**ChemErrrrrrrrrrrer**



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|  | Chemistry Guide2022-2023SCI 301/302 & SCI 3010/3020 |

<http://grading.dmschools.org>

<http://science.dmschools.org>

**Foreword**

**How to use this document:**

**This curriculum guide is *not…***

* A lock-step instructional guide detailing exactly when and how you teach.
* Meant to restrict your creativity as a teacher.
* A ceiling of what your students can learn, nor a set of unattainable goals.

**Instead, the curriculum guide *is* meant to be a common vision for student learning and a set of targets and success criteria directed related to grade-level standards by which to measure and report student progress and provide meaningful feedback.**

The curriculum guide outlines the learning that is **most essential** for student success; it is our district’s guaranteed and viable curriculum. The expectation is that every student in our district, regardless of school or classroom, will have access to and learn these targets. As the classroom teacher, you should use the curriculum guide to help you to decide how to scaffold up to the learning targets and extend your students’ learning beyond them.

Within this document, you will find a foundational structure for planning sequential instruction in the classroom which can be supplemented with materials from any number of the linked resources.

Please consider this guide a living and dynamic document, subject to change and a part of a continuous feedback loop.

## *Chemistry:* Year at a Glance

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| **Semester 1** | **Topic 1: Properties of Matter** | **Topic 2: Atomic Structure and Periodic Trends** | **Topic 3: Kinetic Molecular Theory** | **Topic 4: The Mole and Bonding** |
| Standards Aligned | [HS-PS1-3](https://www.nextgenscience.org/sites/default/files/HS-PS1-3_Evidence%20Statements%20Jan%202015.pdf), [HS-PS2-6,](https://www.nextgenscience.org/sites/default/files/HS-PS2-6_Evidence%20Statements%20Jan%202015.pdf) [HS-ESS2-5](https://www.nextgenscience.org/sites/default/files/HS-ESS2-5_Evidence%20Statements%20Jan%202015.pdf) | [HS-PS1-1](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS1-1%20Evidence%20Statements%20June%202015%20asterisks.pdf), [HS-PS1-2](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS1-2%20Evidence%20Statements%20June%202015%20asterisks.pdf) | [HS-PS3-2,](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS3-2%20Evidence%20Statements%20June%202015%20asterisks.pdf) [HS-PS3-1](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS3-1%20Evidence%20Statements%20June%202015%20asterisks.pdf), [HS-PS1-4](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS1-4%20Evidence%20Statements%20June%202015%20asterisks.pdf) | [HS-PS1-2](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS1-2%20Evidence%20Statements%20June%202015%20asterisks.pdf), [HS-PS1-7](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS1-7%20Evidence%20Statements%20June%202015%20asterisks.pdf), [HS-PS1-3](https://www.nextgenscience.org/sites/default/files/HS-PS1-3_Evidence%20Statements%20Jan%202015.pdf) |
| iHub Resource\* | [Search for Life](https://docs.google.com/document/d/1u-wDEbxSa6MrnLkXUveOPiSX_gWekRtj_mDKo5GFlUI/edit#heading=h.eijogclceufn) | [Search for Life](https://docs.google.com/document/d/1u-wDEbxSa6MrnLkXUveOPiSX_gWekRtj_mDKo5GFlUI/edit#heading=h.eijogclceufn) |  |  |

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| **Semester 2** | **Topic 5: Chemical Reactions and Stoichiometry** | **Topic 6: Reaction Rates & Equilibrium** | **Topic 7: Nuclear Chemistry** | **Topic 8: Energy Transfer** |
| Standards Aligned | [HS-PS1-2](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS1-2%20Evidence%20Statements%20June%202015%20asterisks.pdf), [HS-PS1-7](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS1-7%20Evidence%20Statements%20June%202015%20asterisks.pdf) | [HS-PS1-5](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS1-5%20Evidence%20Statements%20June%202015%20asterisks.pdf), [HS-PS1-6](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS1-6%20Evidence%20Statements%20June%202015%20asterisks.pdf) | [HS-PS1-8](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS1-8%20Evidence%20Statements%20June%202015%20asterisks.pdf) | [HS-PS3-1](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS3-1%20Evidence%20Statements%20June%202015%20asterisks.pdf), [HS-PS3-4](https://www.nextgenscience.org/sites/default/files/HS-PS3-4_Evidence%20Statements%20Jan%202015.pdf) |
| iHub Resource\* | [Oysters](https://docs.google.com/document/d/1xFSlttSshs3zlbYl0FbiyGoD41oKzS5K4lybw5tDgxA/edit) | [Oysters](https://docs.google.com/document/d/1xFSlttSshs3zlbYl0FbiyGoD41oKzS5K4lybw5tDgxA/edit) | [Nuclear](https://docs.google.com/document/d/16ssrQOMAS9LZt5jZGciGGpogb4nTJelEPyvanEYNEIs/edit) | [Polar Ice Melting](https://docs.google.com/document/d/1DDuLrfepxQTdYa9ZVSnTrr9D2Wmky9AkTFbKen_f7bs/edit#heading=h.q3w0gnm3dqi4) |

\*iHub is not an official adoption. This is a resource to leverage while planning. Teacher and student facing materials are free to use. iHub is guided by the NGSS standards and are phenomenon based. Three units are organized with coherent story lines, transfer tasks, and 3D assessments. To learn more about iHub go to <https://www.colorado.edu/program/inquiryhub/curricula/inquiryhub-chemistry>

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| **Evidence shows the student ...** | **Topic Score** |
| Demonstrates proficiency (AT) in all learning targets and success at Level 4 | 4.0 |
| Demonstrates proficiency (AT) in all learning targets with partial success at Level 4 | 3.5 |
| Demonstrates proficiency (AT) in **all** learning targets  | 3.0 |
| Demonstrates proficiency (AT) in **at least half** of the learning targets | 2.5 |
| Demonstrates some success criteria (PT) toward **all** learning targets | 2.0 |
| Demonstrates some success criteria (PT) towards **some** of the learning targets | 1.5 |
| Does not yet meet minimum criteria for the targets.  | 1.0 |
| Produces no evidence appropriate to the learning targets at any level  | 0 |

**Standards-Referenced Grading Basics**

**Our purpose in collecting a body of evidence is to:**

* Allow teachers to determine a defensible and credible topic score based on a representation of student learning over time.

**Start at Level 3 when determining a topic → score.**

* Clearly communicate where a student’s learning is based on a topic scale to inform instructional decisions and push student growth.
* Show student learning of targets through multiple and varying points of data
* Provide opportunities for feedback between student and teacher.

**Scoring**

A collaborative scoring process is encouraged to align expectations of the scale to artifacts collected. Routine use of a collaborative planning and scoring protocol results in calibration and a collective understanding of evidence of mastery. Enough evidence should be collected to accurately represent a progression of student learning as measured by the topic scale. Teachers look at all available evidence to determine a topic score. All topic scores should be defensible and credible through a body of evidence.

**Guiding Practices of Standards-Referenced Grading**

1. A consistent 4-point grading scale will be used.
2. Student achievement and behavior will be reported separately.
3. Scores will be based on a body of evidence.
4. Achievement will be organized by learning topic and converted to a grade at semester’s end.
5. Students will have multiple opportunities to demonstrate proficiency.
6. Accommodations and modifications will be provided for exceptional learners.

**\*\*\*Only scores of 4, 3.5, 3, 2.5, 2, 1.5, 1, and 0 can be entered as Topic Scores**.

**Multiple Opportunities**

Philosophically, there are two forms of multiple opportunities, both of which require backwards design and intentional planning. One form is opportunities planned by the teacher throughout the unit of study and/or throughout the semester. The other form is reassessment of learning which happens after completing assessment of learning at the end of a unit or chunk of learning.

Students will be allowed multiple opportunities to demonstrate proficiency. Teachers need reliable pieces of evidence to be confident students have a good grasp of the learning topics before deciding a final topic score. To make standards-referenced grading work, the idea of “multiple opportunities” is emphasized. If after these opportunities students still have not mastered Level 3, they may then be afforded the chance to reassess.

**Anatomy of a Scale**



**Topic 1: Properties of Matter**

Science and Engineering Practices (SEP)

Disciplinary Core Ideas (DCI)

Cross Cutting Concepts (CCC)

### [Planning and Carrying Out Investigations](http://www.nap.edu/openbook.php?record_id=13165&page=59)

### [PS1.A: Structure and Properties of Matter](http://www.nap.edu/openbook.php?record_id=13165&page=106)

### [PS2.B: Types of Interactions](http://www.nap.edu/openbook.php?record_id=13165&page=116)

### [ESS2.C: The Roles of Water in Earth's Surface Processes](http://www.nap.edu/openbook.php?record_id=13165&page=184)

###  [Patterns](http://www.nap.edu/openbook.php?record_id=13165&page=85)

###  [Structure and Function](http://www.nap.edu/openbook.php?record_id=13165&page=96)

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| **Properties of Matter** | **Achieving Grade Level (AT)** |
| **LT1A**- **Use evidence to infer the relationship between measurable properties and the structure of a substance.** [**(HS-PS1-3)**](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS1-3%20Evidence%20Statements%20June%202015%20asterisks.pdf)* Select relevant data (ex: mass, volume, density)
* Use data to model the substance at the particle level (emphasis on spacing particles not on particle size or mass)
* Compare two or more substances at the particle level

**LT1B**- **Explain the effect that attractive and repulsive intermolecular forces have on the interaction of molecules.** [**(HS-PS1-3)**](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS1-3%20Evidence%20Statements%20June%202015%20asterisks.pdf)* Describe the relationship between charge and attraction
* Compare relative strength of forces using measurable properties of substances (ex: melting point, boiling point, vapor pressure)

**LT1C-** **Plan and conduct an investigation of the properties of water and its impacts at different scales.** [**(HS-ESS2-5)**](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS2-5%20Evidence%20Statements%20June%202015%20asterisks.pdf)* Identify measurable properties of water to investigate (ex: surface tension, solubility, capillary action, cohesion, adhesion)
* Conduct investigation to compare water’s properties to other substances
* Use polarity to explain the dissolution of substance in water
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**Topic 2: Atomic Structure and Periodic Trends**

Science and Engineering Practices (SEP)

Disciplinary Core Ideas (DCI)

Cross Cutting Concepts (CCC)

### [Constructing Explanations and Designing Solutions](http://www.nap.edu/openbook.php?record_id=13165&page=67)

### [Developing and Using Models](http://www.nap.edu/openbook.php?record_id=13165&page=56)

### [PS1.A: Structure and Properties of Matter](http://www.nap.edu/openbook.php?record_id=13165&page=106)

### [PS1.B: Chemical Reactions](http://www.nap.edu/openbook.php?record_id=13165&page=109)

###  [Patterns](http://www.nap.edu/openbook.php?record_id=13165&page=85)

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| **Atomic Structure and Periodic Trends** | **Achieving Grade Level (AT)** |
| **LT2A- Use the periodic table to predict and model an atom’s structure.** [**(HS-PS1-2)**](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS1-2%20Evidence%20Statements%20June%202015%20asterisks.pdf)* Determine the number of protons, neutrons, and electrons for any atom
* Draw models to represent basic atomic structure (ex: Bohr models or electron configuration)

**LT2B- Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level.** [**(HS-PS1-1)**](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS1-1%20Evidence%20Statements%20June%202015%20asterisks.pdf)  * Determine the number of valence electrons of any atom (note: exposure to electron configurations is important for AP)
* Explain trends in atomic radius down and across the periodic table
* Predict relative charges based on valence electrons

**LT2C-** **Explain the reactivity of metals versus nonmetals.** [**(HS-PS1-2)**](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS1-2%20Evidence%20Statements%20June%202015%20asterisks.pdf)* Classify an element as a mental or nonmetal
* Rank elements based on their likelihood to react
* Predict the outcome of simple chemical reactions (ex: combination, single replacement) based on electronegativity and atomic radius (Note: ionization energy could also be discussed)
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**Topic 3: Kinetic Molecular Theory**

Science and Engineering Practices (SEP)

Disciplinary Core Ideas (DCI)

Cross Cutting Concepts (CCC)

### [Developing and Using Models](http://www.nap.edu/openbook.php?record_id=13165&page=56)

### [Using Mathematics and Computational Thinking](http://www.nap.edu/openbook.php?record_id=13165&page=64)

### [PS3.A: Definitions of Energy](http://www.nap.edu/openbook.php?record_id=13165&page=120)

### [PS1.A: Structure and Properties of Matter](http://www.nap.edu/openbook.php?record_id=13165&page=106)

### [PS1.B: Chemical Reactions](http://www.nap.edu/openbook.php?record_id=13165&page=109)

### [PS3.B: Conservation of Energy and Energy Transfer](http://www.nap.edu/openbook.php?record_id=13165&page=124)

### [Energy and Matter](http://www.nap.edu/openbook.php?record_id=13165&page=94)

### [Systems and System Models](http://www.nap.edu/openbook.php?record_id=13165&page=91)

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| **Kinetic Molecular Theory** | **Achieving Grade Level (AT)** |
| **LT3A- Use models to depict the relationship between the pressure, temperature, and volume in terms of molecular collisions and account for energy in the system.** [**(HS-PS3-2)**](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS3-2%20Evidence%20Statements%20June%202015%20asterisks.pdf)* Diagram the temperature, pressure, and volume of a substance at the particle level
* Explain how the model depicts changes/relationships in pressure, temperature and volume
* Relate the changes in temperature, pressure, and volume to molecular collisions

**LT3B-** **Develop a model to illustrate how chemical energy within the system is accounted for by the change in the bond energies of the reactants and the products.** [**(HS-PS1-4)**](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS1-4%20Evidence%20Statements%20June%202015%20asterisks.pdf)* Determine whether a reaction is endothermic or exothermic
* Calculate the energy change in a chemical reaction (ΔH)
* Explain the relationship between the bond energies of reactants/products and energy absorbed or released.

**LT3C**- **Use experimental data to support the claim that energy is conserved during a chemical reaction.** [**(HS-PS3-1)**](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS3-1%20Evidence%20Statements%20June%202015%20asterisks.pdf)* Explain how energy changes when bonds break
* Explain how energy changes when bonds form
* Use a model to show that energy is conserved during a chemical reaction
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**Topic 4: The Mole and Bonding**

Science and Engineering Practices (SEP)

Disciplinary Core Ideas (DCI)

Cross Cutting Concepts (CCC)

### [Developing and Using Models](http://www.nap.edu/openbook.php?record_id=13165&page=56)

### [Using Mathematics and Computational Thinking](http://www.nap.edu/openbook.php?record_id=13165&page=64)

### [PS3.A: Definitions of Energy](http://www.nap.edu/openbook.php?record_id=13165&page=120)

### [PS1.A: Structure and Properties of Matter](http://www.nap.edu/openbook.php?record_id=13165&page=106)

### [PS1.B: Chemical Reactions](http://www.nap.edu/openbook.php?record_id=13165&page=109)

### [PS3.B: Conservation of Energy and Energy Transfer](http://www.nap.edu/openbook.php?record_id=13165&page=124)

### [Energy and Matter](http://www.nap.edu/openbook.php?record_id=13165&page=94)

### [Systems and System Models](http://www.nap.edu/openbook.php?record_id=13165&page=91)

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| **The Mole and Bonding** | **Achieving Grade Level (AT)** |
| **LT4A-** Analyze and explain the relationships between mass, molar mass, and empirical formulas. **LT4B-** Predict ionic and molecular formulas and write their names.  **LT4C-** Use models to support predictions about the type of compound based on the properties of a substance.   |

**Topic 5: Chemical Reactions and Stoichiometry**

Science and Engineering Practices (SEP)

Disciplinary Core Ideas (DCI)

Cross Cutting Concepts (CCC)

### [Constructing Explanations and Designing Solutions](http://www.nap.edu/openbook.php?record_id=13165&page=67)

### [Using Mathematics and Computational Thinking](http://www.nap.edu/openbook.php?record_id=13165&page=64)

### [PS1.A: Structure and Properties of Matter](http://www.nap.edu/openbook.php?record_id=13165&page=106)

### [PS1.B: Chemical Reactions](http://www.nap.edu/openbook.php?record_id=13165&page=109)

### [Patterns](http://www.nap.edu/openbook.php?record_id=13165&page=85)

### [Energy and Matter](http://www.nap.edu/openbook.php?record_id=13165&page=94)

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| **Chemical Reactions and Stoichiometry** | **Achieving Grade Level (AT)** |
| **LT5A- Develop a model of a chemical reaction that supports the claim that atoms and therefore mass are conserved in a chemical reaction** [**(HS-PS1-2)**](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS1-2%20Evidence%20Statements%20June%202015%20asterisks.pdf)**LT5B- Predict chemical reactions based on the properties of the reactants while considering the law of conservation of mass.****LT5C- Explain changes in the amounts of reactants and products based on the balanced reaction equation for a chemical process** [**(HS-PS1-7)**](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS1-7%20Evidence%20Statements%20June%202015%20asterisks.pdf) |

**Topic 6: Reaction Rates & Equilibrium**

Science and Engineering Practices (SEP)

Disciplinary Core Ideas (DCI)

Cross Cutting Concepts (CCC)

### [Constructing Explanations and Designing Solutions](http://www.nap.edu/openbook.php?record_id=13165&page=67)

### [PS1.B: Chemical Reactions](http://www.nap.edu/openbook.php?record_id=13165&page=109)

### [ETS1.C: Optimizing the Design Solution](http://www.nap.edu/openbook.php?record_id=13165&page=208)

### [Patterns](http://www.nap.edu/openbook.php?record_id=13165&page=85)

### [Stability and Change](http://www.nap.edu/openbook.php?record_id=13165&page=98)

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| **Reaction Rates & Equilibrium** | **Achieving Grade Level (AT)** |
| **LT6A- Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.** [**(HS-PS1-5)**](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS1-5%20Evidence%20Statements%20June%202015%20asterisks.pdf)**LT6B- Explain the relationship between the reversable reactions and the system at equilibrium.** **LT6C- Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.** [**(HS-PS1-6)**](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS1-6%20Evidence%20Statements%20June%202015%20asterisks.pdf) |

**Topic 7: Nuclear Chemistry**

Science and Engineering Practices (SEP)

Disciplinary Core Ideas (DCI)

Cross Cutting Concepts (CCC)

### [Developing and Using Models](http://www.nap.edu/openbook.php?record_id=13165&page=56)

###  [PS1.C: Nuclear Processes](http://www.nap.edu/openbook.php?record_id=13165&page=111)

### [Energy and Matter](http://www.nap.edu/openbook.php?record_id=13165&page=94)

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| **Nuclear Chemistry**  | **Achieving Grade Level (AT)** |
| **LT7A- Develop models to illustrate the changes in the composition of the nucleus of the atom and energy released during the process of fusion** [**(HS-PS1-8)**](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS1-8%20Evidence%20Statements%20June%202015%20asterisks.pdf)**LT7B- Develop models to illustrate the changes in the composition of the nucleus of the atom and energy released during the process of fission** [**(HS-PS1-8)**](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS1-8%20Evidence%20Statements%20June%202015%20asterisks.pdf)**LT7C- Develop models to illustrate the changes in the composition of the nucleus of the atom and energy released during the process of radioactivity** [**(HS-PS1-8)**](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS1-8%20Evidence%20Statements%20June%202015%20asterisks.pdf) |

**Topic 8: Energy Transfer**

Science and Engineering Practices (SEP)

Disciplinary Core Ideas (DCI)

Cross Cutting Concepts (CCC)

### [Using Mathematics and Computational Thinking](http://www.nap.edu/openbook.php?record_id=13165&page=64)

### [Planning and Carrying Out Investigations](http://www.nap.edu/openbook.php?record_id=13165&page=59)

### [PS3.A: Definitions of Energy](http://www.nap.edu/openbook.php?record_id=13165&page=120)

### [PS3.B: Conservation of Energy and Energy Transfer](http://www.nap.edu/openbook.php?record_id=13165&page=124)

### [PS3.D: Energy in Chemical Processes](http://www.nap.edu/openbook.php?record_id=13165&page=128)

### [Systems and System Models](http://www.nap.edu/openbook.php?record_id=13165&page=91)

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| **Energy Transfer**  | **Achieving Grade Level (AT)** |
| **LT8A- Use a model to depict the role of energy during a phase change and show how the energy is conserved.** [**(HS-PS3-1)**](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS3-1%20Evidence%20Statements%20June%202015%20asterisks.pdf)**LT8B- Create a computational model to calculate the change in the energy of one component in a system.** [**(HS-PS3-1)**](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS3-1%20Evidence%20Statements%20June%202015%20asterisks.pdf)**LT8C- Predict the changes in a system when two substances of different temperatures are combined within a closed system and support with reasoning.** [**(HS-PS3-4)**](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS3-4%20Evidence%20Statements%20June%202015%20asterisks.pdf) |