1. Central Focus

   a. Describe the central focus and purpose of the content you will teach in the learning segment.

   [Central focus: cellular division. Through a variety of carefully designed activities the students will develop a conceptual understanding of the steps taken during cellular division, including the reasons why cells divide and the natural controls in place that limit growth, model and explain the process, and develop predictions about the results of uncontrolled cell growth. In this unit, students are learning about cellular structures, functions, and processes. Prior to my learning segment, students will have learned about the functions of organelles and their roles. My four-lesson learning segment will address the topic of mitosis including the reasons for and practical applications of cell division, the cell cycle and associated stages, practice recognizing the stages from an authentic example (and related analysis), and generating evidence-based predictions relating to life spans of different types of human cells. Additionally, I will support students in generating explanations based on data that tie the concept of mitosis to the growth patterns displayed by cancerous cells. Students will have the opportunity to demonstrate their understanding through multiple means of representation including drawing, creating 3-D models, discussion and discourse, organization and interpretation of data, and a creative writing assessment. The central focus is aligned to New York State Middle School Science Standards including "Key Idea 2: Organisms inherit genetic information in a variety of ways that result in continuity of structure and function between parents and offspring", "Key Idea 4: The continuity of life is sustained through reproduction and development" which includes Performance Indicator 4.4 "Observe and describe cell division at the microscopic level and its macroscopic effects". Additionally, the central focus addresses Next Generation Science Standards for Science and Engineering Practices ("Develop and use a model to describe phenomena"), and Crosscutting Concepts relating to Structure and Function. The purpose for teaching this content is to provide students with a deeper understanding of cellular processes, the distinct steps involved with cellular division, how those processes relate and connect to their own bodies, and an understanding that cancers are a result of abnormal cell division. In addition to working towards the overarching goal of increased scientific literacy, these lessons provide students practice with the essential scientific skills of questioning, reasoning, data interpretation, evaluation and prediction.]

   b. Given the central focus, describe how the standards and learning objectives within your learning segment address

   - the use of science concepts,
   - the application of scientific practices through inquiry, and
   - the development and evaluation of evidence-based explanations of or reasonable predictions about a real-world phenomenon based on patterns of evidence and/or data.

[Science concepts]

Learning Objectives from Lesson One address the concepts of cell cycle and asexual reproduction. Students will use these concepts to understand how and why cells divide (for growth, repair, and maintenance.) Standards: Key Idea 2: Organisms inherit genetic information
in a variety of ways that result in continuity of structure and function between parents and offspring. Key Idea 4: The continuity of life is sustained through reproduction and development.

Learning Objectives from Lesson Two address the concepts of conservation of genetic material and the stages of mitosis. Students will use these concepts to understand why the process of mitosis is important during cell division (to ensure daughter cells are identical to original cell). Standard: 4.4b In one type of cell division, chromosomes are duplicated and then separated into two identical and complete sets to be passed to each of the two resulting cells. In this type of cell division, the hereditary information is identical in all the cells that result.

Learning Objectives from Lesson Four address the concepts of regulatory controls of cell growth and that cancers result from unrestrained cell growth. Students will use these concepts to understand why regulatory controls are an important part of healthy growth and the dangerous implications when these controls fail. Standard: 4.4d Cancers are a result of abnormal cell division.

**Application of scientific practices through inquiry-**

Learning Objectives from Lessons Two and Three address the practice of developing and using models (One of the eight practices of science and engineering outlined by A Science Framework for K-12 Science Education: #2- Developing and Using Models)

Learning Objectives from Lesson Three address the practice of analyzing and interpreting data, using mathematics and computational thinking, and constructing explanations (Three of the eight practices of science and engineering outlined by A Science Framework for K-12 Science Education: #4- Analyzing and interpreting data, #5- Using mathematics and computational thinking, and #6- Constructing explanations)

Learning Objectives from Lessons One and Three address the development and evaluation of evidence-based explanations of or reasonable predictions about a real-world phenomenon based on patterns of evidence and/or data. Students will develop predictions about cell division based on observations of onion root tip cells and later evaluate and analyze the same cells to generate data based on the visible stages of nuclear division. They will also develop predictions about the types of controls that limit cell growth and draw the conclusion about the causes of cancer (a real world phenomena).

c. Explain how your plans build on each other to help students understand relationships between scientific concepts, scientific practices through inquiry, and the phenomenon in the learning segment.

[My lessons in this learning segment build on each other by presenting material in a scaffolded manner, gradually increasing the complexity of the content and the students' tasks. We begin with the general concept of the steps that are needed to prepare for division (starting with the dividing monster) before looking closely at the stages of mitosis. I intentionally limit the amount of initial vocabulary and instead present it in context along the way. Students will sculpt and then photograph the stages of mitosis, later using these images to create a poster of the process. The segment spirals back to lesson one in lesson three when students use the same image used during their inquiry investigation to then extract data for analysis. Students will understand the relationships between the concepts of cell division for growth and repair, and the stages of mitosis that carefully regulate the division process. They will recognize and identify the stages of mitosis through an inquiry based activity, and understand that these stages occur in all cell division (not just the onion cells we use as an example).]
The relationships my students will understand include:
• making the connection between conceptual ideas about cellular division and how they relate to human body cells
• using inquiry to develop an understanding about the phenomenon of mitosis using an authentic example
• the understanding that special cellular controls are in place to limit cell growth and that cancer is uncontrolled cell growth. When provided with information about current cancer treatments students will be guided toward the understanding of why cancer patients lose their hair.]

2. Knowledge of Students to Inform Teaching
For each of the prompts below (2a–b), describe what you know about your students with respect to the central focus of the learning segment.

Consider the variety of learners in your class who may require different strategies/support (e.g., students with IEPs or 504 plans, English language learners, struggling readers, underperforming students or those with gaps in academic knowledge, and/or gifted students).

a. Prior academic learning and prerequisite skills related to the central focus—Cite evidence of what students know, what they can do, and what they are still learning to do.

[ Prior to the beginning of this learning segment students studied the parts of the cell and made analogies to the specific functions of organelles, comparing the cell to their school and also to a factory. They know the names of organelles and can usually recognize depictions of organelles in diagrams. The most common confusion is identifying specific organelles in plant cells. Students were assessed on their knowledge of cell parts on their mid-term (taken three weeks before the learning segment). They can make the connection between individual single celled organisms and how they perform life functions, but have not yet begun to discuss the importance of DNA or the means by which cells divide. Also, they have not discussed cell specialization related to specific human tissues and organs. My lower level students have trouble expressing their knowledge in written format, but tend to do reasonably well with a multiple choice assessment format.

My students began their introduction to microscopes (a new skill set for the entire class) including parts and their functions, calculating total magnification, concepts of field of view and depth of field and practice viewing specimens and diagramming what they see at different levels of magnification. They have observed cells (both plant and animal) and can recognize the nucleus. They are still learning to use the microscopes independently, and many find it challenging to draw exactly what they see (and not make interpretations of their specimens). Many students in this class often have very literal interpretations of information and sometimes struggle to make independent connections. When taking notes they look for the information to be presented in an identical format to their graphic organizers and struggle to isolate concepts on their own. ]

b. Personal, cultural, and community assets related to the central focus—What do you know about your students’ everyday experiences, cultural and language backgrounds and practices, and interests?

[ The students in this community have experienced a sequential set of field trips to a local nature preserve (during grades K-6) and spent two nights away at an Environmental Education Center at the beginning of 6th grade. They are living in a community that values nature and... ]
open spaces. They have a familiarity with the local plants and animals and can relate to stories or analogies that tie classroom concepts to this region. For example, cellular reproduction for growth and repair is common to maple trees, chipmunks, vultures and humans alike. Additionally, many students are involved in sports (basketball etc) and can relate to the experience of receiving an injury and later healing (related to cellular division). My students live in a relatively affluent area with limited cultural or socioeconomic diversity. The majority have access to technology outside of school, which is a popular interest for most of them. They enjoy using devices (iphone, tablet, etc) to communicate, explore the internet and take pictures. They are also creative students who enjoy drawing and design.

3. Supporting Students' Science Learning

Respond to prompts 3a–c below. To support your justifications, refer to the instructional materials and lesson plans you have included as part of Planning Task 1. **In addition, use principles from research or theory to support your justifications.**

a. Justify how your understanding of your students’ prior academic learning and personal, cultural, and community assets (from prompts 2a–b above) guided your choice or adaptation of learning tasks and materials. Be explicit about the connections between the learning tasks and students’ prior academic learning, their assets, and research/theory.

[ My students already know about cell organelles and their roles, having previously completed a unit of study on the topic and the mid term exam. Many students in this class have processing issues, reading and writing disabilities, attention difficulties, and there are two with aides (including an autistic student). For this population of students I selected activities and pacing throughout my learning segment that intentionally present material in varied formats, keeps the lesson moving and breaks up the class time with different activities. Following the recommendations of Universal Design for Learning (UDL) I have included varied representation of information (presenting information and content in different ways- CAST.org, 2015). For example, in the first three lessons my students will be discussing, drawing, modeling, photographing and creating posters about the process of mitosis. These forms of learning tie into my students’ interests in drawing and photography. I will also be showing video animation and providing graphic organizers for written notes. During lesson four, students will have a choice of assessment, including a written option. The RAFT assessment choice provides a structured, non traditional and creative format to demonstrate their learning. I have made sure to include a drawing option for this assignment specifically for those students who struggle with writing, and a standard multiple choice quiz that is straightforward (requires very little creativity or pretending) for my autistic student. An additional noteworthy component of my lessons are the inquiries included in lessons 1 and 4. They are designed to help students use and demonstrate their existing knowledge while exploring, discovering, and applying new information. For example, in lesson 1 students are guided through an inquiry based activity and will use observations to make conclusions about some “mystery cells”. In lesson 4 we will be brainstorming methods of cellular control and making predictions about instances when these controls fail. In both cases participation does not require much writing and instead guides the students through careful questioning. This technique is supported by The National Science Teachers Association (NSTA) which recommends that all K–16 teachers embrace scientific inquiry.]
b. Describe and justify why your instructional strategies and planned supports are appropriate for the whole class, individuals, and groups of students with specific learning needs.

Consider the variety of learners in your class who may require different strategies/support (e.g., students with IEPs or 504 plans, English language learners, struggling readers, underperforming students or those with gaps in academic knowledge, and/or gifted students).

Many of my students are especially sensitive to order, routine and format. They require explicit instructions, consistency and clearly explained expectations. To meet these needs I have maintained the opening format of the class that they are used to (with the Question, Objective, Do Now, etc on the board). I have also designed these lessons to allow sufficient time for clear explanations and time to address questions or concerns. My activities, strategies, and planned supports are appropriate for the whole class because I have selected highly engaging materials and organized the lessons to progress in a logical order that present the information within understandable contexts and in a scaffolded format. For example, in Lesson One my students are not even presented with the term mitosis or the vocabulary associated with the topic. They are introduced to the concept of cell division via an exercise using imagination and illustration. They are then presented with an image of "mystery cells" and through guided inquiry will develop fundamental understandings about cell division. Therefore, in Lesson One, my entire class is engaged in activities and discovery without being bogged down by unfamiliar terms. The higher level students will be stretched to grasp the concepts of cell division during the inquiry activity. Also, by starting mitosis with foundational concepts, the whole class will be at the same level in terms of academic knowledge and prepared for the subsequent lessons. These specifically chosen guides and scaffolds meet my students at their Zone of Proximal Development and facilitate their learning as we build content in subsequent lessons.

In Lesson Two, students will work with dough, other materials and digital cameras to create models of the process of mitosis while learning the names of the stages. This kinesthetic and visual learning activity engages my tactile learners while providing a visual representation of an otherwise microscopic process. While working on their models all of the students will be engaged with the materials, and the novelty of both the activity and the use of cameras will provide exciting variety of representation. During this lesson, students will be introduced to the vocabulary terms, first through a Knowledge Rating Guide, and will then write them as labels during the modeling activity. This gradual introduction to the terms will ease them into the learning process and set them up for success when we complete the graphic organizer the following day. Advanced students may begin to make the connection between their observations of the "mystery cells" and the shapes being sculpted in the models. This learning segment includes many visual aides, recommended by Edutopia.org, among others.

In Lesson Three students will practice scientific discourse and use their new terms in context while they work together to identify, count, tally and analyze information from an image of onion cells. This lab activity provides an opportunity for students to learn from one another and justify their ideas based on observation. The calculation section of the lab will be demonstrated to the whole class, and I will be circulating around the room to provide additional clarification when needed. This lesson provides students an opportunity to practice real science skills encouraged by A Science Framework for K-12 Science Education. During Lesson Four, students will be assessed on their knowledge of the cell cycle. I am providing 4 assessment options: students will select one. The choices include traditional question types (multiple choice etc), drawing, real-world application and a creative writing (RAFT style) option. These question types are all suggested by the IRIS Center and support differentiated assessment in that they appeal to the wide array of strengths and weaknesses this class includes. Throughout this learning segment,
materials, content and activities are differentiated to meet the learning needs and intelligences (Gardner) of my specific group of students.]

c. Describe common preconceptions (based on prior academic learning and experiences) within your central focus and how you will identify and address them.

[When most students think about reproduction they automatically think about the human life cycle as this is the most relevant to their lives. The discussion of reproduction on the cellular level is foreign to them, and many students will never have considered the means by which they grow, develop and heal. It is important that they understand that cells duplicate their DNA prior to passing through the critical stages of mitosis, ensuring that identical nuclear material is present in the resulting daughter cells. A solid understanding of mitosis sets students up with critical base knowledge needed to understand meiosis, and therefore the process of human reproduction. Cell division is a difficult concept for many students because the process is mostly invisible and happens without their conscious control. To make these lessons understandable and meaningful I will progress at a slow pace, beginning with an analogy and drawings, before presenting more detailed material. Analogies can help clarify students’ thinking, give them ways to visualize abstract concepts and are supported as an effective teaching strategy by the NSTA. I will be sure to relate the process of mitosis to their own lives and experiences by discussing growth, maintenance, development and also average rates of growth for common human cells.]

4. Supporting Science Development through Language

As you respond to prompts 4a–d, consider the range of students’ language assets and needs—what do students already know, what are they struggling with, and/or what is new to them?

a. Language Function. Using information about your students’ language assets and needs, identify one language function essential for students to

- use science concepts,
- apply scientific practices through inquiry, or
- develop and evaluate explanations or reasonable predictions about a real-world phenomenon.

Listed below are some sample language functions. You may choose one of these or another language function more appropriate for your learning segment.

<table>
<thead>
<tr>
<th>Analyze</th>
<th>Explain</th>
<th>Interpret</th>
<th>Justify with evidence</th>
</tr>
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[During the course of this learning segment my students will be spend time practicing accurately describing their observations. The science concepts addressed are new to all of my students, and by presenting material in varied formats and providing them with a range of activities, all of my students can build understanding in the ways that match their individual learning styles. Among these Language Functions, describing is essential for understanding the concept of mitosis. My students will be thinking about the logical steps that a cell will need to complete prior do cell division and describing them out loud. They will be provided with an image of "mystery cells" and asked to describe what they see and then explain what they think might be happening. Also, during the lab activity (Lesson Three), they will be collaborating with classmates to both describe what they see and explain how it should be classified. Since many of my students have reading and writing disabilities, I chose activities that would engage their...
thinking and reasoning skills without requiring a written component. Being able to accurately describe observations is an important scientific skill that they will use to create understanding about the scientific concept of cellular division.]

b. Identify a key learning task from your plans that provides students with opportunities to practice using the language function. Identify the lesson in which the learning task occurs. (Give the lesson/day and number.)

[Describing: There are many opportunities for them to practice using the language function. For example, in Lesson One, I will use questioning to guide their inquiry as they describe and interpret an image (the "mystery cells"). I will begin by explaining how scientists and detectives, when presented with a mystery, begin with careful observation and description before seeking to explain their observations. I will model this process and invite the students to practice with a different image before they begin with the "mystery cells". This introduction will make clear the expectations and provide a structure and format for their thinking.]

c. **Additional Language Demands.** Given the language function and learning task identified above, describe the following associated language demands (written or oral) students need to understand and/or use:

- **Vocabulary and/or symbols**
- **Plus at least one of the following:**
  - Syntax
  - Discourse

[Vocabulary: This learning segment includes several vocabulary terms that describe the stages of mitosis. (see lesson plans for list of terms) The learning task identified above is an introductory lesson, prior to the introduction of terms. However, during the remainder of the learning segment students will hear, read, write and speak the words (there are both written and oral demands associated with this learning segment). They will be provided with a graphic organizer for the terms that includes a space for a diagram of the important components. During their written assessment piece they will be required to demonstrate their learning using the terms correctly and in context.

Discourse: During Lesson One, students will practice scientific discourse (participate in knowledge construction through a verbal narrative that includes accurate description and analysis, followed by generation of conclusions based on evidence) when they are presented with “mystery cells” and guided through an oral inquiry exercise.]

d. **Language Supports.** Refer to your lesson plans and instructional materials as needed in your response to the prompt.

- Identify and describe the planned instructional supports (during and/or prior to the learning task) to help students understand, develop, and use the identified language demands (function, vocabulary and/or symbols, syntax, or discourse).

[ Vocabulary: Introduction to the terms begins after establishing a basic understanding of the concept and process involved. In Lesson Two, students will rank their current level of terms using a Knowledge Rating Guide. They will return to this guide during Lesson Four to re-rate their knowledge after completing several activities and exercises. The terms will be presented in varied formats to support learning needs as the students begin to understand the vocabulary. In Lesson Two they will receive a basic introduction before learning the stages of mitosis while they sculpt them using playdough. They will label and photograph each stage, further engaging the students in the learning process. They will take their images from Lesson Two and use them
to create a poster in Lesson Three. They will complete a graphic organizer in class that ties the stage to a diagram of what it looks like. Also during Lesson Three will be a practical application portion during which students will work in teams to identify and categorize cells. They will need to use the vocabulary to discuss their ideas with their teammates. Finally, in Lesson Four, the students will be assessed on their new understandings, including specific vocabulary. Students will have access to their posters and their graphic organizers to help them study. Throughout the entirety of my lesson segment, the learning is gradual, meaningful and scaffolded.

**Discourse:** During Lesson One, students will practice scientific discourse (participate in knowledge construction through a verbal narrative that includes accurate description and analysis, followed by generation of conclusions based on evidence) when they are presented with "mystery cells" and guided through an oral inquiry exercise. This type of discourse exercise will be new to the students and to foster their understanding I am including a modeling activity prior to distributing the images of the onion cells. I will also provide examples of sentence starters for their initial observations like: "I noticed, I observed, The structures appear", etc. Once we have generated a comprehensive list of descriptions I will guide students to make connections and begin to try and explain what they see. Their explanations and conclusions may be phrased with the following starters: "Because of ____, I think ____", "The observations suggest that _____", etc. This structured format will help ensure their success and limit any confusion about the activity while supporting their practice with scientific discourse.

5. **Monitoring Student Learning**

In response to the prompts below, refer to the assessments you will submit as part of the materials for Planning Task 1.

a. Describe how your planned formal and informal assessments will provide direct evidence of students' understanding of

- science concepts,
- the real-world phenomenon, **AND**
- the application of scientific practices through inquiry **throughout** the learning segment.

[The assessments in this learning segment are: Knowledge Rating Guide (given at the beginning of lessons 2 and 4), Stoplight (end of lesson 1), Exit ticket (at the end of lesson 2), informal observation and questioning (especially during lessons 1 and 3) and summative assessment choice (lesson 4).]

**Science Concepts:** By evaluating the changes in vocabulary ranking on the KRG, I will have reflective feedback of how the students feel they understand the terms associated with this learning segment. From their exit tickets (lesson 2) I will be able to gauge their understanding about the reasons for cell division. By observing their arrangement of the photographs into a poster (lesson 3), I will be able to tell if they understand the progression of changes that occur during mitosis. Through their selected assessment format, students will demonstrate their understanding of the process of cell division.

**Real World Phenomenon:** The information that students write in their exit tickets (Stoplight assessment and exit tickets, ends of lessons 1 & 2) will provide evidence of their understanding of the general process of mitosis. They will demonstrate understanding of the process in detail in the summative assessment.

**Application of scientific practices through inquiry:** Students will use scientific practices of observation, explanation, and description during the guided inquiry portion of the learning
segment (lesson 1 and again in lesson 4). Through informal observation and guided questions I will be able to assess their conceptual understanding and thought process. Additionally they will generate and analyze data (lesson 3). I will collect their lab reports to assess their work.

b. Explain how the design or adaptation of your planned assessments allows students with specific needs to demonstrate their learning.

Consider the variety of learners in your class who may require different strategies/support (e.g., students with IEPs or 504 plans, English language learners, struggling readers, underperforming students or those with gaps in academic knowledge, and/or gifted students).

Knowledge Rating Guides are a useful means of introducing terms and reflecting on learning. All students will be asked to rank their current level of understanding for several specific terms both at the beginning and end of the learning segment. This type of assessment helps students gauge their progress towards mastery of content and understanding, while making it clear to the instructor what the starting level is and where any gaps may be at the end. This KRG does not require students to write the terms, only repeat them out loud and rank them by checking a box. It is simple and straightforward for all learners, yet also provides meaningful assessment for the educator.

The Stoplight exit ticket (end of lesson 1) will offer students an anonymous way to ask for additional clarification without drawing attention to themselves in front of the class. This is important for those students who may be too shy to ask out loud during class time. It requires only a short written piece and students will appreciate the novelty of the activity.

The exit ticket (end of lesson 2) will tie into the day’s work and check to see that students grasp the reasons for the careful division of nuclear material during cellular division. By providing a prompt, students will be guided in their response, and again, just a short written piece is all that is required. This is important, since these formative assessments are given at the end of the lesson and several students have a heightened sense of anxiety about finishing on time. By observing their arrangement of the photographs into a poster (lesson 3), I will be able to tell if my students understand the progression of changes that occur during mitosis. This piece is important as it requires a visual assemblage of the process and I will be able to tell if students understand the steps involved and the order they occur. This informal assessment requires no writing and is especially important for my students who struggle with written pieces.

The work that my students complete during the lab (lesson 3) will demonstrate their skill when working with numerical representations of data and their ability to calculate percentages. Finally, the summative assignment will demonstrate their understanding both of the scientific concept of cellular division and the detailed aspects of the specific stages and their names. It is my hope that by offering choice and creativity that the students will be able to address the assessment goals through an enjoyable format. I have made sure to include a diagram/drawing option in this assignment specifically for those students who struggle with writing, and a format choice that is straightforward (requires very little creativity or pretending) for my autistic student.