Intro to Cancer: Leukemia and Hina's Story

DEVELOPER: Fred Hutchinson Cancer Center

GRADE: 9-12 **| DATE OF REVIEW:** May 2022*

Educators Evaluating Quality Instructional Products

NextGen Science WestEd

Intro to Cancer
EQuIP RUBRIC FOR SCIENCE EVALUATION

OVERALL RATING: E/I

TOTAL SCORE: 6

CATEGORY I: NGSS 3D Design Score	CATEGORY II: NGSS Instructional Supports Score	CATEGORY III: Monitoring NGSS Student Progress Score
2	2	2

Click here to see the scoring guidelines.

This review was conducted by NextGenScience using the EQuIP Rubric for Science.

CATEGORY I CRITERIA RATINGS			CATEGORY II CRITERIA RATINGS			CATEGORY III CRITERIA RATINGS		
A.	Explaining Phenomena/ Designing Solutions	**Adequate**	**A.**	Relevance and Authenticity	**Extensive**	**A.**	Monitoring 3D Student Performances	**Adequate**
B.	Three Dimensions	**Adequate**	**B.**	Student Ideas	**Extensive**	**B.**	Formative	**Adequate**
C.	Integrating the Three Dimensions	**Extensive**	**C.**	Building Progressions	**Inadequate**	**C.**	Scoring Guidance	**Inadequate**
D.	Unit Coherence	**Extensive**	**D.**	Scientific Accuracy	**Extensive**	**D.**	Unbiased Tasks/Items	**Adequate**
E.	Multiple Science Domains	**Adequate**	**E.**	Differentiated Instruction	**Adequate**	**E.**	Coherence Assessment System	**Adequate**
F.	Math and ELA	**Extensive**	**F.**	Teacher Support for Unit Coherence	**Adequate**	**F.**	Opportunity to Learn	**Adequate**
			G.	Scaffolded Differentiation Over Time	**Adequate**			

Summary Comments

Thank you for your commitment to students and their science education. NextGenScience is glad to partner with you in this continuous improvement process. The unit is strong in many areas, including integrating the three dimensions and unit coherence.

During revisions or use in the classroom, the reviewers recommend paying close attention to the following focus areas to strengthen materials:

- **Building on students' prior learning in all three dimensions.** It would be helpful to provide connections between prior learning experiences and development of practices and crosscutting concepts (CCCs) to the expected grade level learning experiences.
- **Scoring Guidance.** This is a critical component of assessment and feedback. The unit would be strengthened with the specification of element-level assessment targets and the addition of rubrics and formative assessment guidance for quantitative measures.

Note that in the feedback below, black text is used for either neutral comments or evidence the criterion was met and purple text is used as evidence that doesn't support a claim that the criterion was met. The purple text in these review reports is written directly related to criteria and is meant to point out details that could be possible areas where there is room for improvement. Not all purple text lowers a score; much of it is too minor to affect the score. For example, even criteria rated as Extensive could have purple text that is meant to be helpful for continuous improvement processes. In these cases, the criterion WAS met. The purple text is simply not part of the argument for that Extensive rating.

**v1 of the unit was reviewed in May 2022. In January 2023, the Criteria I.B and I.D sections of this review report were updated to reflect related changes in v2 of the unit. The page numbers described under other EQuIP criteria refer to v1 and therefore may no longer be accurate.*

CATEGORY I

NGSS 3D DESIGN

I.A. EXPLAINING PHENOMENA/DESIGNING SOLUTIONS

I.B. THREE DIMENSIONS

I.C. INTEGRATING THE THREE DIMENSIONS

I.D. UNIT COHERENCE

I.E. MULTIPLE SCIENCE DOMAINS

I.F. MATH AND ELA

I.A. EXPLAINING PHENOMENA/DESIGNING SOLUTIONS

Making sense of phenomena and/or designing solutions to a problem drive student learning.

i. Student questions and prior experiences related to the phenomenon or problem motivate sense-making and/or problem solving.
ii. The focus of the lesson is to support students in making sense of phenomena and/or designing solutions to problems.
iii. When engineering is a learning focus, it is integrated with developing disciplinary core ideas from physical, life, and/or earth and space sciences.

Rating for Criterion I.A. Explaining Phenomena/Designing Solutions	Adequate *(None, Inadequate, Adequate, Extensive)*

The reviewers found adequate evidence that learning is driven by students making sense of phenomena or designing solutions to a problem. The focus of the unit is primarily to support students in making sense of the central phenomenon of how leukemia affects the body as introduced through Hina Marsey, an eleven-year-old girl. However, there is inconsistent student-driven learning. Although some opportunities for students to ask questions related to the phenomenon are present, in many cases the motivation for student sense-making is teacher driven.

The unit centers on students making sense of the effects of leukemia on an eleven-year-old girl. Student questions related to the phenomenon arise at the beginning of the unit and are arranged in a Driving Question Board (DQB) that is organized by the teacher and the class. The class returns to add or answer these questions at the end of some of the lessons throughout the unit. Students also use the Incremental Model Tracker (IMT) as support when creating questions. However, explicit examples of where the materials provide support for teachers to elicit these questions were inconsistently provided.

Related evidence includes:

- Lesson 1: The anchoring phenomenon of the effects of Hina Marsey's leukemia is presented by students reading, and students generate questions based on their observations to create a DQB.
- Lesson 2: Students review class "What We Know" chart and DQB to guide the investigation focus of examining data from complete blood count (CBC) tests to look for patterns in order to determine what leukemia does to a person's blood, and specifically to Hina's blood.
- Lesson 3: Guidance is provided for the teacher, "Recap some of the takeaways from the previous lessons. Students can use their IMT documents to share major takeaways from the first two lessons" (Teacher Guide, Page 5). However, guidance as to how to elicit questions from students to drive sense-making was not located.

- Lesson 4: Students are prompted to share what they know about why cells divide, making connections to previous lessons before learning about how cell differentiation results in mature specialized cells and how that relates to Hina's numbers of immature blast cells. This is a missed opportunity for students to return to the DQB to address questions answered and create new questions for the unit.
- Lesson 5: After modeling the cell cycle, students revisit their IMT to revisit or revise their model about the cell cycle and how it connects to understanding Hina's disease. Again, guidance as to how to elicit questions from students and how to use those questions to drive sense-making was not located. This is another missed opportunity for students to address questions answered and create new questions for the unit.
- Lesson 6: Students return to the IMT and DQB to elicit any questions about the topic of cancer treatment before investigating how different cancer treatments work to control the growth of cancer cells.
- Lesson 7: After reading articles and engaging with simulations about the concept of human leukocyte antigens (HLA) matching, students return to the IMT and DQB to conclude the lesson. Also, guidance as to how to elicit questions from students to drive sense-making was not located.
- Lesson 8: Students are reminded of the blog post about Hina's condition and make connections to the lack of diversity of HLA alleles in the bone marrow database before explaining why finding a bone marrow transplant match might be difficult for Hina. However, guidance as to how to elicit questions from students to drive sense-making was not located. This is a missed opportunity for students to use the blog posts to create their own questions, which could drive the end of the unit.
- Lesson 9: Revisiting blog post #5, students are prompted to share questions they have before discovering that cord blood stem cells may be an option for Hina. The lesson closes with students creating a final conceptual model of Hina's bone marrow and blood cells as a way of understanding her treatments. Students are encouraged to write any additional questions they may have and add them to the DQB.
- Lesson 10: Students work in groups to create an educational campaign to raise awareness about becoming a stem cell donor through bone marrow or cord blood donation before creating a luminaria to honor someone who has experienced cancer. However, in this activity, students are not focused explicitly on trying to solve a problem or explain a phenomenon.

Suggestions for Improvement

- Consider providing clear guidance to help ensure that students will feel as if they are driving the learning.
- Consider more often using students' prior learning and experiences, either from previous lessons or grades, to motivate their sense-making.

I.B. THREE DIMENSIONS

Builds understanding of multiple grade-appropriate elements of the science and engineering practices (SEPs), disciplinary core ideas (DCIs), and crosscutting concepts (CCCs) that are deliberately selected to aid student sense-making of phenomena and/or designing of solutions.

i. Provides opportunities to *develop and use* specific elements of the SEP(s).

ii. Provides opportunities to *develop and use* specific elements of the DCI(s).

iii. Provides opportunities to *develop and use* specific elements of the CCC(s).

Rating for Criterion I.B. Three Dimensions	*Adequate* *(None, Inadequate, Adequate, Extensive)*

The reviewers found adequate evidence that the materials give students opportunities to build understanding of grade-appropriate elements of the three dimensions. Throughout the unit, students have opportunities to use grade-appropriate elements of all three dimensions. Specific element-level claims are present in the lesson-level materials. However, students have few opportunities to develop new understanding of and proficiency in SEPs and CCCs in the unit. They primarily apply elements that have previously been learned.

Science and Engineering Practices (SEPs) | **Rating: Adequate**

The reviewers found adequate evidence that students have the opportunity to use or develop the SEPs in this unit. There are some opportunities for students to use grade-appropriate SEP elements and some of those elements are used in service of making sense of the phenomenon. However, explicit consistent evidence that the students develop (rather than just use) the claimed focus SEP elements was not located.

Developing and Using Models

- *Develop, revise, and/or use a model based on evidence to illustrate the relationships between systems or between components of a system.*
    - Lesson 1: After being introduced to Hina, a student who has leukemia, students develop and share initial conceptual models to understand the systems or components within a system interacting to cause Hina's symptoms.
    - Lesson 2: Students analyze the different types of cells that make up blood, then they use the conceptual model created in Lesson 1 to discuss relationships between body systems.
    - Lesson 3: Students use sequencing cards and analogies modeling mitosis to help them understand cell division and how it is affected by cancer.

- Lesson 4: After learning about blood cell differentiation and hematopoiesis, students create clay models of the differentiation of blood cells, modeling for both healthy cells and cancer cells.
- Lesson 5: Students develop a second conceptual model to show the role of blood stem cells when Hina was healthy and how that changed when Hina got sick. Students compare, discuss, and revise their models based on peer feedback.
- Lesson 7: Students determine if anyone in their class would be a good HLA match through a simulated dice rolling activity before they discuss how this process would be applied in Hina's situation.
- Lesson 9: Students develop a third conceptual model to illustrate and compare the systems of blood stem cells while Hina was receiving chemotherapy and after Hina's cord blood transplant. Students are prompted to, "Show two or more body systems are impacted or restored through this process" (Student Handout 9.2, page 1).
- Lesson 10: Students develop a Public Service Announcement (PSA) that communicates why stem cell donation is important and how it pertains to Hina. Students are told they can use all three conceptual models created throughout the unit as a resource for their PSA. However, there is no evidence that students would directly use the models in their PSAs to illustrate relationships between systems or system components. Explicit prompts for students to represent the relationship between systems were not located.

Constructing Explanations and Designing Solutions

- *Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.*
    - Lesson 1: The first part of the element is claimed. Students develop their initial model to showcase their understanding of the systems interacting in Hina's body and then explain what could be causing her symptoms.
    - Lesson 5: Part of this element is claimed. After developing a conceptual model to illustrate the role of blood stem cells, students write an explanation that addresses how Hina's cancer is affecting her body.
    - Lesson 7: In an optional lab activity, students use gel electrophoresis to construct explanations about genes, DNA, and HLA matching. Note that in the Materials, Timeline, and Virtual Learning sections of the lesson, this lab activity is labeled as optional. If this activity is therefore treated as optional, students might not use this element.
    - Lesson 8: Students read an article about the experience of being Black and having cancer, participate in activities at stations focused on racial health inequities, and watch a video on the U.S. Public Health Service Syphilis Study to construct an explanation for the text-based Socratic Seminar.
    - Lesson 9: The first part of the element is claimed. Using graphs, student-created models and articles, students write an explanation that addresses how chemotherapy and cord

blood transplant cured Hina's cancer and how the new donor stem cells replaced her cancerous cells.

Engaging in Argument from Evidence

- *Construct, use, and/or present an oral and written argument or counter arguments based on data and evidence.*
    - Lesson 2: This element is claimed as being built toward and partially addressed in this lesson. After learning about the different types of specialized cells that make up blood, students analyze data and identify patterns in blood test data. Then they use those patterns to create an evidence-based claim about microscope blood smear images. Students are asked to share their evidence-based claim and to share what evidence supports the claim. The rest of the class is asked to agree and to share why or why not (Teacher Guide, pages 13–14). Students are then asked, "Can you make an evidence-based claim for who might be Patient A and Patient B in the microscope blood smear images we looked at? How do the blood charts data support your claim?" (Teacher Guide, page 14).

Obtaining, Evaluating and Communicating Information

- *Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions and/or to obtain scientific and/or technical information to summarize complex evidence, concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.*
    - Lesson 6: This element is claimed as being built toward and partially addressed. Students read cancer survivor stories to learn about a person's personal cancer journey and then research one type of cancer, cancer treatment, and one career related to cancer treatment and patient care.
    - Lesson 8: This element is claimed as being built toward and partially addressed. Students read an article about the experience of being Black and having cancer.
- *Communicate scientific and/or technical information or ideas (e.g., about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically) instead.*
    - Lesson 10: This element is claimed. Students obtain information from various sources to develop a PSA that communicates why stem cell donation is important.

Disciplinary Core Ideas (DCIs) | **Rating: Extensive**

The reviewers found extensive evidence that students have the opportunity to use or develop the DCIs in this unit because students are supported to fully develop one DCI throughout the unit and students use this DCI in service of making sense of unit phenomena. Students partially develop two additional DCI elements.

LS1.A: Structure and Function

- *Systems of specialized cells within organisms help them perform the essential functions of life.*
    - Lesson 2: The first part of this DCI element is claimed. Students learn about the different types of specialized cells that make up blood to maintain a healthy individual.
    - Lesson 4: This element is claimed as being built toward and partially addressed in the lesson. Students learn about blood cell differentiation and hematopoiesis through modeling healthy cells and cancer cells.
- *All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out the work of cells.*
    - Lesson 7: Students learn that the HLA genes determine the structure of cell surface proteins and look for patterns around HLA inheritance.

LS1.B: Growth and Development of Organisms

- *In multicellular organisms individual cells grow and then divide via a process called mitosis, thereby allowing the organism to grow. The organism begins as a single cell (fertilized egg) that divides successively to produce many cells, with each parent cell passing identical genetic material (two variants of each chromosome pair) to both daughter cells. Cellular division and differentiation produce and maintain a complex organism, composed of systems of tissues and organs that work together to meet the needs of the whole organism.*
    - Lesson 3: Students learn about the process of mitosis, cell division, and the cell cycle as a way to understand what is happening in Hina's blood and bone marrow.
    - Lesson 4: Students learn about blood cell differentiation and how it is caused by the expression of certain genes. They then connect hematopoiesis to leukemia and how this process affects Hina's cells.
    - Lesson 5: Students learn about the role of blood stem cells by taking on the role of healthy hematopoietic blood stem cells, cancerous stem cells, and checkpoint proteins. Students connect their knowledge of the cell cycle and cell differentiation to how an accumulation of mutations causes cancerous cells to grow in an uncontrolled fashion.
    - Lesson 6: After learning about how chemotherapy destroys cells in the process of mitosis within the body, they also learn about stem cell transplants including the process of engraftment.
    - Lesson 7: Students learn that the HLA genes determine the structure of cell surface proteins and how they function in the immune system.
    - Lesson 9: After learning about three sources of stem cells for transplantation, students show the types of blood cells, how and where cell differentiation occurs, and which cells are dividing faster and slower.
    - Lesson 10: Students showcase understanding of blood stem cells, cancer cells, and body systems by developing a PSA that communicates why stem cell donation is important.

Crosscutting Concepts (CCCs) | **Rating: Adequate**

The reviewers found adequate evidence that students have the opportunity to use or develop the CCCs in this unit. There are some opportunities for students to use grade-appropriate CCC elements and sometimes those elements are used in service of making sense of the phenomenon. However, explicit consistent evidence that the students develop (rather than just use) the claimed focus CCC elements was not located.

The following elements were claimed or used in the unit:

Systems and System Models

- *Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions – including energy, matter, and information flows – within and between systems at different scales.*
    - Lesson 1: The unit launch elicits students' prior knowledge about blood cells and body systems by having them create an initial model to show what they think is happening within Hina's body.
    - Lesson 2: Part of this element is claimed. Students participate in a data-based seminar where they use blood chart data to discuss relationships between body systems to connect the blood test data and Hina's symptoms. Student Handout 2.1 asks students to, "Build a conceptual model of the interactions between different body systems involving the blood. Add labels, arrows, and other details to express your knowledge about the blood and these organ systems….Models like this can help organize ideas and our understanding of complex systems."
    - Lesson 3: Students learn about what is happening in Hina's blood and bone marrow and how her cancer is affecting other systems in her body through different ways of modeling mitosis.
    - Lesson 4: Students model blood cell differentiation to show how the cells express different genes and proteins. Then they discuss how this process affects Hina's body systems.
    - Lesson 5: Students develop a second conceptual model to illustrate the interacting systems of blood stem cells when Hina was healthy and how that changed when Hina became sick from leukemia.
    - Lesson 9: The third student-developed conceptual model shows the types of blood cells, how and where cell differentiation occurs, and what each treatment does to her cells and body systems.

Structure and Function

- *Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components and connections of components to reveal its function and/or solve a problem.*

- Lesson 2: After learning about the different types of specialized cells that make up blood and their functions, students are able to explain the typical amounts of cells needed to maintain a healthy individual.
- Lesson 4: Students learn about the structure and function of different blood cells through modeling both healthy cells and cancer cells.
- Lesson 7: Through a series of modeling activities students learn that the HLA genes determine the structure of cell surface proteins and how they function in the immune system.

Suggestions for Improvement

Science and Engineering Practices (SEPs)

Consider providing explicit supports for students to develop new understanding of or proficiency in targeted SEP elements.

Crosscutting Concepts (CCCs)

Consider providing explicit supports for students to develop new understanding of or proficiency in targeted CCC elements. This kind of explicit learning would help allow students to apply these concepts as lenses when faced with a new phenomenon to explain or problem to solve.

I.C. INTEGRATING THE THREE DIMENSIONS

Student sense-making of phenomena and/or designing of solutions requires student performances that integrate elements of the SEPs, CCCs, and DCIs.

Rating for Criterion I.C. Integrating the Three Dimensions	Extensive *(None, Inadequate, Adequate, Extensive)*

The reviewers found extensive evidence that student performances integrate elements of the three dimensions in service of figuring out phenomena and designing solutions to problems. Students have several opportunities to engage in multi-dimensional learning in service of problem solving or sense-making.

The following student sense-making tasks of the phenomenon included elements of all three dimensions at a grade-appropriate level:

- Lesson 3: Students learn about the process of mitosis, cell division and the cell cycle (DCI **LS1.B**) through modeling (SEP **Developing and Using Models**) to understand how her cancer is affecting the other systems in her body (CCC **Systems and System Models**).

- Lesson 4: Students create clay models of the differentiation of blood cells (SEP **Developing and Using Models),** modeling the process for both healthy cells and cancer cells (DCI **LS1.A**). Then they learn about the structure and function of different blood cells (CCC **Structure and Function).**
- Lesson 7: Through modeling activities (SEP **Developing and Using Models)** and data interpretation, students learn that HLA genes (DCI **LS1.A)** determine the structure of cell surface proteins and how they function (CCC **Structure and Function**) in the immune system as markers.

The following lessons included two-dimensional student performances at the high school level:

- Lesson 5: Students connect their knowledge of the cell cycle and cell differentiation to how an accumulation of mutations causes cancerous cells to grow in an uncontrolled fashion (DCI **LS1.B**); students then compare, discuss, and revise their second conceptual checkpoint model. Next, students write an explanation (SEP **Constructing Explanations and Designing Solutions**) that addresses how Hina's cancer is affecting her body (K–2-level CCC **Cause and Effect**)
- Lesson 9: Students use their models to write an explanation (6–8-level SEP **Constructing Explanations and Designing Solutions**) that addresses how these treatments cured Hina's cancer (CCC **Systems and System Models**) and how new donor stem cells replaced her cancerous cells (DCI **LS1.B**).

Suggestions for Improvement

- Consider supporting students to use more CCC elements at the high school level. This would allow an increase in the amount of time students participate in high school-level three-dimensional learning.

I.D. UNIT COHERENCE

Lessons fit together to target a set of performance expectations.

i. Each lesson builds on prior lessons by addressing questions raised in those lessons, cultivating new questions that build on what students figured out, or cultivating new questions from related phenomena, problems, and prior student experiences.

ii. The lessons help students develop toward proficiency in a targeted set of performance expectations.

Rating for Criterion I.D. Unit Coherence	*Extensive* *(None, Inadequate, Adequate, Extensive)*

The reviewers found extensive evidence that lessons fit together coherently to target a set of performance expectations (PEs) because most lessons build on prior lessons and many times this is apparent to students. Additionally, there are “Bridges” between each bend that help students connect the first bend to the second bend. Across lessons, there is evidence that students should refer to prior lessons to figure out what has happened to Hina. Students also work toward developing proficiency on targeted learning for all three dimensions of the primary PE in most lessons.

Some lessons build on prior lessons in a way that makes sense from students’ perspectives by engaging students in asking questions based on what they’ve learned so far or pursuing relevant questions unanswered in the previous lesson. Related evidence includes:

- Lesson 1: “Students then write a question they are curious about having answered on a sticky note and add it to the ‘Driving Questions’ board. One question that students might come up with is: How did Hina’s doctors know that she has leukemia? This question will motivate the next lesson (Lesson 2) where we look toward understanding how leukemia is diagnosed” (Teacher Guide, pages 6–7).
- Lesson 2: Students review class “What We Know” chart and a DQB to guide the investigation focus of examining data from CBC tests to look for patterns. In the opening/bridge of the lesson it states, “Tell students that they will be revisiting one of the big questions that should have come up in their earlier discussion or in their conceptual models: ‘What does leukemia do to a person’s blood, and specifically, to Hina’s blood?’” (Teacher Guide, page 5).
- Lesson 3: Students use an IMT to review the previous lesson and central phenomenon. Guidance is provided for the teacher, “Recap some of the takeaways from the previous lessons. Students can use their IMT documents to share major takeaways from the first two lessons” (Teacher Guide, page 5).

- Lesson 4: In the opening to the lesson the teacher is told to, “Refer to the class Driving Question boards and students’ Incremental Modeling Trackers to prompt students to identify information from previous lessons that may help them think about potential answers to this question” (Teacher Guide, page 8).
- Lesson 5: The lesson states, “Recall that in the previous lesson, students learned how cell differentiation results in mature specialized cells as a way to understand why Hina has elevated numbers of immature blast cells. Today, we are to combine our understanding of the cell cycle and cell differentiation in the blood. Engage students' previous knowledge with this question” (Teacher Guide, page 7).
- Lesson 6: This lesson begins Bend 2. Therefore, there are explicit directions as to how the teacher can connect the two bends. The lesson states, “Surface any questions that students might have developed around the topic of cancer treatment or what is going to happen to Hina now. These could be questions from the initial driving question board or questions that have popped up in their IMTs. Have students share any previous knowledge they may have about cancer treatments. Students may have some knowledge related to solid cancers” (Teacher Guide, page 6). Then, the lesson begins with an update from Hina’s sister through a blog post.
- Lesson 7: Early in the lesson, the teacher is told, “On page one of the 7.1 HLA Matching Introduction Student Handout, students summarize what they have learned about Hina’s case, drawing from both new information from Blog Post #4 (from Lesson 6) and what they have discovered in previous lessons (such as from handouts, previous blog posts, their IMT, or class Driving Question Boards)” (Teacher Guide, page 10). After reading articles and engaging with simulations about the concept of HLA matching, students return to IMT and DQB to conclude the lesson.
- Lesson 8: Students are reminded of the blog post about Hina’s condition and make connections to the lack of diversity of HLA alleles in the bone marrow database before explaining why finding a bone marrow transplant match might be difficult for Hina.
- Lesson 9: Revisiting blog post #5, students are prompted to share questions they have before discovering that cord blood stem cells may be an option for Hina. The lesson closes with students creating a final conceptual model of Hina’s bone marrow and blood cells as a way of understanding her treatments. Students are encouraged to write any additional questions they may have and add them to the DQB.

One PE is claimed in this unit, “Learning Standards Connection Document” (Teacher Guide, page 5). All three dimensions of this primary PE (**HS-LS1-4**) are fully developed. See Criterion I.B for evidence related to each element: **HS-LS1-4:** Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms. This PE is fully addressed in Lessons 3, 4, and 5.

Suggestions for Improvement

- Consider including sample student questions or sentence stems to assist teachers in using the DQB throughout the unit.
- Consider building out more lessons to cover the secondary PEs, especially **HS-LS1-1** and **HS-LS1-2**. These PEs are partially developed and could be easily fully developed if additional supports were added.

I.E. MULTIPLE SCIENCE DOMAINS

When appropriate, links are made across the science domains of life science, physical science and Earth and space science.

i. Disciplinary core ideas from different disciplines are used together to explain phenomena.

ii. The usefulness of crosscutting concepts to make sense of phenomena or design solutions to problems across science domains is highlighted.

Rating for Criterion I.E. Multiple Science Domains	*Adequate* *(None, Inadequate, Adequate, Extensive)*

The reviewers found adequate evidence that links are made across the science domains when appropriate because the unit focuses on one science domain and the phenomena or problem driving the learning can be fully addressed within that domain. This unit focuses on the life sciences domain to develop an explanation for cell growth, cell cycles, and mutations. However, the CCC elements are not explicitly used in the unit to make connections between science domains.

Related evidence includes:

- The anchoring phenomena is mostly explained using the DCI **LS1.B Growth and Development of Organisms**. Most of the lessons, eight of 10, focus on this DCI. For example:
  - Lesson 3: Students learn about the process of mitosis, cell division, and the cell cycle as a way to understand what is happening in Hina's blood and bone marrow.
  - Lesson 4: Students learn about blood cell differentiation and how it is caused by the expression of certain genes. They then connect hematopoiesis to leukemia and how this process affects Hina's cells.
  - Lesson 5: Students learn about the role of blood stem cells by taking on the role of healthy hematopoietic blood stem cells, cancerous stem cells, and checkpoint proteins. Students connect their knowledge of the cell cycle and cell differentiation to how an accumulation of mutations causes cancerous cells to grow in an uncontrolled fashion.

  - Lesson 6: After learning about how chemotherapy destroys cells in the process of mitosis within the body, they also learn about stem cell transplants including the process of engraftment.
  - Lesson 7: Students learn that the HLA genes determine the structure of cell surface proteins and how they function in the immune system.
  - Lesson 9: After learning about three sources of stem cells for transplantation, students show the types of blood cells, how and where cell differentiation occurs, and which cells are dividing faster and slower.
- DCI **LS1.A Structure and Function** is partially explained in Lessons 2, 4, 7, and 8. For example:
  - Lesson 2: Students learn about the different types of specialized cells that make up blood to maintain a healthy individual.
  - Lesson 4: Students learn about blood cell differentiation and hematopoiesis through modeling healthy cells and cancer cells.
  - Lesson 7: Students learn that the HLA genes determine the structure of cell surface proteins and look for patterns around HLA inheritance.
  - Lesson 8: After learning about the difficulty of finding a bone marrow donor, students observe that there is insufficient diversity of HLA alleles in the bone marrow database to support patients of non-European descent.

Potential connections to the physical sciences domain are mentioned in the Connections Across Disciplines section of the Unit Overview document (Teacher Guide, pages 21–22). However, teachers and students are not supported to make these potential connections using CCCs. For example:

- Lesson 2: The materials state, “There are potential physical sciences connections to explore related to how centrifuges work to separate blood components.” However, explicit evidence of where these connections could be made using the CCCs was not located.
- Lesson 5: The materials state, “In this lesson, growth factors are introduced, providing an opportunity for making connections between chemical signals and biological processes. Growth factors are chemical signals that ‘tell’ the cell to divide.” However, explicit evidence of where these connections could be made using the CCCs was not located.
- Lesson 6: The materials state, “In this lesson, students explore how chemo works and why it produces side effects. Students also learn about other types of cancer treatments through a jigsaw activity, which *could* include learning about radiation therapy or hormone therapy, providing an opportunity for making connections between physics, chemistry, and biology concepts.” The quote says that a cross-discipline connection could be made, but there is no explicit guidance on how to do this, reducing the likelihood of students making the claimed connections.

Suggestions for Improvement

- Consider supporting student use of CCC elements and their understanding of the utility of CCC elements to help explain phenomena related to different domains. For example, students could be supported to connect their understanding of scale, proportion, and quantity in blood components (life science) to centrifuge processes (physical science). As another example, when students use a CCC element in this unit, they could be reminded of how that same CCC element was useful in a prior unit that focused on physical sciences.

I.F. MATH AND ELA

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.

Rating for Criterion I.F. Math and ELA	Extensive *(None, Inadequate, Adequate, Extensive)*

The reviewers found extensive evidence that the materials provide grade-appropriate connections to the Common Core State Standards (CCSS) in mathematics and English language arts (ELA) because CCSS are identified for every lesson and there is evidence that the students are engaging with those standards. However, these connections are not made explicit to students.

CCSS are listed in the Learning Standards Connections Table document (Teacher Guide, page 9) for each lesson. However, these connections are not explicitly called out during the lessons. Therefore, teachers may miss these opportunities.

Some examples include:

- ***CCSS.ELA.SL.11-12.5****: Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.*
    - Lesson 10: Students showcase understanding of blood stem cells, cancer cells, and body systems by developing a PSA that communicates why stem cell donation is important.
- ***CCSS.ELA.RST.9-10.3****: Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.*
    - Lesson 7: Students learn about the difficulty of finding an HLA match for BMT through a series of modeling activities and data interpretation. Then, students interpret data and look for patterns around HLA inheritance and how the proportion of matching HLA genes relates to family and unrelated donors. Students also compare the probability of finding a match to the demographics of the bone marrow registry.
- ***CCSS.ELA.RST.9-10.4****: Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics.*

    - Lesson 2: Students learn about the different types of specialized cells that make up blood, their functions, and the typical amounts needed to maintain a healthy individual.
    - Lesson 3: Students learn about the process of mitosis, cell division, and the cell cycle as a way to understand what is happening in Hina's blood and bone marrow (including genetic mutations), and how her cancer is affecting other systems in her body.
    - Lesson 4: Students learn about blood cell differentiation and hematopoiesis and how cancer affects cells' abilities to differentiate and mature.
    - Lesson 5: Students play an interactive game that models the cell cycle and illustrates the role of blood stem cells. They take on the role of healthy hematopoietic blood stem cells (HSCs), cancerous HSCs, and checkpoint proteins. Students connect their knowledge of the cell cycle and cell differentiation to how an accumulation of mutations causes cancerous cells to grow in an uncontrolled fashion.
    - Lesson 6: Students learn how chemotherapy destroys cells in the process of mitosis within the body and what side effects that causes across multiple body systems.
    - Lesson 7: Students learn about the difficulty of finding an HLA match for BMT through a series of modeling activities and data interpretation. Then, students interpret data and look for patterns around HLA inheritance and how the proportion of matching HLA genes relates to family and unrelated donors. Students also compare the probability of finding a match to the demographics of the bone marrow registry.
    - Lesson 8: Students learn about examples of historically unethical and morally reprehensible research activities. They then read an article about the experience of being Black and having cancer, which highlights both patient experiences as well as individuals who are working to make healthcare more equitable. Students participate in a text-based Seminar to discuss the article.
    - Lesson 9: Students learn about the three sources of stem cells for transplantation. They compare the pros/cons, processes, and obstacles for each source. Students interpret data about racial disparities in access to donor transplants. This exploration helps students to understand why cord blood was the best solution for Hina.
- ***CCSS.ELA.RST.11-12.1****: Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.*
    - Lesson 8: Students learn about examples of historically unethical and morally reprehensible research activities. They then read an article about the experience of being Black and having cancer, which highlights both patient experiences as well as individuals who are working to make healthcare more equitable. Students participate in a text-based Seminar to discuss the article.
- ***CCSS.ELA.RST.11-12.9****: Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.*
    - Lesson 6: Students learn about stem cell transplants, including the process of engraftment and possible risks and side effects. Students read stories of cancer patients'

journeys to survival, including identifying people who work in the careers of cancer research and patient care and conduct internet research on types of cancer, treatments, and related careers.

- ***CCSS.ELA.WHST.9-12.2****: Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.*
  - Lesson 10: Students showcase understanding of blood stem cells, cancer cells, and body systems by developing a PSA that communicates why stem cell donation is important.
- ***CCSS.ELA.WHST.9-12.9****: Draw evidence from informational texts to support analysis, reflection, and research.*
  - Lesson 6: Students learn about stem cell transplants, including the process of engraftment and possible risks and side effects. Students read stories of cancer patients' journeys to survival, including identifying people who work in the careers of cancer research and patient care and conduct internet research on types of cancer, treatments, and related careers.
  - Lesson 8: Students learn about examples of historically unethical and morally reprehensible research activities. They then read an article about the experience of being Black and having cancer, which highlights both patient experiences as well as individuals who are working to make healthcare more equitable. Students participate in a text-based Seminar to discuss the article.
  - Lesson 10: Students showcase an understanding of blood stem cells, cancer cells, and body systems by developing a PSA that communicates why stem cell donation is important.

- ***CCSS.MATH.PRACTICE.MP2****: Reason abstractly and quantitatively.*
  - Lesson 2: No explicit evidence is found of student use or development of this standard.
  - Lesson 7: In an optional lab activity, students use gel electrophoresis to construct explanations about genes, DNA, and HLA matching. However, since this lab is optional, students are not guaranteed to use this CCSS mathematics standard in this lesson.
  - Lesson 8: There is a missed opportunity for students to use the graphs depicting categorical data about alleles versus frequency in different geographical regions. There is no explicit strategy discussed or explained to help teachers surface how mathematics helps makes sense of the data. The mathematics concept of comparable scales is not discussed. That would be important because the horizontal axis of the three graphs is different, rendering interpretation difficult.
  - Lesson 9: Students analyze a complex bar graph depicting racial disparities. The bar height shows numbers of people. The mathematical concepts of precision and accuracy are not discussed, resulting in students having to accept that any difference in bar height is significant.

Suggestions for Improvement

- Consider making the connections to the CCSS Mathematics and ELA standards explicit to students and teachers when they are being used during lessons.
- Consider examining any graph, number-oriented data table, or numerical summary table, and thinking about the underlying mathematical concept that is essential in making sense of the information. This mathematical concept could be made explicit and students could be supported to understand why it is important.

OVERALL CATEGORY I SCORE: **2** (0, 1, 2, 3)	
Unit Scoring Guide – Category I	
Criteria A-F	
3	At least adequate evidence for all of the unit criteria in the category; extensive evidence for criteria A–C
2	At least some evidence for all unit criteria in Category I (A–F); adequate evidence for criteria A–C
1	Adequate evidence for some criteria in Category I, but inadequate/no evidence for at least one criterion A–C
0	Inadequate (or no) evidence to meet any criteria in Category I (A–F)

CATEGORY II

NGSS INSTRUCTIONAL SUPPORTS

II.A. RELEVANCE AND AUTHENTICITY

II.B. STUDENT IDEAS

II.C. BUILDING PROGRESSIONS

II.D. SCIENTIFIC ACCURACY

II.E. DIFFERENTIATED INSTRUCTION

II.F. TEACHER SUPPORT FOR UNIT COHERENCE

II.G. SCAFFOLDED DIFFERENTIATION OVER TIME

II.A. RELEVANCE AND AUTHENTICITY

Engages students in authentic and meaningful scenarios that reflect the practice of science and engineering as experienced in the real world.

i. Students experience phenomena or design problems as directly as possible (firsthand or through media representations).

ii. Includes suggestions for how to connect instruction to the students' home, neighborhood, community and/or culture as appropriate.

iii. Provides opportunities for students to connect their explanation of a phenomenon and/or their design solution to a problem to questions from their own experience.

Rating for Criterion II.A. Relevance and Authenticity	Extensive *(None, Inadequate, Adequate, Extensive)*

The reviewers found extensive evidence that the materials engage students in authentic and meaningful scenarios that reflect the real world because most of the unit materials provide opportunities to make connections between the phenomena and students' lives. The phenomena and classroom activities used are engaging to students, reflect grade-appropriate scenarios, and inspire curiosity from students.

Students experience the phenomenon, problems, and investigative phenomenon as directly as possible in many cases. They also are supported to understand that the phenomenon and problem are relevant to people.

For example:

- Lesson 1: The anchoring phenomenon of Hina Marsey's leukemia diagnosis is presented by students reading and students generate questions based on their observations to create a DQB.
- Lesson 2: Students learn about the different types of specialized cells that make up blood by comparing blood smear slides from healthy patients and those with ALL so they can understand the effect blast cells have on healthy individuals.
- Lesson 6: Students read cancer survivor stories to learn about a person's personal cancer journey and then research one type of cancer, cancer treatment, and one career related to cancer treatment and patient care.
- Lesson 8: After observing that some groups are underrepresented, overrepresented, or have greater allelic diversity in donations, students explore some of the effects related to characterizing people by race in medical settings.

Connections are made to students' home lives and communities, and teacher support is provided. However, it is located after each lesson rather than within the lesson materials themselves, so it is less likely to be used. For example:

- Before the unit begins the teacher is encouraged to send a letter home to families outlining the unit. Teachers are also guided on how to address the topic of cancer with students. "Explain that cancer is a complex group of diseases that impacts many people's lives. Many people either know someone affected by cancer personally, or indirectly through a friend or the media. Emphasize the importance of approaching this unit of study with compassion and kindness, as we do not necessarily know the impacts that cancer has had on each other. Explore students' current understanding of the topic by using these prompts to activate student discussion" (Teacher Guide, page 5).
- The end of each lesson includes an "Opportunities for Personal Connections to Students" section that features guidance for the teacher to assist when facilitating conversations about sensitive topics throughout the unit. However, these opportunities are not called out in the lesson so teachers may not see these suggestions.
- A Career Connections Section is located at the end of each lesson, supporting teachers with making connections between Hina's story and possible professional careers. However, these opportunities are not called out in the lesson so teachers may not know when to make these connections.
- Lesson 2: Students learn about the different types of specialized cells that make up blood by comparing blood smear slides from healthy patients and those with ALL so they can understand the effect blast cells have on healthy individuals. The opportunities for Personal Connections to Students (Teacher Guide, page 15) states that this lesson would be a good opportunity for students to make the connection between the phenomenon and someone in their personal family having blood tests done.
- Lesson 10: Student participate in a luminaria activity. The materials say, "The main focus of the luminaria activity is the opportunity for students to make personal connections to the content they have been studying across this unit." This represents at least one opportunity for students make connections to their own lives. However, the materials do not provide support to teachers to help students in this regard. Rather, the materials simple state that students have the opportunity. There are no explicit teacher tips or strategies other than to "be sensitive".

<u>Suggestions for Improvement</u>

- Consider relocating the Opportunities for Personal Connections to Students and the Career Connections to the beginning of the lesson and having call outs throughout the lesson. This may increase the likelihood that teachers will see these supports, assisting them in providing opportunities for students to make connections to their lives.
- Consider providing students the opportunity to make a connection to their own personal lives in Lessons 6 and 8.

II.B. STUDENT IDEAS

Provides opportunities for students to express, clarify, justify, interpret, and represent their ideas and respond to peer and teacher feedback orally and/or in written form as appropriate.

Rating for Criterion II.B. Student Ideas	*Extensive* *(None, Inadequate, Adequate, Extensive)*

The reviewers found extensive evidence that the materials provide students with opportunities to both share their ideas and thinking and respond to feedback on their ideas. Students have many opportunities to share ideas with peers. However, students have few opportunities to use peers' ideas to change or improve their own thinking and prompts for teachers to provide feedback to students were not found.

Most lessons include small group or partner work that focuses on students sharing their ideas and thinking.

For example:

- Lesson 1: After students are introduced to the anchor phenomenon, the teacher asks students to read about Hina's symptoms in groups and share their ideas.
- Lesson 2: Students analyze CBC reports with a partner. Then they participate in a seminar discussing the data they have analyzed. "During the seminar, pose the following questions, beginning with the more clarifying and literal questions, progressing to the analytical and inferential ones. After posing a question, allow ample time for students to respond (it may take longer than usual, but be patient) and student discussion before moving onto the next question. Encourage students to ask their own questions, build off the answers of others, and to reference specific data in their answers. They should be talking to each other, not you" (Teacher Guide, page 10).
- Lesson 3: Students work in pairs to share their thinking. "Ask students to think-pair-share their response to the following question: What do you think would happen to your body if the cell cycle was not regulated properly cells did not divide fast enough?" (Teacher Guide, page 8).
- Lesson 4: Students work with partners or in groups to reflect on the IMT.
- Lesson 5: Students work in groups to model the cell cycle. At the end of the lesson, there is a model analysis where students partner turn-and-talk to share their ideas.
- Lesson 8: Students work in pairs to reflect/and or pair share to discuss HLA matching.

There are some opportunities in the unit for students to receive and respond to peer feedback. For example:

- Lesson 1: After students are introduced to the anchor phenomenon, the teacher asks students to create an initial model of what they think is happening in Hina's body. "In groups of 4, have students compare their models and discuss them, making revisions or additions as they see fit" (Teacher Guide, page 6).
- Lesson 4: Students show their model of cell differentiation on a document camera. This is a missed opportunity for students to receive and respond to peer feedback. After answering reflection questions, they meet with partners and discuss their answers.
- Lesson 10: Students showcase understanding of blood stem cells, cancer cells, and body systems by developing a PSA that communicates why stem cell donation is important. Presenting the PSAs or participating in a gallery walk are the two options given for teachers as a way for students to share their work. This is a missed opportunity for feedback from the teacher and peers.

Suggestions for Improvement

- Consider including guidance about opportunities where teacher feedback can be given for individual student work, supporting students in changing their thinking. It could be helpful to add specific prompts for the teacher to provide students with feedback on their ideas.
- Consider indicating in what modality (orally or in writing) teachers will provide feedback to students and when and how students will respond or incorporate feedback in their learning.

II.C. BUILDING PROGRESSIONS

Identifies and builds on students' prior learning in all three dimensions, including providing the following support to teachers:

i. Explicitly identifying prior student learning expected for all three dimensions

ii. Clearly explaining how the prior learning will be built upon.

Rating for Criterion II.C. Building Progressions	Inadequate *(None, Inadequate, Adequate, Extensive)*

The reviewers found inadequate evidence that the materials identify and build on students' prior learning in all three dimensions. Although the reviewers located evidence of the materials referencing students' expected prior proficiencies in the three dimensions, there was no connection made between prior learning and the learning throughout the targeted materials. In addition, the unit materials did not explain how this learning will be built upon throughout the unit.

Two references to prior learning were in the Unit Overview document. The related evidence includes:

- The "Assumptions about students' prior knowledge" (Teacher Guide, page 12) states, "it is assumed that before engaging in the activities presented in this curriculum, students will have some basic understanding of cells, multicellular organisms, DNA, and blood cells. It is also helpful if students have some basic understanding of body and organ systems. In addition, it would be helpful if students had been introduced to the basics of microscopy. If not, you may need to make adaptations to Lesson 2 if using real blood smear slides. Therefore, before starting the unit, *students should know...*The basic tenets of cell theory; Living things are made up of many different types of cells; Multicellular organisms are a collection of different cell types. Each cell within an organism has the same DNA; DNA is passed between cells during cell division; Genes are segments of DNA that hold instructions for the cell; Blood is made up of red and white blood cells; The human body is a system made up of multiple interacting subsystems, each which contain groups of cells that form organs and tissues that are specialized for particular body functions. (In particular, a basic understanding of the lymphatic system and circulatory system is helpful)." However, identification of the progression for the specific DCI was not located.
- There is a statement addressing student prior knowledge of SEPs and CCCs. It states, "In addition to what they should already know, students should also have grade-level appropriate experience with leveraging Science and Engineering Practices (SEPs) and Crosscutting Concepts (CCCs) to make sense of scientific phenomena" (Teacher Guide, page 13). However, identification of the progression for elements of the SEPs and CCCs was not located.

Suggestions for Improvement

- Consider including information to explicitly state the expected level of prior proficiency students should have with individual elements of all three dimensions as well as how students will build on those understandings throughout the unit.
- Consider describing where and how in the unit students are expected to build from their expected prior learning to the unit's targeted learning goals.
- Think about including explicit support to provide teachers with clarification on possible alternate conceptions that they or their students may have while building toward students' three-dimensional learning.

II.D. SCIENTIFIC ACCURACY

Uses scientifically accurate and grade-appropriate scientific information, phenomena, and representations to support students' three-dimensional learning.

Rating for Criterion II.D. Scientific Accuracy	Extensive *(None, Inadequate, Adequate, Extensive)*

The reviewers found extensive evidence that the materials use scientifically accurate and grade-appropriate scientific information. No inaccuracies were identified in the unit.

Suggestions for Improvement
N/A

II.E. DIFFERENTIATED INSTRUCTION

Provides guidance for teachers to support differentiated instruction by including:

i. Supportive ways to access instruction, including appropriate linguistic, visual, and kinesthetic engagement opportunities that are essential for effective science and engineering learning and particularly beneficial for multilingual learners and students with disabilities.

ii. Extra support (e.g., phenomena, representations, tasks) for students who are struggling to meet the targeted expectations.

iii. Extensions for students with high interest or who have already met the performance expectations to develop deeper understanding of the practices, disciplinary core ideas, and crosscutting concepts.

Rating for Criterion II.E. Differentiated Instruction	*Adequate* *(None, Inadequate, Adequate, Extensive)*

The reviewers found adequate evidence that the materials provide guidance for teachers to support differentiated instruction because the materials provide guidance for teachers to meet the needs of a variety of student learners throughout the unit. However, these materials are provided at the end of each lesson with no explicit connection to the specific activities, and the differentiation strategies are mostly generic and repetitive.

Materials provide support for students who struggle to meet learning goals. At the end of each lesson there is a "Supporting Diverse Learners" section to provide teachers with support in assisting students who might not be meeting their goals. However, many of these suggestions appear to be generic support or alternative assignments instead of support with an explicit connection to the lesson's sense-making and learning in all three dimensions.

Related evidence includes:

- Lesson 1: "Some students may need extra support understanding how to develop their initial conceptual models or may be uncomfortable with not knowing what to write/draw. Encourage students to try, explaining that it is okay that they do not yet know the answers; they will be returning to revise this model several times throughout the unit as their knowledge builds. Encourage students to first read through the blog post, underlining/highlighting information about Hina's symptoms and diagnosis. Then, they can add this information using words, sketches, labels, and symbols to their model. Encourage students to draw on any existing knowledge they may have about cancer, leukemia, the immune system, blood, and bone marrow. They can talk in their groups as they work on this task, and work together when developing the written explanation" (Teacher Guide, page 16).
- Lesson 2: "If students need extra support understanding the CBC reports and filling out the data organizer in Student Handout 2.2b: Blood Test Background & Data Organizer, divide up the analysis among group members or go through it together as a class" (Teacher Guide, page 16). This is generic support for cooperative learning strategies.
- Lesson 6: "Activity 6.1, 6.3, and 6.5: For students who need more structure with note taking, Student Handout 6.2b: Notes Page for Chemotherapy Resources, Student Handout 6.4b: Notes Page - Bone Marrow Transplantation Table, and Student Handout 6.5b: Graphic Organizer may be helpful. Other students may prefer to take notes in a less structured format on a piece of blank paper or a digital document." This is generic support.
- Lesson 9: "Activity 9.3: If students need more support in developing their conceptual models, share Teacher Resource 9.4: Final Model Rubric with them to offer additional guidance. In addition to the checklist already provided on Student Handout 9.4, you might consider offering a word bank, a few sentence starters for the written explanation, or other scaffolds. They can talk in their groups as they work on this task, and work together when developing the written explanation" (Teacher Guide, page 12).

Strategies are provided to address the needs of multilingual learners, learners with disabilities, and those who read below grade level. However, many of the suggested strategies are repetitive or generic.

- Lesson 2:
    - "Alt text has been provided for all images in the student handouts, including the blood smear slide images of Patient A and Patient B. These descriptions can be useful for low vision or blind students using screen readers. Image descriptions can also be shared with students who have color blindness" (Teacher Guide, page 17).

  - "Another option is to create a tactile model of the two blood smear slide images. Use two petri dishes (Patient A and Patient B) filled with beads of different sizes/shapes to represent red blood cells, white blood cells, and blast cells. For example, purple pony beads for blast cells, white Perler beads for WBCs, and red seed beads for RBCs" (Teacher Guide, page 17).
- Lesson 3:
  - "Captions are available for videos hosted on YouTube, but as they are often auto generated, they are not always accurate; be on the lookout for any mistakes that need to be clarified for students who rely on captioning" (Teacher Guide, page 14).
  - The materials state, **"**Vocabulary word definitions are integrated into Student Handout 3.4." (Teacher Guide, page 14).
  - "Alt text has been provided for all images on Student Handout 3.1, 3.3, and 3.4. These descriptions can be useful for low vision or blind students using screen readers. Image descriptions can also be shared with students who have color blindness. As an alternative to Activity 3.2 Steps to Division and Student Handout 3.2, students can create tactile models of the phases of mitosis" (Teacher Guide, page 14).
- Lesson 4:
  - "Captions are available for all videos that have sound. Note that many captions are auto generated and may have inaccuracies that need to be addressed with students who rely on captioning. For virtual or in-person learning, consider using homemade dough, gluten-free dough, or modeling clay, especially for students with Celiac disease or gluten intolerance" (Teacher Guide, page 11).
  - "For students who do not have the ability to work with clay, the virtual learning activity may be a viable option" (Teacher Guide, page 11).
  - Students who need support with writing/drawing can be paired with a scribe" (Teacher Guide, page 11).
- Lesson 5:
  - "The virtual game is designed for use in remote learning settings but could also be helpful to provide students with an alternate way of engaging in the activity" (Teacher Guide, page 19).
  - "Students can also work through the Khan Academy Regulation of the Cell Cycle module (video and articles, captioning available), including the Cancer and the Cell Cycle chapter (Khan Academy). This could be especially helpful for students who benefit from having a textual explanation in addition to or as an alternative to playing the kinesthetic game" (Teacher Guide, page 19).
- Lesson 6:
  - "Activity 6.3: A transcript for the radio story Seattle Doctor's Radical Idea Saves 70,000 People a Year, can be found here. The short article and slideshow of five photos is available on the story website that can be read as an alternative assignment" (Teacher Guide, page 21).

- "Activity 6.4: Teacher Resource 6.4 provides a list of Cancer Survivor Stories, organized by 'developing' and 'proficient' reading levels. There are a total of 18 possible Cancer Survivor Stories to assign for this activity. You may wish to pair up students as a way to support students who need extra help with reading and understanding texts with advanced vocabulary. Engaging classroom reading strategies may be helpful, such as annotating the reading, skimming the text and then re-reading for more detail, and looking up definitions to unfamiliar terms" (Teacher Guide, page 21).

Materials provide support and extensions for students who have already met PEs. However, these supports focus primarily on deepening students' DCI-related understanding rather than attending to all three dimensions. At the end of nine of the ten lessons there is a "Supporting Diverse Learners" section to provide teachers with support in assisting students with extension opportunities. For example:

- Lesson 2: "Students may wish to learn more about how leukemia is diagnosed, typed, and staged. This article from Verywell Health provides an accessible summary and includes an explanation of the differences in CBC results and blood smear images for patients with different types of leukemia" (Teacher Guide, page 17).
- Lesson 3: "Using the slide deck, show the slide 'Watch the Sci Show Video'. Tell students cells are living which means they also die. When cells die they have to be replaced. Your students might have heard that all of the cells that make up their body are replaced every seven years, or that all of their skin cells are replaced every two weeks. Watch the short video (2 minutes) on this slide to learn more about how often different types of cells are replaced. This video introduces the idea that not all cell types divide at equal rates and this will come up later in the unit" (Teacher Guide, page 14).
- Lesson 5: "Challenge students to adapt the game to be more accurate or to reduce assumptions. Alternatively, students can create their own version of a model of the cell cycle" (Teacher Guide, page 19).
- Lesson 6: "If students express a strong interest in learning more about immunotherapy, some resources for additional learning are listed below. The topic of immunotherapy provides opportunities for making connections between life sciences and engineering design topics" (Teacher Guide, page 22).

Suggestions for Improvement

- Consider providing call out boxes throughout the unit that provide strategies that teachers can use to support students in their development of the three dimensions.
- Consider providing guidance on how to identify students who might benefit from stated support at the point of the lesson where differentiation supports are embedded and how these suggested supports will help students demonstrate progress towards understanding the PEs.

II.F. TEACHER SUPPORT FOR UNIT COHERENCE

Supports teachers in facilitating coherent student learning experiences over time by:

i. Providing strategies for linking student engagement across lessons (e.g. cultivating new student questions at the end of a lesson in a way that leads to future lessons, helping students connect related problems and phenomena across lessons, etc.).

ii. Providing strategies for ensuring student sense-making and/or problem-solving is linked to learning in all three dimensions.

Rating for Criterion II.F. Teacher Support for Unit Coherence	Adequate *(None, Inadequate, Adequate, Extensive)*

The reviewers found adequate evidence that the materials support teachers in facilitating coherent student learning experiences over time because frequent guidance is provided to teachers to support linking student engagement across lessons, particularly in the Lesson Progression portion of each lesson. However, support is not provided to help students see connections between CCC learning and their sense-making or problem solving.

Frequent guidance is provided to teachers in the Lesson Progression to support linking student engagement across lessons by providing explicit connections between lessons. Related evidence includes:

- Lesson 1: "Students then write a question they are curious about having answered on a sticky note and add it to the 'Driving Questions' board. One question that students might come up with is: How did Hina's doctors know that she has leukemia? This question will motivate the next lesson (Lesson 2) where we look toward understanding how leukemia is diagnosed" (Teacher Guide, pages 6–7). Although the class revisits the DQB multiple times to see what questions they can answer, the materials do not regularly provide strategies for using students' questions from the DQB or new questions that may arise during the lesson to drive the learning in the next lessons.
- Lesson 2: "Review Hina's story from Lesson 1. Quickly review the class's 'What We Know' and 'Driving Question' boards. Focus attention on the questions about blood and her leukemia diagnosis" (Teacher Guide, page 5).
- Lesson 3: "Remind students that at the end of the last lesson, they wondered how Hina ended up with too many blast cells in her blood. Today, they will explore the process of cell division and learn what caused Hina to have elevated numbers of blast cells in her blood, which is a sign of leukemia" (Teacher Guide, page 5).
- Lesson 5: Evidence of student-generated questions was not located. Thus, there are no teacher supports for curating student questions.

- Lesson 6: "In the last lesson, students completed their models of Hina's disease. Surface any questions that students might have developed around the topic of cancer treatment or what is going to happen to Hina now. These could be questions from the initial driving question board or questions that have popped up in their IMTs" (Teacher Guide, page 6).
- Lesson 8: "Present this quote from the previous blog post for students to react to. 'Hina's doctor told us that it may be even more difficult to find a match for Hina, because her biological parents are Haitian. There are few people with Hina's African-Caribbean background in the bone marrow registry'" (Teacher Guide, page 8).

Throughout the unit insufficient guidance is provided that allows students to recognize what they have learned in all three dimensions and there is little guidance provided to link students' CCC learning to sense-making. For example:

- A list of the aligned CCCs is included in the Learning Standards Connections document in the Unit (Teacher Guide, page 3). However, evidence of guidance provided to ensure student sense-making or problem solving in the CCCs was not located.
- Lesson 2: Activity 1.3: Initial Conceptual Model has a call out box that explains the concept of modeling. It states, "Emphasize that modeling ideas is a key part of what scientists and researchers do to explain and predict phenomena and build their understanding. Scientists often start with initial ideas and then refine them as they ask new questions and gather new evidence. Emphasize that scientists do this work in community with one another, so as these lessons progress students will also be working together to discuss their findings and models" (Teacher Guide, page 5). Student Handout 2.1 tells students that "Models like this can help organize ideas and our understanding of complex systems."
- Lesson 3: Students are asked to use the process of mitosis, cell division, and the cell cycle as a way to understand what is happening in Hina's blood and bone marrow (including genetic mutations), and how her cancer is affecting other systems in her body. However, students are not supported to consider how their use of the CCC helps them to make progress in explaining the phenomenon.
- Lesson 6: Students are asked how chemotherapy destroys cells in the process of mitosis within the body and what side effects that causes across multiple body systems. However, students are not supported to consider how their use of the CCC helps them to make progress in explaining the phenomenon.

Suggestions for Improvement

Consider including explicit teacher guidance and strategies for supporting students to see how their learning in all three dimensions connects to their sense-making and problem solving. For example, consider frequently incorporating more prompts, reflections, and reminders strategically throughout the unit.

II.G. SCAFFOLDED DIFFERENTIATION OVER TIME

Provides supports to help students engage in the practices as needed and gradually adjusts supports over time so that students are increasingly responsible for making sense of phenomena and/or designing solutions to problems.

Rating for Criterion II.G. Scaffolded Differentiation Over Time	*Adequate* *(None, Inadequate, Adequate, Extensive)*

The reviewers found adequate evidence that the materials support teachers in helping students engage in the practices as needed and gradually adjusting supports over time. Although scaffolding for some SEP elements is introduced or changed across different lessons, the scaffolding is not reduced over time in a logical way for most SEP elements claimed, supporting students in using the elements more independently over the course of the unit.

The Learning Standards Connection document (Teacher Guide, page 2) clearly states where eight SEP elements are used through specific lessons in the unit. However, the initial scaffolding of the targeted SEP elements is unclear, and the scaffolds are not reduced gradually over time for most SEP targets.
Related Evidence includes:
Developing and Using Models was the main claimed SEP in this unit.

- *Develop, revise, and/or use a model based on evidence to illustrate the relationships between systems or between components of a system.*
    - Lesson 1: After being introduced to Hina, a student who has leukemia, students develop and share initial conceptual models to understand the systems or components within a system interacting to cause Hina's symptoms. The exemplar model provided is a sketch of a human (Hina) with stars drawn on her body.
    - Lesson 2: Students analyze the different types of cells that make up blood, then they use the conceptual model created in Lesson 1 to discuss relationships between body systems.
    - Lesson 3: Students use sequencing cards and analogies modeling mitosis to help them understand cell division and how it is affected by cancer.
    - Lesson 4: After learning about blood cell differentiation and hematopoiesis, students create clay models of the differentiation of blood cells, modeling for both healthy cells and cancer cells.
    - Lesson 5: Students develop a second conceptual model to show the role of blood stem cells when Hina was healthy and how that changed when Hina got sick. Students compare, discuss, and revise their models based on peer feedback.
    - Lesson 9: Students develop a third conceptual model to illustrate and compare the systems of blood stem cells while Hina was receiving chemotherapy and after Hina's cord blood transplant.

- **Analyzing and Interpreting Data:** *Apply concepts of statistics and probability ~~(including determining function fits to data, slope, intercept and correlation coefficient for linear fits)~~ to scientific and engineering questions and problems, ~~using digital tools when feasible.~~*
    - Lesson 2: Students examine patient CBC data to determine patterns and make claims about which patients are healthy and which have CBC reports that are concerning. The materials state, "You may wish to scaffold this process by asking pairs of students to complete the second row together before moving on to individual work. Dividing up the remaining analysis among group members will speed this process up" (Teacher Guide, page 7).
    - Lesson 7: After learning about the HLA matching process, students calculate the total numbers of matches to find the likelihood of different racial groups finding a match in the registry. The materials state, "Once done with these calculations students can proceed to the analysis questions. This can also be assigned as homework" (Teacher Guide, page 6). The HLA matching simulation in this activity results in a data table with numbers. The data collection was accomplished in a group work fashion. If the teacher assigns the analysis questions as homework, then this is an example of slowly removing scaffolding to encourage individual work.
- **Constructing Explanations and Designing Solutions:** *Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.*
    - Lesson 1: Students develop their initial model to showcase their understanding of the systems interacting in Hina's body and then explain what could be causing her symptoms. The student prompt says "Write a summary paragraph (about 4–5 sentences) of your model that answers the question 'Why is Hina sick?' and focuses on understanding her symptoms and the cells, tissues, and body systems affected (think about different scales within her body). Think about what you added to your model above. If you drew it in the model, it should also be included in your written explanation."
    - Lesson 5: After developing a conceptual model to illustrate the role of blood stem cells, students write an explanation that addresses how Hina's cancer is affecting her body.
    - Lesson 7: In a lab activity, students use gel electrophoresis to construct explanations about genes, DNA, and HLA matching. An explicit gradual change in student expectations or supports for constructing explanations was not located.
    - Lesson 8: Students read an article about the experience of being Black and having cancer, participate in activities at stations focused on racial health inequities, and watch a video on the U.S. Public Health Service Syphilis Study to construct an explanation for the text-based Socratic Seminar. An explicit gradual change in student expectations or supports for constructing explanations was not located.

- Lesson 9: Using graphs and student created models and articles, students write an explanation that addresses how chemotherapy and a cord blood transplant cured Hina's cancer and how the new donor stem cells replaced her cancerous cells. An explicit gradual change in student expectations or supports for constructing explanations was not located.

Suggestions for Improvement

- Consider including explicit support for a few focus SEP elements on which to support student development throughout the unit. These elements could then be used multiple times throughout the unit, with progressively reduced teacher scaffolds such that students are able to use the elements more independently or deeply by the end of the unit.

OVERALL CATEGORY II SCORE: **2** (0, 1, 2, 3)	
Unit Scoring Guide – Category II	
Criteria A-G	
3	At least adequate evidence for all criteria in the category; extensive evidence for at least two criteria
2	Some evidence for all criteria in the category and adequate evidence for at least five criteria, including A
1	Adequate evidence for at least three criteria in the category
0	Adequate evidence for no more than two criteria in the category

CATEGORY III

MONITORING NGSS STUDENT PROGRESS

III.A. MONITORING 3D STUDENT PERFORMANCES

III.B. FORMATIVE

III.C. SCORING GUIDANCE

III.D. UNBIASED TASK/ITEMS

III.E. COHERENT ASSESSMENT SYSTEM

III.F. OPPORTUNITY TO LEARN

III.A. MONITORING 3D STUDENT PERFORMANCES

Elicits direct, observable evidence of three-dimensional learning; students are using practices with core ideas and crosscutting concepts to make sense of phenomena and/or to design solutions.

Rating for Criterion III.A. Monitoring 3D Student Performances	Adequate *(None, Inadequate, Adequate, Extensive)*

The reviewers found adequate evidence that the materials elicit direct, observable evidence of students using practices with DCIs and CCCs to make sense of phenomena or design solutions because the materials routinely elicit direct, observable evidence that students integrate the three dimensions in service of sense-making. However, not all tasks require students to use grade-appropriate elements of multiple dimensions.

The Unit Storyline document specifies the observable evidence of learning for each lesson. For example:

- Lesson 1: Students create a model showing what they think is happening between systems in Hina's body to explain what could be causing her symptoms. Students share models and explanations with groups (Teacher Guide, page 6).
- Lesson 2: The students analyze data and identify patterns in blood test data of healthy and leukemia patients to determine what amount of healthy blood cells are needed to maintain a healthy individual (Teacher Guide, page 5).
- Lesson 3: Using their knowledge of mitosis and cell division, students show understanding of what is happening to Hina's body systems, and the effect leukemia has on her cells (Teacher Guide, page 5).
- Lesson 5: After developing a second model to compare the role of healthy blood stem cells versus leukemia blood cells, students explain how the cancer is affecting Hina's body (Teacher Guide, page 5).
- Lesson 6: Students discuss initially what prior knowledge they have about chemotherapy at the start of this lesson and participate in a jigsaw activity.
- Lesson 7: After learning about the HLA matching process, students calculate the total numbers of matches to find the likelihood of different racial groups finding a match in the registry (Teacher Guide, page 7).
- Lesson 8: Students rotate through station activities to examine HLA diversity data to determine the differences in bone marrow donations in the database from different racial groups (Teacher Guide, page 6).
- Lesson 9: Students examine a racial disparities graph that shows data for HLA-matched, unrelated donor transplants illustrating why cord blood can be a good option for some people who need a stem cell transplant due to the lack of HLA diversity in the bone marrow donor databases (Teacher Guide, page 6).

Formal assessment tasks in the materials are driven by phenomena and require students to use three dimensions. However, some parts of the summative assessment (exam) are confirmatory, rather than new sense-making for students. For example, the Learning Standards Connections document states that Lesson 10 is a three-dimensional, summative assessment (Teacher Guide, page 4). The summative exam is broken into nine lessons, each lesson could have up to four parts. In Lesson 10, the Teacher Guide states, "This assessment takes a storyline approach by having students imagine that they are summer interns at the same children's hospital that treated Hina Marsey. A same-but-different phenomenon is introduced for students to investigate" (Teacher Guide, page 6). Evidence of the "same-but-different" phenomenon for Lessons 1–3 of the exam was not located; the phenomenon is extremely similar. The Teacher Key states, "Throughout this assessment, the assumption is that you have been hired for a summer internship at the same children's hospital where Hina Marsey was treated for leukemia."

Suggestions for Improvement

- Consider adding explicit prompts for students to use grade-appropriate SEPs and CCCs in the assessment opportunities.

III.B. FORMATIVE	
Embeds formative assessment processes throughout that evaluate student learning to inform instruction.	
Rating for Criterion III.B. Formative	Adequate *(None, Inadequate, Adequate, Extensive)*

The reviewers found adequate evidence that the materials embed formative assessment processes throughout the unit that evaluate student learning and inform instruction because formative assessment opportunities are called out regularly throughout the unit. The assessments and teacher materials include accompanying guidance for teacher interpretation. However, reviewers found limited guidance for when and how to modify whole group instruction based upon assessment results. Examples include:

- At the end of each lesson there is a "Formative Assessment Opportunities" section that denotes the formal and informal assessment opportunities that could occur throughout the lesson. However, there aren't consistent teacher supports to assist students if formative assessment reveals that they are struggling with the concepts.
- Lesson 2: Page 19 of the Teacher Guide states, "There are four formative assessment ideas for this lesson: Discussion/oral responses to teacher-led questions about the blood, Students' written responses to the Blood Data Organizer, Collaborative discussion of data-based claims in

the seminar, and Claim-Evidence-Reasoning written response about microscopic blood smears." Explicit strategies regarding modification of instruction based on formative assessment data from these tasks was not located.

- Lesson 3: Students sequence the steps to cell division through the "Cell Cycle Cartoon." The teacher is given an answer key and given instructions on how to present the information to students. However, specific guidance as to how teachers should proceed instructionally if students incorrectly complete this activity was not located.
- Lesson 5: Students play a game to model what is happening in Hina's blood and bone marrow. The materials contain teacher guidance to assist students as they move through each round of the game. Page 17 of the Teacher Guide states, "teachers can assess student understanding through observations of the simulation, as student's progress through the stages of the cell cycle. Do the students' progress through the stages in the correct order (i.e., G1 → S → G2 → M)? Do students stop at the correct checkpoints in the cell cycle, and do they accomplish the necessary steps at each checkpoint in order to progress forward? Teachers can also formatively assess the students' documented record of their progress in the simulation, the cell cycle tracking sheet".
- Lesson 7: Students are introduced to HLA mapping, but first they summarize their learning up to this lesson. The materials state, "Students should be able to explain that Hina was diagnosed with leukemia and her initial chemotherapy treatment was not effective enough to combat her cancer, so she then required a bone marrow transplant" (Teacher Guide, page 5). However, guidance about what to do if students struggle with different parts of this understanding is not provided.
- Lesson 8: Students rotate through stations to better understand HLA diversity data. Guidance as to how teachers should proceed instructionally if students incorrectly complete these station activities was not located.
- Lesson 9: Page 15 of the Teacher Guide states, "There are two formative assessment ideas for this lesson: Students' final conceptual models of Hina's treatment on Student Handout 9.3: Modeling Hina's Treatment, and Students completed Incremental Modeling Tracker (IMT)". Neither opportunity offers specific support for modifications or ties to multiple dimensions.

Suggestions for Improvement

- Consider including suggestions for how instruction might be modified to react to the learning needs of individual students.

III.C. SCORING GUIDANCE

Includes aligned rubrics and scoring guidelines that provide guidance for interpreting student performance along the three dimensions to support teachers in (a) planning instruction and (b) providing ongoing feedback to students.

Rating for Criterion III.C. Scoring Guidance	Inadequate *(None, Inadequate, Adequate, Extensive)*

The reviewers found inadequate evidence that the materials include aligned rubrics and scoring guidelines that help the teacher interpret student performance for all three dimensions. Element-level assessment targets and scoring guidance tools to interpret student progress in relation to the learning targets were not located. While most of the formative assessment opportunities (student handouts) contain an answer key; they do not provide enough interpretation information about student performance in each dimension such that the teacher would be able to modify instruction accordingly and provide feedback to students. In addition, guidance is not provided to help interpret student progress along a continuum of performance — only exemplar student responses are included. Examples include:

- The unit overview states, "Scoring guidance is provided for teachers by offering teacher answer keys and scoring rubrics. Within each lesson folder, look for 'teacher resource' and 'teacher key' documents. These can also be accessed by following the links in the Materials table within each teacher guide. Scoring guidance and example student work is provided for student handouts, the three conceptual models, the final project, and the summative assessment. In some cases, rubrics are available both for scoring guidance by teachers and to be used with students to plan and guide their work" (Teacher Guide, page 9). However, scoring guidance and rubrics for student handouts were not located. Also, guidance for the teachers to use the rubrics with students to guide their work was not located.
- Lesson 2: Answer keys are given for worksheets, but these answer keys do not make explicit links between student actions and any claimed dimension.
- In Lesson 7, Handout 7.2, there is a teacher answer key provided. However, no sample data in the data table for teachers to look at for a reasonable frame of reference were located. Several correct answers say, "answers will vary" with no guidance about what variation looks like.
- Lesson 10:
  - Summative assessment: The materials provide a teacher answer key that provides tables that use checkmarks to indicated dimensions claimed to be covered by the assessment. The key also repeats the color-coded claims about dimensions covered in each lesson. While example student responses are provided, they are not linked to explicit elements, and there is not guidance on how to interpret the responses relative to the integration of sense-making. In addition, several answers say, "answers will vary"

rather than providing a rubric or examples of different levels and types of student responses.
- Final project (stem cell donation) rubric: The rubric provides columns with words across the top like exemplary, proficient, partially proficient, and developing. Further, there is a column on the left that seems to describe complex cognitive skills like analysis, communication, and demonstrates understanding.

Suggestions for Improvement

- Consider including scoring guidance notes that would support interpretation of student performance in each of the three dimensions such that teachers would be able to modify instruction if, for example, students understood the DCIs but not the CCCs. Criterion D of the Science Task Screener is a helpful resource when developing scoring guidance. This would ideally be done for all major assessments in the unit, including:
  - identifying the elements for each learning target;
  - providing guidance for how the teacher can interpret student progress toward each targeted element of each dimension and how students can interpret their own progress, and;
  - providing enough interpretation information about student performance in each dimension that the teacher would be able to modify instruction and provide feedback to students.

III.D. UNBIASED TASK/ITEMS

Assesses student proficiency using methods, vocabulary, representations, and examples that are accessible and unbiased for all students.

Rating for Criterion III.D. Unbiased Task/Items	*Adequate* *(None, Inadequate, Adequate, Extensive)*

The reviewers found adequate evidence that the materials assess student proficiency using accessible and unbiased methods, vocabulary, representations, and examples because the unit offers opportunities that measure student learning in a variety of ways. Over the course of the unit students write, draw, discuss, and verbally present. However, students are not given a choice of modality for expression and some tasks provide limited supports to ensure that all students can successfully understand and complete the expected procedure. Related evidence includes:

- Multiple lessons throughout the unit feature videos with Closed Captioning.

- Each lesson includes vocabulary at the end. These vocabulary words are referred to throughout the lessons.
    - Lesson 2: There are “Teacher Notes” that indicate where the teacher will need to expand on the vocabulary. The materials state, “Teacher Note: ‘Blast’ is a general term for an early, undifferentiated stem cell. Technically these blasts on the CBC are ‘myeloblasts’” (Teacher Guide, page 8).
    - Lesson 4: The Guide for following the Slide Deck explains each vocabulary word for this lesson. It states, “On the ‘Cd117 gene’ slide, describe the Cd117 gene, then provide the prompt as to whether students are wearing a shirt or jacket with a hood. Depending on their response, have them complete the three tasks associated with their outcome. On the ‘Lymphoid Cell: Growth Gene’ slide, describe the growth gene, then provide the prompt as to whether students are wearing shoes with laces or shoes without laces. Depending on their response, have them complete the three tasks associated with their outcome” (Teacher Guide, page 6).
- While multiple modalities are included in some lessons, they are not always meaningful and are repetitive. In most lessons, students express their understanding through the completion of a handout and then are asked to discuss the handout.
    - Lesson 3: Students complete Student Handout 3.3 to apply their understanding of uncontrolled cell growth and how it relates to cancer, then they discuss with a partner.
    - Lesson 4: After modeling cell differentiation with clay, students complete Student Handout 4.2 and discuss their responses.
    - Lesson 6: Students read cancer survivor stories and complete Student Handout 6.5 and discuss their answers as a group.

Suggestions for Improvement

- Consider incorporating reminders for educators to offer students a choice of modality (e.g., oral, written, gestures, drawing) during assessment opportunities.

III.E. COHERENT ASSESSMENT SYSTEM

Includes pre-, formative, summative, and self-assessment measures that assess three-dimensional learning.

Rating for Criterion III.E. Coherent Assessment System	Adequate *(None, Inadequate, Adequate, Extensive)*

The reviewers found adequate evidence that the materials include pre-, formative, summative, and self-assessment measures that assess three-dimensional learning. Both formative and summative assessment types are included, but the materials provide very little guidance for how assessments can be used to support students in meeting multi-dimensional learning goals. The materials also do not provide descriptions of how different assessment types work together to provide a coherent assessment system. Related evidence includes:

- At the end of each lesson there is a “Formative Assessment Opportunities” section that denotes the formal and informal assessment opportunities that could occur throughout the lesson. However, the reviewers did not find consistent teacher support for teachers to know what student learning is intended to be measured when and how to use that information to support students. Also, this document does not specify the elements or portion of the elements being assessed in each lesson. Additional evidence related to formative assessments is listed under Criterion III.B.
- Pre-Assessment and Self-Assessment opportunities are not included. Only formative (see evidence under Criterion III.B.) and summative assessment is explicitly referenced throughout the learning sequence. For example:
    - Lesson 2: The materials state, “Formative Assessment Opportunity: Students will work in small groups to complete a data organizer (Student Handout 2.2b: Blood Test Background & Data Organizer) which analyzes the Complete Blood Count (CBC) results of eight patients. This provides students the opportunity to identify patterns and trends they are noticing in the patient results and allows students to demonstrate an understanding of how the result of a leukemic CBC differs from a healthy patient’s CBC results” (Teacher Guide, page 14).
    - Lesson 5: The materials state, “Formative Assessment Opportunity: Student Handout 6.1 Student’s modeling of what is happening in Hina’s blood and bone marrow, both before and after her cancer in order to understand her disease. While the model building is collaborative, the individual written explanation can be used as an assessment tool” (Teacher Guide, page 16).
    - Lesson 9: “The IMTs that students updated at the end of each lesson in the unit and submitted to the teacher at the end of Lesson 9 also provide an opportunity for an

assessment of how students developed their knowledge of core content as the unit progressed and they engaged in activities, discussions, and labs" (Teacher Guide, page 11).

- Lesson 10:
    - The materials state, "Teachers can summatively assess students' understanding of material covered in previous lessons based on the public service announcement (PSA) produced by the student, as part of Activity 10.1. The PSA provides students the opportunity to creatively express what they have learned as well as synthesizing the information from several past lessons. A scoring rubric can be found in Teacher Resource 10.1: Stem Cell Donation PSA Project Rubric." (Teacher Guide, page 11).
    - The end of unit summative assessment exam is labeled as optional. Because it is optional, teachers may not use this assessment. Also, the format of the assessment is not similar to any of the other assessments. Therefore, it may not provide clear information about student learning since students might not be familiar with the format.

Suggestions for Improvement

- Consider including assessment forms for measuring student learning throughout the unit, including self-assessments and pre-assessments for SEPs and CCCs, in addition to the summative and formative assessments. It would also be helpful to clearly identify to teachers why students are engaging in each of those assessment opportunities and how teachers can make use of the information they receive.
- Consider including a variety of measures of student growth and feedback for the students so they are aware of their progress.

III.F. OPPORTUNITY TO LEARN

Provides multiple opportunities for students to demonstrate performance of practices connected with their understanding of disciplinary core ideas and crosscutting concepts and receive feedback.

Rating for Criterion III.F. Opportunity to Learn	Adequate *(None, Inadequate, Adequate, Extensive)*

The reviewers found adequate evidence that the materials provide multiple opportunities for students to demonstrate performance of practices connected with their understanding of DCIs. Students have some opportunities to demonstrate they have progressed toward learning in two dimensions during the unit.

Students have opportunities to demonstrate their growth in understanding related to **Developing and Using Models** and **LS1.B: Growth and Development of Organisms.** Students have the option to receive some agreement- or disagreement-based feedback from peers and have a chance to revise their performance before the final student artifacts are created, but students do not receive feedback from the teacher. Related evidence includes:

- Lesson 1: The materials state, "Invite students to create an initial conceptual model of what they think is happening inside Hina's body, using the template on page 2 of Student Handout 1.2: Blog Post & Modeling Hina's Symptoms. Have students individually write/draw what factors they think are impacting Hina's body. Factors should include her symptoms, the bone marrow, and her blood. In groups of 4, have students compare their models and discuss them, making revisions or additions as they see fit" (Teacher Guide, page 6).
- Lesson 3: Students model mitosis in different ways to understand cell division and how the process is affected by cancer.
- Lesson 4: Students create clay models of the differentiation of blood cells, modeling the process for healthy cells and cancer cells.
- Lesson 5: The materials state, "Provide an opportunity for students to share their models with one another in small groups and work towards a consensus model. Students should indicate changes or new ideas with a colored pen/pencil or other method. Stress that scientists often refine models through discussion. If time permits, you may wish to develop a class consensus model using the seminar guidelines provided in Lesson 2" (Teacher Guide, page 14).
- Lesson 9: Students develop a model to show the types of blood cells and how and where cell differentiation occurs.

Suggestions for Improvement

- Consider ensuring that educator and student materials consistently include clear and iterative opportunities for student learning toward *all* key learning goals in each key targeted dimension such that students can: 1) demonstrate their learning through assessment, 2) receive oral and written feedback, and 3) have a chance to apply the feedback to improve their performance in a subsequent assessment opportunity.
- Proportionate to the length of the unit, students have very limited to no opportunities to apply feedback from the educator to construct new learning that will advance their progress in sense-making and performance related to their learning goals. Consider incorporating regular guidance for educators to give feedback and to prompt students to apply feedback.

OVERALL CATEGORY III SCORE: **2** (0, 1, 2, 3)	
Unit Scoring Guide – Category III	
Criteria A-F	
3	At least adequate evidence for all criteria in the category; extensive evidence for at least one criterion
2	Some evidence for all criteria in the category and adequate evidence for at least five criteria, including A
1	Adequate evidence for at least three criteria in the category
0	Adequate evidence for no more than two criteria in the category

SCORING GUIDES FOR EACH CATEGORY

UNIT SCORING GUIDE – CATEGORY I (CRITERIA A-F)

UNIT SCORING GUIDE – CATEGORY II (CRITERIA A-G)

UNIT SCORING GUIDE – CATEGORY III (CRITERIA A-F)

OVERALL SCORING GUIDE

Scoring Guides for Each Category

Unit Scoring Guide – Category I (Criteria A-F)	
3	At least adequate evidence for all of the unit criteria in the category; extensive evidence for criteria A–C
2	At least some evidence for all unit criteria in Category I (A–F); adequate evidence for criteria A–C
1	Adequate evidence for some criteria in Category I, but inadequate/no evidence for at least one criterion A–C
0	Inadequate (or no) evidence to meet any criteria in Category I (A–F)

Unit Scoring Guide – Category II (Criteria A-G)	
3	At least adequate evidence for all criteria in the category; extensive evidence for at least two criteria
2	Some evidence for all criteria in the category and adequate evidence for at least five criteria, including A
1	Adequate evidence for at least three criteria in the category
0	Adequate evidence for no more than two criteria in the category

Unit Scoring Guide – Category III (Criteria A-F)	
3	At least adequate evidence for all criteria in the category; extensive evidence for at least one criterion
2	Some evidence for all criteria in the category and adequate evidence for at least five criteria, including A
1	Adequate evidence for at least three criteria in the category
0	Adequate evidence for no more than two criteria in the category

OVERALL SCORING GUIDE	
E	**Example of high quality NGSS design—**High quality design for the NGSS across all three categories of the rubric; a lesson or unit with this rating will still need adjustments for a specific classroom, but the support is there to make this possible; exemplifies most criteria across Categories I, II, & III of the rubric. (total score ~8–9)
E/I	**Example of high quality NGSS design if Improved—**Adequate design for the NGSS, but would benefit from some improvement in one or more categories; most criteria have at least adequate evidence (total score ~6–7)
R	**Revision needed—**Partially designed for the NGSS, but needs significant revision in one or more categories (total ~3–5)
N	**Not ready to review**—Not designed for the NGSS; does not meet criteria (total 0–2)