Reviewer Name_____ Grade:__7-8th Lesson/Unit Title: Crime Lab Chemistry_____

I. Alignment to the NGSS

The lesson or unit aligns with the conceptual shifts of the NGSS:

Students who demonstrate understanding can:

MS-PS1-1. **Develop models to describe the atomic composition of simple molecules and extended structures.** [Clarification Statement: Emphasis is on developing models of molecules that vary in complexity. Examples of simple molecules could include ammonia and methanol. Examples of extended structures could include sodium chloride or diamonds. Examples of molecular-level models could include drawings, 3D ball and stick structures, or computer representations showing different molecules with different types of atoms.] [*Assessment Boundary: Assessment does not include valence electrons and bonding energy, discussing the ionic nature of subunits of complex structures, or a complete description of all individual atoms in a complex molecule or extended structure is not required.*]

Criteria	Specific evidence from materials and reviewers' reasoning	Suggestions for improvement
A. Grade-appropriate elements of the science and engineering practice(s), disciplinary core idea(s), and crosscutting concept(s), work together to support students in three-dimensional learning to make sense of phenomena and/or to design solutions to problems. i. Provides opportunities to develop and use specific elements of the practice(s) to make sense of phenomena and/or to design solutions to problems. ii. Provides opportunities to develop and use specific elements of the disciplinary core idea(s) to	i. Evidence of opportunities for students to develop and use the practices include: ● *Students will be Introduced to chromatography as a technique in chemistry through which substances in a mixture can be separated. (Students are creating a model of ink blots to determine which marker is the marker which wrote the note.)* ● *Students will learn fundamental chemistry and forensic concepts and processes in the rest of the Crime Lab Chemistry Unit.* ● Students use chromatography to separate the components of "clue" substances to originate, discuss, and refine their own	● Students should be planning their investigations at this point. Or they should at least engage in meaningful discussions about the type of data they need to answer their question and how to organize that data. These supports will help them plan their own investigations in the future. ● Have students consider the limitations of their data (accuracy and precision in measurements). ● Have students construct a written explanation after Session 1: Investigating the evidence and then revise their explanation after Session 2: Solving the

make sense of phenomena and/or to design solutions to problems. iii.Provides opportunities to develop and use specific elements of the crosscutting concept(s) to make sense of phenomena and/or to design solutions to problems. iv.The three dimensions work together to support students to make sense of phenomena and/or to design solutions to problems.	molecular models and scientific explanations of evidence ● In activity two, Students will observe a model which includes molecules represented by rocks, paper wads, styrofoam balls and styrofoam packing peanuts. ● Students examine four different models of the ink-paper-water chromatography system used in activity one. ● During activity three, Students use water and chromatography paper to explore a variety of test substances to observe which separation method works best. (Activity 3 Part 1) Ii. Evidence of opportunities for students to develop and use the DCIs include: ● Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms. (MS-PS1-1) ● Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. (MS-PS1-3) *(Note: This Disciplinary Core Idea is also addressed by MS-PS1-2.)* Iii. Evidence of opportunities for students to develop and use the CCC include : **<u>Developing and Using Models</u>** Modeling in 6–8 builds on K–5 and progresses to developing, using and revising models to describe,	mystery after applying scientific ideas and evidences from both exploration activities. ● Provide opportunities for students to develop claims regarding the different types of ink and communicating their findings to each other. ● Before the investigation begins have students develop a claim based on the writer of the note and their motive. ● Consider providing students with a template for graphic representation of the test strips with the pen markings to match up with the ransom note sample . ● Adapt one of the scenarios to your situation by changing suspect names and/or other details. ● Some teachers create in-school mysteries in which school staff are the suspects. ● On the board write a list of the six suspects' names and numbers. This should be visible to the entire class and

	test, and predict more abstract phenomena and design systems. ● Develop a model to predict and/or describe phenomena. ● Students begin to formulate a scientific model to explain chromatography. ● Students will understand that models can be very useful but also have limitations and that all models are inaccurate in one or more ways. **Cause and Effect** ● Chromatography is a system composed of a medium, a solvent and a test substance Scale, Proportion and Quantity ● Session 2: Develop students abilities to observe and discuss test results. ● Help students make inferences and draw conclusions based on evidence (and refrain from jumping to conclusions!) ● Enable students to understand that all substances are made of molecules, and their molecular structure in part determines how they interact with other substances. ● Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (MS-PS1-3) System and System Models ● Chromatography is a system composed of a medium, a solvent and a test substance	will to be referred to periodically during Activities 1 and 2.

A unit or longer lesson will also:

Criteria	Specific evidence from materials and reviewers' reasoning	Suggestions for improvement
B. Lessons fit together coherently targeting a set of performance expectations. i. Each lesson links to previous lessons and provides a need to engage in the current lesson. ii. The lessons help students develop proficiency on a targeted set of performance expectations. C. Where appropriate, disciplinary core ideas from different disciplines are used together to explain phenomena. D.Where appropriate, crosscutting concepts are used in the explanation of phenomena from a variety of disciplines.	I. Students are introduced to the science of chromatography through an engagement activity. Activity one has the the students using paper chromatography to test pens and use the results to identify the "mystery pen". Lesson two teaches the students that chromatography is a system for separating mixtures. Students analyze molecular structure and then evaluate and adjust their initial molecular models. The third activity has the students designing their own tests and chromatography systems. Ii. The lessons provide students with real life connection of how physical properties of matter can affect the formation of objects. These activities meet the performance expectations which state "Students who demonstrate understanding can: develop models to describe the atomic composition of simple molecules and extended structures."	

E. Provides grade-appropriate connection(s) to the Common Core State Standards in Mathematics and/or English Language Arts & Literacy in History/Social Studies, Science and Technical Subjects.	MP2 Reason abstractly. **RST.6-8.3** Follow precisely a multistep procedure when carrying out experiments, taking measures or performing technical tasks. CCSS.ELA-LITERACY.RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table)	Students could indicate how many different colors are visible in each test. Measure the distance each color travels.

Activity 1

Reviewer Name_____ Grade:_____ Lesson/Unit Title:_____

Evidence that Disciplinary Core Ideas (DCIs), Science and Engineering Practice (SEP) and Crosscutting Concepts (CCCs) were included in this lesson

Disciplinary Core Ideas (DCIs)	Element	Evidence
MS-PS1. A: Structure and Properties of Matter	**Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms. (MS-PS1-1)** **Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. (MS-PS1-4)** **In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations. (MS-PS1-4)**	**Session 1: Introduce students to chromatography as a technique in chemistry through which substances in a mixture can be separated. (Students are creating a model of ink blots to determine which marker is the marker which wrote the note.)** **Set the stage for learning fundamental chemistry and forensic concepts and processes in the rest of the Crime Lab Chemistry Unit.**

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Evidence that Disciplinary Core Ideas (DCIs), Science and Engineering Practice (SEP) and Crosscutting Concepts (CCCs) were included in this lesson

Science and Engineering Practice (SEP)	Element	Evidence
Developing and Using Models	**Modeling in 6–8 builds on K–5 and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems.(MS-PS1-1)** **Develop a model to predict and/or describe phenomena. (MS-PS1-1)**	**Session 2: Have students begin to formulate a scientific model to explain chromatography.** **Help students understand that models can be very useful but also have limitations and that all models are inaccurate in one or more ways.** **Students debate and vote on whether or not the evidence from their chromatography tests alone is enough to convict the suspect with the matching pen.** **Students draw a model to show why some ink molecules go up the paper better than others.**

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Evidence that Disciplinary Core Ideas (DCIs), Science and Engineering Practice (SEP) and Crosscutting Concepts (CCCs) were included in this lesson

Crosscutting Concepts (CCCs)	Element	Evidence

Cause and Effect **Scale, Proportion, and Quantity**	**Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-PS1-4)** **Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (MS-PS1-1)**	**Students discuss how they could change the medium and the solvent in the model to separate all molecules of the test substance more effectively.** **Students examine four different models of the ink-paper-water chromatography system they used in Activity 1.**

Activity 2

Reviewer Name_____ Grade:_____ Lesson/Unit Title:_____

Disciplinary Core Ideas (DCIs)	Element	Evidence
MS-PS1. A: Structure and Properties of Matter	**Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms. (MS-PS1-1) Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. (MS-PS1-3) *(Note: This Disciplinary Core Idea is also addressed by MS-PS1-2.)***	**Students will observe a model which includes molecules represented by rocks, paper wads, styrofoam balls and styrofoam packing peanuts.** **Students examine four different models of the ink-paper-water chromatography system used in activity one.**

Evidence that Disciplinary Core Ideas (DCIs), Science and Engineering Practice (SEP) and Crosscutting Concepts (CCCs) were included in this lesson

Reviewer Name_____ Grade:_____ Lesson/Unit Title:_____

Science and Engineering Practice (SEP)	Element	Evidence

ETS1.C: Optimizing the Design Solution	• **Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design. (MS-ETS1-3)predecessors. (MS-ETS1-3)**	**The challenge is redraw their molecular models due to new information and evidence. .**

Evidence that Disciplinary Core Ideas (DCIs), Science and Engineering Practice (SEP) and Crosscutting Concepts (CCCs) were included in this lesson

Reviewer Name_____ Grade:_____ Lesson/Unit Title:_____

Evidence that Disciplinary Core Ideas (DCIs), Science and Engineering Practice (SEP) and Crosscutting Concepts (CCCs) were included in this lesson

Crosscutting Concepts (CCCs)	Element	Evidence
System and system models **<u>Scale, Proportion, and Quantity</u>**	• **Chromatography is a system composed of a medium, a solvent and a test substance** • **Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (MS-PS1-3)**	**Students will observe a model conducted by the teacher which includes molecules represented by rocks, paper wads, styrofoam balls and styrofoam packing peanuts.** **Students will draw a "microscope eyes" model to show what they think happened to the molecules of the test substance. They should then explain colors visible, determine which colors traveled higher, lower or not at all.**

Activity 3

Reviewer Name_____ Grade:_____ Lesson/Unit Title:_____

Disciplinary Core Ideas (DCIs)	Element	Evidence
MS-PS1. A: Structure and Properties of Matter	**Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms. (MS-PS1-1) Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. (MS-PS1-3) *(Note: This Disciplinary Core Idea is also addressed by MS-PS1-2.)***	**Students use water and chromatography paper to explore a variety of test substances to observe which separation method works best. (Activity 3 Part 1)**

Evidence that Disciplinary Core Ideas (DCIs), Science and Engineering Practice (SEP) and Crosscutting Concepts (CCCs) were included in this lesson

Reviewer Name_____ Grade:_____ Lesson/Unit Title:_____

Science and Engineering Practice (SEP)	Element	Evidence
ETS1.B: Developing Possible Solutions **ETS1.C: Optimizing the Design Solution**	• **<u>A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (MS-ETS1-4)</u>** • **There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MS-ETS1-2), (MS-ETS1-3)** • **Sometimes parts of different solutions can be combined to create**	**Students must determine which solvent (vinegar or alcohol) works best to separate some of the test substances (Activity 3 Part 1)** **Students design the best system to separate the test substance. Students**

	a solution that is better than any of its predecessors. (MS-ETS1-3) • Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design. (MS-ETS1-3)predecessors. (MS-ETS1-3)	choose one test substance that interests them. They will have three material stations to choose from.

Evidence that Disciplinary Core Ideas (DCIs), Science and Engineering Practice (SEP) and Crosscutting Concepts (CCCs) were included in this lesson

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Evidence that Disciplinary Core Ideas (DCIs), Science and Engineering Practice (SEP) and Crosscutting Concepts (CCCs) were included in this lesson

Crosscutting Concepts (CCCs)	Element	Evidence
Cause and Effect	• Chromatography is a system composed of a medium, a solvent and a test substance	Student will choose investigations from three material stations and propose explanation for results.
Scale, Proportion, and Quantity	• Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (MS-PS1-3)	Students will draw a "microscope eyes" model to show what they think happened to the molecules of the test substance. They should then explain colors visible, determine which colors traveled higher, lower or not at all.