.

https://www.nextgenscience.org/resources/ngss-messaging-card

Next Generation Science Standards - Example

SCIENCE EDUCATION WILL INVOLVE LESS:	SCIENCE EDUCATION WILL INVOLVE MORE:
Rote memorization of facts and terminology	Facts and terminology learned as needed while developing explanations and designing solutions supported by evidence-based arguments and reasoning.
Learning of ideas disconnected from questions about phenomena	Systems thinking and modeling to explain phenomena and to give a context for the ideas to be learned
Teachers providing information to the whole class	Students conducting investigations, solving problems, and engaging in discussions with teachers' guidance
Teachers posing questions with only one right answer	Students discussing open-ended questions that focus on the strength of the evidence used to generate claims

https://www.nextgenscience.org/sites/default/files/resource/files/NewVision.pdf

Content Area Domains of the NGSS

HIGH SCHOOL

PHYSICAL SCIENCE	LIFE SCIENCE	EARTH AND SPACE SCIENCES
HS.Structure and Properties of Matter	HS.Structure and Function	HS.Space Systems
HS.Chemical Reactions	HS.Matter and Energy in Organisms and Ecosystems	HS.History of Earth
HS.Forces and Interactions	HS.Interdependent Relationships in Ecosystems	HS.Earth's Systems
HS.Energy	HS.Inheritance and Variation of Traits	HS.Weather and Climate
HS.Waves and Electromagnetic Radiation	HS.Natural Selection and Evolution	HS.Human Sustainability

https://www.nextgenscience.org/overview-topics

Development of the D86 Science Program

Development of the D86 Science Program

As a result of the alignment focus of D86 Strategic Plan Goal 1, the Science Program Team met to decide upon an aligned science program during the spring of 2019.

This team, consisting of teachers and administrators from both schools, considered various sequences, the D86 Strategic Plan, the NGSS, and other goals determined by the Science Program Team.

Physics: Physics of the Universe and **Honors Physics: Physics of the Universe** welcomed their first cohort of students in the 2020-2021 school year at both high schools. As we welcome the second cohort of students this fall, our original cohort will move into **Chemistry: Chemistry of Earth Systems** or **Honors Chemistry: Chemistry of Earth Systems**.

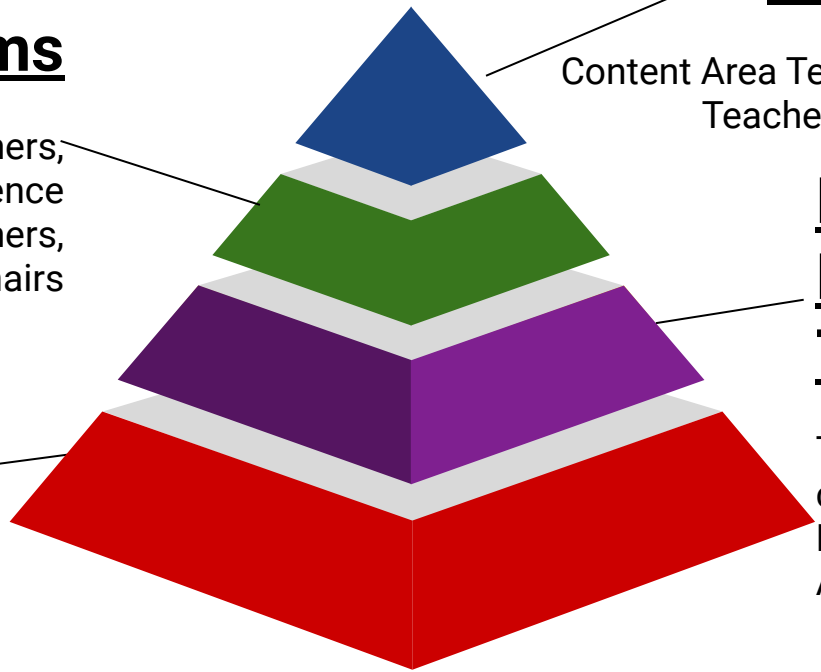
Structure of the D86 Curriculum Alignment Process

Writing Teams

Content Area Teachers, Earth Science Teachers, Department Chairs

Development Teams

Content Area Teachers, AP Teachers, Earth Science Teachers, SPED Teachers, Department Chairs



D86 Science Program Team

Teachers from diverse content areas, Department Chairs, Administrators

D86 Strategic Plan

Community Members, Parents, Students, Board Members, Administrators, Department Chairs, Teachers, Consultants

D86 Science Program & Curricular Teams

D86 SCIENCE PROGRAM TEAM

Dr. Carol Baker	Assistant Sup, Academics
Arwen Pokorny Lyp	Principal -- South
Bill Walsh	Principal -- Central
Eric Martzolf	Assistant Princ, Instruction -- South
Jessica Hurt	Assistant Princ, Instruction -- Central
Dr. Julie Gaubatz	Dept Chair/AP Bio -- South
Julie May	Dept Chair/AP Chem -- Central
Jim Vetrone	Physics/AP Phys -- Central
Dr. David Bonner	Physics/AP Phys -- South
JR Paige	Biology/AP Bio -- Central
Randy Brogan	GeoPhys, SPED -- South
Dylan Canavan	Earth Science -- Central
Tracy McDonald	Chemistry/A&P -- South

PHYSICS CURRICULUM TEAM (TEACHERS)

Dr. David Bonner	Physics/AP Physics -- South
Randy Brogan	Physics/SPED -- South
Dylan Canavan	Earth Science/Physics -- Central
Tom Jacobson	Physics -- South
Kristin Kaduk	Physics/APES -- South
Chris McClain	Physics/AP Physics -- Central
Alan McCloud	Earth Science

CHEMISTRY CURRICULUM TEAM (TEACHERS)

Jim Ludois	Earth Sci/Chem/APES -- Central
Alan McCloud	Earth Science
Tracy McDonald	Chemistry/A&P -- South
Ryan Mott	SPED -- South
Dan Scheldrup	Chemistry -- Central
Melissa Scheldrup	Chemistry -- Central
Stephen Snider	Chemistry/AP Chemistry -- South
Paul Woods	Chemistry/AP Chemistry -- Central

BIOLOGY CURRICULUM TEAM (TEACHERS)

Joel Borowicz	Earth Science/Biology -- South
Maria Conyer	Biology -- South
Kathy Craig	Science -- DHH
Ewa Dybaczewska	SPED
Robb Gotlund	Biology/AP Biology -- South
Adam Hallihan	AP Biology/APES -- South
Michael Jazak	Biology/Interventionist
Kimberly Kim	Biology -- Central
JR Paige	Biology/AP Biology -- Central
Peter Pintz	Biology/AP Biology -- Central
Brigid Walsh	Biology/Chemistry -- Central
Brittany Zust	SPED

D86 Science Program Goals that guided the alignment process

1. **Align courses: Fees, textbooks, objectives, grading practices, and assessments.**

2. **Increase student exposure to and interest in core sciences.**
    a. Student experience more core sciences (B,ES,P,C)
    b. Students experience more of the NGSS PEs, CCC, and DCIs
    c. Students enroll in more than the required 2 yrs of science, or the 3 yrs suggested by colleges

3. **Align courses with college and career opportunities.**
    a. Increase AP enrollment
    b. Increase the number of students passing AP exams
    c. Enrollment in capstone course(s)
    d. Provide junior/senior courses matching high demand careers and student interests

4. **Create a strategic and coherent science program.**
    a. One course leads to another in terms of knowledge and skills, and in building interest
    b. Courses align intuitively
    c. Courses reflect student developmental level

5. **Maximize teacher expertise.**

6. **Provide informed student choice in coursework junior and senior year.**
    a. Provide options for upperclassman specialization
    b. Support level changes

7. **Increase SEL considerations for students and parents.**
    a. Decrease confusion on course selection
    b. Decrease perceived need for tutoring
    c. Support student ability to change levels
    d. Support academic risk-taking
    e. Courses address various student academic needs

Final Science Sequences/Programs Analyzed

The D86 Science Program Team explored a large number of possible science course sequences and programs. Once these were preliminarily examined, the team identified nine finalists. All nine of these options were viewed as potentially beneficial for our D86 students. The team then analyzed which of these nine options would have the most potential to meet the D86 Science Program goals. Below is the list of the nine options that were further investigated:

1. Semester courses aligned by semester (specified fall and spring courses)
2. Semester courses aligned by year (flexible fall and spring courses)
3. Integrated ESS-PCB (Earth and Space Science integrated Physics-Chemistry-Biology)
4. Integrated ESS-BCP (Earth and Space Science integrated Biology-Chemistry-Physics)
5. Multiple Sequences/Pathways (two or three sequence paths, similar to New Trier)
6. Traditional Biology-Chemistry-Physics
7. Open-Enrollment (similar to HCHS)
8. PCB (similar to HSHS)
9. Designer model (four tracks, two levels each, two options within each track)

Based on the team's evaluation of each of the sequences against the program goals, the integrated ESS-PCB sequence was chosen.

D86 Science Program

FRESHMAN	SOPHOMORE	JUNIOR	SENIOR
Physics: Physics in the Universe --OR-- **Physics Honors**: Physics in the Universe	**Chemistry**: Chemistry of Earth Systems --OR-- **Chemistry Honors:** Chemistry of Earth Systems	**Biology**: Biology of the Living Earth --OR-- **Advanced Placement Biology**	<u>Capstones</u>: Anatomy & Physiology Earth Science <u>Advanced Placement:</u> AP Biology AP Chemistry AP Environmental Sci AP Physics C AP Physics C-M AP Research AP Seminar
	<u>Can be concurrent:</u> AP Physics C AP Physics C-M AP Seminar	<u>Can be concurrent:</u> Anatomy & Physiology Earth Science (capstone) AP Chemistry AP Environmental Science AP Physics C AP Physics C-M AP Research AP Seminar	

Program Updates and Future Work

D86 Science Program Implementation Timeline

	Physics PITU	Physics Honors PITU	Chemistry COES	Chemistry Honors COES	AP Chem	Biology BOTLE	AP Biology	AP Physics C & C-M	Anatomy & Physiology	Earth Science Capstone	APES
Partial CHS implementation	Fall 2020	Fall 2020	Fall 2021	Fall 2021	NA	Fall 2022	NA	NA	NA	NA	NA
Full CHS implementation	Fall 2022	Fall 2022	Fall 2023	Fall 2023	Fall 2021	Fall 2024	Fall 2022	Fall 2022	Fall 2022	Fall 2023	Fall 2023
Full SHS implementation	Fall 2020	Fall 2020	Fall 2021	Fall 2021	Fall 2021	Fall 2022	Fall 2022	Fall 2022	Fall 2022	Fall 2023	Fall 2023
Sequence of Units Aligned	Complete	Complete	Complete	Complete	Complete	In progress	In progress	Not started	Not started	Not started	Not started
Unit Objectives Aligned	Complete	Complete	Complete	Complete	Complete	In progress	In progress	Not started	Not started	Not started	Not started
Textbook determined	Complete	Complete	Complete	Complete	Complete	In progress	Complete	Complete	Complete	Not started	Complete
Course fee	$10	$10	$10	$10	$10	$10	$10	$10	$10	$10	$10

D86 Science & Next Generation Science Standards - Example

NGSS PE	Performance Expectation	PITU & PITU H	COES & COES H	BOTLE
HS-PS1-6	Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.		x	
HS-PS3-1	Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.	x	x	
HS-LS2-4	Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.			x
HS-LS2-5	Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.			x
HS-ESS1-1	Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy in the form of radiation.		x	
HS-ESS1-2	Construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe.	x	x	
HS-ESS1-3	Communicate scientific ideas about the way stars, over their life cycle, produce elements.		x	

DRAFT: Content and Skills Vertical Alignment - Example

	Physics **Physics Honors**	***Chemistry*** **Chemistry Honors**	***Biology*** **AP Biology**
Science Practices	Collecting quality data Organizing, analyzing, interpreting data Using a graph to make predictions Designing, constructing and carrying out experiments Creating, interpreting, examining graphs Developing and using models Using mathematical and computational thinking Working with quantitative data	Collecting quality data Organizing, analyzing, interpreting data Using a graph to make predictions Designing, constructing and carrying out experiments Creating, interpreting, examining graphs Developing and using models Using mathematical and computational thinking Working with quantitative/qualitative data	Writing Team at Work
Math/ Graphing/ Statistics	Apply mathematical and computational thinking to datasets Identifying mathematical and graphical trends IV/DV; Line of best fit Uncertainty (quantity/quality of data sets) Use spreadsheets to graph data sets Unit conversions Manipulating algebraic equations Sine, cosine and tangent Systems of equations Function identification (linear/quadratic)	Unit conversions (moles, grams…) Proportions/Dimensional Analysis Unit conversations Identifying mathematical and graphical trends Manipulating algebraic equations	Writing Team at Work

Vertical Alignment Categories:

- Science Practices
- Math/ Graphing/ Statistics
- Earth Science
- Energy
- Motion/Movement
- Waves
- Bonds & Intermolecular Attractions
- Forces & Momentum
- Chemical Reactions
- Thermodynamics

Physics: Physics in the Universe (PITU)

The D86 Physics and Physics Honors courses for freshmen were implemented partially at CHS and fully at SHS in the Fall of 2020, with full implementation to occur at CHS in 2022.

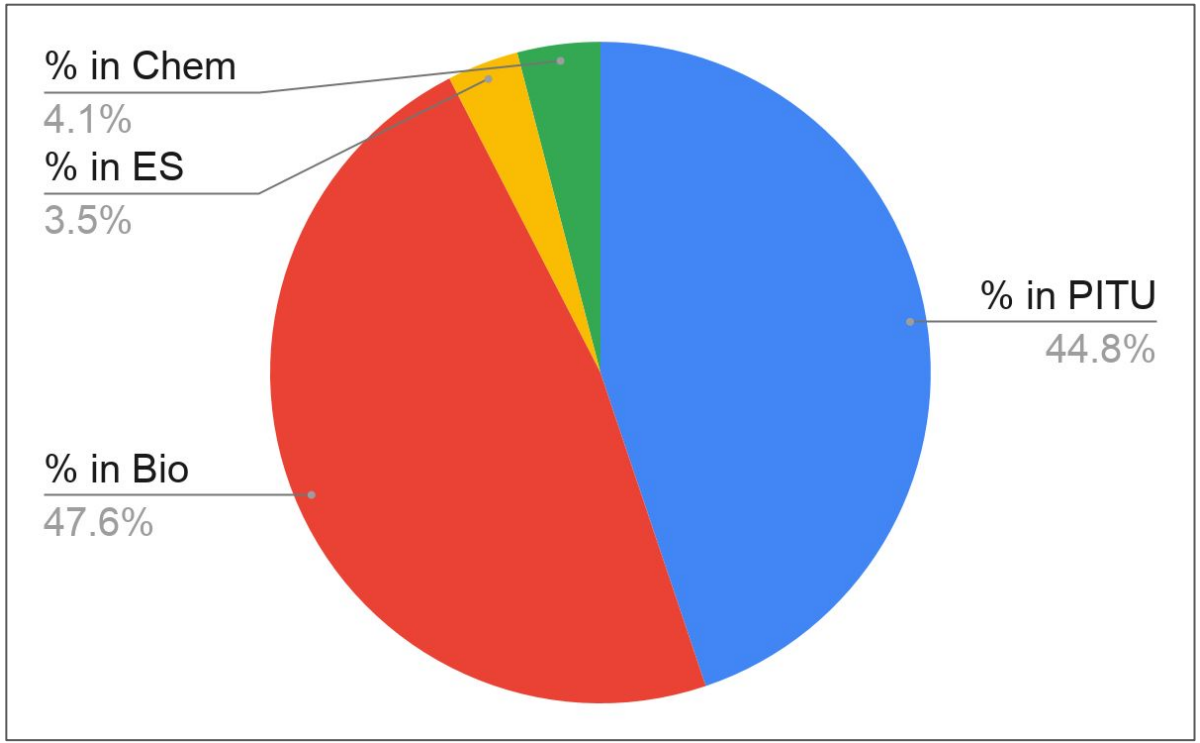
The D86 Physics: The Physics in the Universe Teaching Team worked together this year, sharing and refining lessons, labs, remote teaching ideas, and assessments. Curriculum refinements based on experiences this year will be made during the summer. Three more CHS teachers will be added to the teaching team for 2021-2022.

- **Approximately 33% of CHS freshmen are enrolled in Physics/ Physics Honors in 2020-2021.**
- **Approximately 45% of CHS freshmen have enrolled for Physics/Physics Honors for 2021-2022.**

All SHS freshmen are enrolled in Physics or Physics Honors for 2020-2021 and 2021-2022.

Incoming Freshman Enrollment for 2021-2022 at CHS

CHS Freshmen Enrollment 2021-2022	
Biology	258
Physics	243



Physics Course Descriptions (PITU)

PHYSICS: Physics in the Universe

This course covers the skills and content of a first year physics course within the context of the Earth and its place in the Universe. Topics include science practices, waves, Big Bang, motion, plate tectonics, forces, energy, momentum, gravity, orbital motion, and projectiles.

PHYSICS HONORS: Physics in the Universe

This course covers similar topics as Physics: Physics in the Universe, but at a deeper level and an accelerated pace. This course requires mastery of Algebra I and strong math critical thinking skills.

Physics Course Units (PITU and PITU Honors)

Course Sheet for Physics

Physics Units
Science Practices
Constant Velocity
Waves
Application of Waves: Big Bang
Application of Waves: Earth's Interior and Plate Tectonics
Acceleration and Gravity
Forces
Momentum
Energy
Orbital Motion
Application of Orbital Motion: Seasons and Climate

Physics Honors Units
Science Practices
Constant Velocity
Forces & Motion (1-D)
Forces & Motion (2-D)
Circular Motion
Momentum
Waves
Application of Waves: Big Bang
Energy
Circuits + Electromagnetic Energy Production
Orbital Motion
Application of Orbital Motion: Seasons and Climate

Course Sheet for Physics Honors

Chemistry: Chemistry of Earth Systems (COES)

The D86 Chemistry and Chemistry Honors courses for sophomores will be implemented partially at CHS in 2021-2022, serving about 33% of sophomores in the first cohort. This course will be fully implemented at SHS will all sophomores enrolling. Full implementation will begin at CHS in 2023.

The D86 Chemistry of Earth Systems Curriculum Development and Writing teams met last summer and throughout the 2020-2021 school year. These teams have worked to finalize Chemistry and Chemistry Honors units, learning objectives, grading practices, and textbooks. The COES Teaching Team is now meeting to plan the details of their year.

Chemistry Course Descriptions (COES)

CHEMISTRY: Chemistry of Earth Systems

This course covers the skills and content of a first-year Chemistry course within the context of Earth Systems. Topics include: Big Bang and the origin of elements, atomic structure, chemical reactions and their role in Earth processes, bonding, chemistry topics applied to environmental issues, stoichiometry, thermodynamics and equilibrium.

CHEMISTRY HONORS: Chemistry of Earth Systems

This course covers similar topics as Chemistry: Chemistry of Earth Systems, but at a deeper level and an accelerated pace. This course requires strong math critical thinking skills.

Chemistry Course Units (COES and Honors COES)

Course Sheet for Chemistry

Course Sheet for Chemistry Honors

Big Bang and Nuclear Chemistry
Atomic Structure
The Periodic Table
Chemical Bonding
Chemical Quantities
Chemical Reactions
Stoichiometry
Copper Unlimited Project

Thermochemistry
Gases
Weather and Climate
Climate Change
Reaction Rates and Equilibrium
Acid-Base Equilibria
Ocean Acidification
Organic Chemistry

Honors course has additional learning objectives within units that increase the rigor of the course. In addition, Honors level students will be asked to delve deeper into objectives, to use critical thinking skills that incorporate multiple learning objectives across multiple units, and to apply those skills to novel situations.

Biology: Biology of the Living Earth (BOTLE)

The D86 Biology course for juniors will be implemented partially at CHS and fully at SHS in the Fall of 2022, with full implementation to occur at CHS in 2024.

The Development team met in the spring of 2021 to begin planning for this aligned course. The Writing Team will meet this summer to continue the work, and then both teams will meet periodically throughout the 2021-2022 school year to prepare for implementation the following year.

Work in Progress Recap

Physics and Physics Honors (Physics in the Universe)	Course Alignment completed. First cohort took this course in 2021-2022. All D86 freshman will enroll in 2022-2023 school year.
Chemistry and Chemistry Honors (Chemistry of Earth Systems)	Course Alignment completed. First cohort will take this course in 2021-2022
Biology (Biology of the Living Earth)	Course Alignment is in progress. Development Team and Writing Team are working this summer and in 2021-2022 school year. First cohort will take this course in 2022-2023.

Program Analysis

Based on D86 Science Program Goals,
which were created using the D86 Strategic Plan as a guide.

D86 Science Program Goals

1. **Align courses: Fees, textbooks, objectives, grading practices, and assessments.**

2. **Increase student exposure to and interest in core sciences.**
    a. Student experience more core sciences (B,ES,P,C)
    b. Students experience more of the NGSS PEs, CCC, and DCIs
    c. Students enroll in more than the required 2 yrs of science, or the 3 yrs suggested by colleges

3. **Align courses with college and career opportunities.**
    a. Increase AP enrollment
    b. Increase the number of students passing AP exams
    c. Enrollment in capstone course(s)
    d. Provide junior/senior courses matching high demand careers and student interests

4. **Create a strategic and coherent science program.**
    a. One course leads to another in terms of knowledge and skills, and in building interest
    b. Courses align intuitively
    c. Courses reflect student developmental level

5. **Maximize teacher expertise.**

6. **Provide informed student choice in coursework junior and senior year.**
    a. Provide options for upperclassman specialization
    b. Support level changes

7. **Increase SEL considerations for students and parents.**
    a. Decrease confusion on course selection
    b. Decrease perceived need for tutoring
    c. Support student ability to change levels
    d. Support academic risk-taking
    e. Courses address various student academic needs

D86 Science Goal 1 KPIs -- Program Analysis

Goal		Key Performance Indicators
Align Courses	- Align fees, texts, objectives, and semester exams.	1. Monitor percentage of course fees and textbooks aligned. 2. Determine number of courses with aligned units and objectives compared to the total courses.

1. Fees and Texts

Fall 2020	D86 Science fees aligned	100% Completed
Spring 2021	D86 Science Program text materials aligned	82% Completed
Fall 2023	D86 Science Program text materials aligned	100% Projected

2. Course Alignment

Fall 2021	Physics, Physics Honors, Chemistry, Chemistry Honors, AP Chem	42% Completed
Fall 2022	-- Add Biology (BOTLE), AP Bio, A&P, AP Phys C, AP Phys C-M	75% Projected
Fall 2023	-- Add Earth Science Capstone, APES	100% Projected

D86 Science Goal 2 KPIs -- Program Analysis

Goal		Key Performance Indicators
Increase student exposure to and interest in core sciences.	- Student experience more core sciences (B,ES,P,C) - Students experience a large percentage of NGSS - Students enroll in more than the required 2 yrs of science, or the 3 yrs suggested by colleges	1. Compare # of students who experienced all four disciplines (B,ES,P,C) pre-alignment to the number of students enrolled in PITU, COES, and BOTLE post-alignment. 2. Determine percentage of NGSS PEs covered within D86 science core course sequence. 3. Compare the number of science courses students took by the end of their senior year pre-alignment to the number of science courses taken by the end of senior year post-alignment. 4. Questions from the annual D86 Science Student Survey designed to elicit information to gauge student enjoyment of science and interest in future science pursuits.

1. Pre-alignment data available, post-alignment data preliminarily available for cohort 1 in 2024
2. Physics, Physics H, Chemistry, Chemistry H = Completed 43%, Projected >80% with Bio by 2022
3. Pre-alignment data available, post-alignment data preliminarily available for cohort 1 in 2024
4. Data collection began Spring 2020, on-going -- preliminary data available in 2024

D86 Science Goal 3 KPIs -- Program Analysis

Goal		Key Performance Indicators
Align courses with college and career opportunities	- Increase AP enrollment - Increase the number of students passing AP exams - Increase content knowledge of core sciences as measured by the ISA	1. Compare student enrollment in AP science courses pre- and post-alignment by cohort year. 2. Compare the number of students passing AP exams with a score of 3 or higher pre- and post- alignment by cohort. 3. Compare cohort scores on ISA using pre- and post-alignment data. *(ISA cancelled in 2020)*

1. Pre-alignment data available, post-alignment data preliminarily available for cohort 1 in 2024
2. Pre-alignment data available, post-alignment data preliminarily available for cohort 1 in 2023/2024
3. Pre-alignment data available, post-alignment data preliminarily available for cohort 1 in 2023

D86 Science Goal 4 KPIs -- Program Analysis

Goal		Key Performance Indicator
Create a strategic and coherent science program.	- One course leads to another in terms of knowledge and skills, and in building interest	1. Demonstrate strands of progression in content and skills via an alignment grid from freshman to sophomore to junior year once the curriculum for these courses is finalized and established.

1. Analysis of alignment began in Spring 2021 and will be completed in Fall 2022.

D86 Science Goal 5 KPIs -- Program Analysis

Goal		Key Performance Indicators
Maximize teacher expertise.	- Utilize content area backgrounds of department teachers in both the development and teaching of the courses - Provide teachers the opportunity to develop their expertise through collaboration, professional development, and experience	1. Analyze curriculum team composition to determine if teacher expertise represents the core content found within each course. 2. Analyze teaching team composition and teacher schedules to determine scope of teacher availability for collaboration. 3. Analyze teaching team composition over time to ensure experience within each course team. 4. Compile professional development sessions attended by content area teachers/teams and create a gap analysis.

1. Physics, Chemistry, and Biology teams all contain(ed) content area teachers, Earth science teachers, and special services teachers at the Development and/or Writing Team levels.
2. All members of the teaching teams are/have been available for collaboration.
3. Ongoing.
4. Ongoing. Pandemic interference currently.

D86 Science Goal 6 KPIs -- Program Analysis

Goal		Key Performance Indicators
Provide informed student choice in coursework junior and senior year.	- Provide options for upperclassman specialization	1. Compile the number of courses available to juniors and seniors outside of core courses. 2. Analyze the above to ensure that students' various interest and skill levels are addressed.

1&2. D86 junior/senior non-core courses:

a.	AP Biology	2-sem college credit, science/research/medicine
b.	AP Chemistry	2-sem college credit, science/research/medicine/engineering
c.	AP Environmental Science	1-sem college credit, research/environmental/political/business
d.	AP Physics C	2 sem college credit, science/research/engineering
e.	AP Physics C-M	1 sem college credit, science/research/engineering
f.	Anatomy & Physiology	high school credit, medicine
g.	Earth Science Capstone	high school credit, environmental/political/business
h.	AP Seminar/AP Research	2-sem college credit, science/research/political/humanities

D86 Science Goal 7 KPIs -- Program Analysis

Goal		Key Performance Indicators
Increase SEL considerations for students and parents.	- Decrease confusion on course selection - Decrease perceived need for tutoring - Support academic risk-taking (diagonal progression)	1. Analyze course choices and prerequisites for clarity. 2. Compare student survey responses to questions on science course difficulty and perceived need for tutoring pre- and post- alignment. 3. Compare the number of students who moved from regular to Honors pre- and post-alignment.

1. Ongoing -- Requires the D86 Math Program to be implemented due to science's use of math within the D86 Science curriculum.
2. Data collection began Spring 2020, on-going -- preliminary data available in 2024
3. Data collection will begin in Fall 2021 and will be preliminarily available 2022.

Thank you.

D86 SCIENCE PROGRAM TEAM

Dr. Carol Baker	Assistant Sup, Academics
Arwen Pokorny Lyp	Principal -- South
Bill Walsh	Principal -- Central
Eric Martzolf	Assistant Princ, Instruction -- South
Jessica Hurt	Assistant Princ, Instruction -- Central
Dr. Julie Gaubatz	Dept Chair/AP Bio -- South
Julie May	Dept Chair/AP Chem -- Central
Jim Vetrone	Physics/AP Phys -- Central
Dr. David Bonner	Physics/AP Phys -- South
JR Paige	Biology/AP Bio -- Central
Randy Brogan	GeoPhys, SPED -- South
Dylan Canavan	Earth Science --Central
Tracy McDonald	Chemistry/A&P -- South

PHYSICS CURRICULUM TEAM (TEACHERS)

Dr. David Bonner	Physics/AP Physics -- South
Randy Brogan	Physics/SPED -- South
Dylan Canavan	Earth Science/Physics -- Central
Tom Jacobson	Physics -- South
Kristin Kaduk	Physics/APES -- South
Chris McClain	Physics/AP Physics -- Central

CHEMISTRY CURRICULUM TEAM (TEACHERS)

Jim Ludois	Earth Sci/Chem/APES -- Central
Tracy McDonald	Chemistry/A&P -- South
Ryan Mott	SPED -- South
Dan Scheldrup	Chemistry -- Central
Melissa Scheldrup	Chemistry -- Central
Stephen Snider	Chemistry/AP Chemistry -- South
Paul Woods	Chemistry/AP Chemistry -- Central

BIOLOGY CURRICULUM TEAM (TEACHERS)

Joel Borowicz	Earth Science/Biology -- South
Maria Conyer	Biology -- South
Kathy Craig	Science -- DHH
Robb Gotlund	Biology/AP Biology -- South
Adam Hallihan	AP Biology/APES -- South
JR Paige	Biology/AP Biology -- Central
Peter Pintz	Biology/AP Biology -- Central
Brigid Walsh	Biology/Chemistry -- Central
Brittany Zust	SPED
Michael Jazak	Biology/Interventionist
Ewa Dybaczewska	SPED
Kimberly Kim	Biology -- Central

Supporting Information

(Ancillary Slides)

The PCB sequence is not unique: Examples of PCB Schools in Illinois

US News and World Report Illinois Ranking

Walter Payton College Prep	PCB only	#1
Northside College Prep	PCB only	#2
Jones College Prep	PCB only	#3
Lindblom Math and Science Academy	PCB only	#9
Glenbrook North	PCB (high track)	#12
New Trier	PCB (high track)	#13
Deerfield	PBC (intg ESS)	#14
Glenbrook South	PCB (high track)	#17
Proviso Math and Science Academy	PCB only	#20

Other IL Schools Offering a PCB Sequence

Illinois Science & Mathematics Academy (ISMA)	PCB (by semester)
Latin School of Chicago	PCB only
Lakes High School	PCB only
Argo High School	PCB only
Antioch High School	PCB only
Hinsdale South High School	PCB only
Tinley Park High School	PCB only
Bremen High School	PCB only
Huntley High School	PCB only
Loyola Academy (adopted in 2018)	PCB only
Oak Forest High School	PCB only
Hillcrest High School	PCB only

Research supporting a PCB sequencing, 1 - Examples

Bouma, 2013	Cohort study. N=571. The PCB program had a significant impact on **SAT math scores** in the second cohort at MRHS. Statistically adjusted, the SAT math means for PCB students were **21.4 points higher** than their non-PCB counterparts when controlling for prior math achievement, socioeconomic status, and ethnicity/race.
Glasser, 2012	Cohort study. Students taking the freshman physics showed positive effects on their **mathematical performance on standardized tests.**
Pasero, 2008	Quasi-experimental study, self-selection into either the BCP or PCB sequence. N=185. **Gain scores between the EXPLORE and PLAN** were calculated for the composite scores and for the science and mathematics subscale scores. A two-factor analysis of variance (ANOVA) on course sequence and cohort showed **significantly greater composite score gains** by students taking the inverted sequence.
Gaubatz, 2013	Cohort study. N by cohort = 7. The modified-PCB program transition was associated with **increases in students' honors and Advanced Placement (AP) course enrollments, AP examination scores, understanding of the Nature of Science and experimentation, and self-reported affect toward themselves as learners and toward science in general.**
Bouma, 2008	Natural/quasi-experimental study. N=168 The analysis indicates that the freshmen scored as well as their senior counterparts on the **California Standards Test in Physics** and on par with typical high school scores on the **Force Concept Inventory.**

Research supporting a PCB sequencing, 2 - Examples

Burgess, 2019	Quasi-experimental study. N= 1100. The transition to a PCB sequence resulted in immediate, rapid, statistically significant, large **increases in every ACT section** with scores rising during the transition and sustained for four years after the transition to the new sequence of science courses.
Burgess, 2013	Quasi-experimental study. N by cohort = 10. **AP Science course enrollment increased 398%** when comparing the four years prior to the change in sequence to the four years after the change in sequence. **AP Science Exam performance displayed a 259% increase** when comparing the four years prior to the change with the three years after the change in science course sequence.
JK, 2012 Popkin, 2009	Two summaries of **why physics first program fail**: Lack of teacher training, implemented in a top-down fashion, unsupportive community, easier to implement in smaller, independent, private, or magnet schools than public schools ("...in the public school system, inertia rules"), in San Diego, 20 of the district's 27 high schools *continue to offer physics to at least some ninth-graders.*
Lovell, 2010	Quasi-experimental. N by cohort = 15. Impact of freshman physics on the involvement and performance of girls. Of those students who took biology first before the new program was initiated, only 24% graduated with a physics course on their transcript and only 43% took more than the required three years of science. Of the students who took an introductory physics course in ninth grade, **27% went on to take the advanced physics course and 74% took four years of science**.

Physics professors from Harvard, MIT, University of Massachusetts, and University of Chicago explaining the benefits of Freshman Physics.

Student footage taken from Northside College Prep in Chicago and the Illinois Math and Science Academy in Aurora, IL.