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Traveling Through Cells:

An Online Learning Experience to Engage Students in Science Learning

Megan A. Stamer

Ramapo College of New Jersey

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Abstract

This paper provides detailed information about the online learning module, for grades 4 and 5, developed in order to complete my Capstone Thesis for the MSET program at Ramapo College of New Jersey. This project is a unit on cells and cell organelles. It will consist of an online learning portal and a 3-D model building portion. It will also consist of a written research paper. It encompasses multiple grade levels and is interdisciplinary in nature.

Keywords: Online learning module, Eukaryotic cells, Prokaryotic cells, cell organelles, NGSS, Common Core, ISTE, research paper, Google Docs, Google Sheets, Google Slides, Microsoft PowerPoint, laptops

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Traveling Through Cells:

An Online Learning Experience to Engage Students in Science Learning

Introduction

This unit and online learning module fulfills the requirements for the Capstone project for the Master of Science Technology program. This project is an accumulation of our learning from all of the courses thus far in the program. It will incorporate numerous technology aspects to help students gain a better understanding of the content being taught—cell types and cell organelles.

Tom March, author of “The Learning Power of WebQuests” published in 2003 in *Educational Leadership*, states that

“A real WebQuest is a scaffolded learning structure that uses links to essential resources on the World Wide Web and an authentic task to motivate students’ investigation of an open-ended question, development of individual expertise, and participation in a group process that transforms newly acquired information into a more sophisticated understanding. The best WebQuests inspire students to see richer thematic relationships, to contribute to the real world of learning, and to reflect on their own metacognitive processes.”¹

This online learning module that I am creating will encompass the definition that Tom March uses. March also states that real WebQuests will have “Students see richer thematic relationships...Students contribute to the real world of learning...Students reflect on their own metacognitive processes.”² My students will be able to do all of these tasks while completing this online learning experience. Research also tells us that, according to S.Kim MacGregor and

¹ <http://tommarch.com/writings/ascdwebquests/>

² <http://tommarch.com/writings/ascdwebquests/>

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Yiping Lou, "Using WebQuests for inquiry-based learning represents a higher-order use of technology requiring students to exercise information seeking, analyzing, and synthesizing strategies"³.

Culture of Technology in Professional Life

Technology plays a huge part of my life both personally and professionally. I recently became a Google Certified Educator Level 1. This has helped me become more able to help my students as they work their way through Google Classroom and learning the Google Suite. I have always been a supporter of technology in the classroom. Throughout my undergraduate career, I always tried to tie in technology to my learning. I am the only teacher on my floor who has an Epson Smart Board. I am able to fully use the interactive technology to teach my science classes.

Individualization of Teaching Strategies

This online learning module will help enhance my individualization as a teacher. I already incorporate technology, videos and music into my curriculum. This module is just the start of increasing this individualization even further. Our school has started to incorporate more Chromebooks and iPads into our classrooms, giving us access to working technology 5 days out of the week, instead of just the 2 days when the computer teacher is not there.

Changing Curriculum

The module will change my curriculum allowing my students to become more technology literate. Students could also start to become more comfortable with the format of online learning so that they will be able to use it more in the future.

Demographic Information	
Location	Clark, New Jersey
Type of School	Private, Catholic

³ <http://www.tandfonline.com/doi/abs/10.1080/15391523.2004.10782431>

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Number of Students in School	About 425+
Grades in School	Pre-K 3 through 8 th
Targeted Students	Grades 4 & 5
Targeted Student Ages	9-11
Number of Years Teaching	Currently in my 3 rd year (2016-2017)
Ethnicities of Targeted Students	Caucasian, African American, Hispanic, Asian, Pacific Islander
Other Information	Middle States Accredited School Blue Ribbon Accreditation 2011 *Note: Some targeted students attend our school on scholarship, come from home with little school support, or have learning disabilities.

Scope of Project

For more information of the scope of this project, please see the sections titled “Website Layout”, “Procedure”, and “Unit Timeline”.

Objectives & Essential Questions

This unit on cells encompasses numerous pieces of knowledge that will be taught. First, students will need to learn what cells are. Second, they will learn how cells are different. Thirdly, students will learn what cells include and each component’s function. Finally, students learn how all of these pieces are put together. Students will be challenged to take notes and synthesize information from videos and readings. Students will demonstrate their learning by writing research papers on various cells. They will also produce a 3-D model of these cells to compare and contrast their structure and function. Below is a list of essential questions for the unit, a list of lesson objectives and a list of performance activities for the unit.

Essential Question

What defines a living thing?

Unit Question

Why is each part of the cell essential to survival?

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Content Questions

How do plant and animal cells differ?

How do bacterium and Protista cells differ?

How do Prokaryotic and Eukaryotic cells differ?

How do the functions of cell organelles help the overall cells?

What structures (organelles) are in eukaryotic cells and prokaryotic cells?

Are these organelles the same in each cells? How do they differ?

Why is each part of the cell essential to survival?

Unit Lesson Objectives

1-2

Welcome & Introduction

- Students will be able to utilize technology to access a unit plan's website.
- Students will be able to understand the requirements of the unit.

3

What Are Cells?

- Students will be able to describe the cell as a three-dimensional object.
- Students will be able to identify

4-5

Types of Cells

- Students will be able to summarize the main idea from a video, articles, or books.
- Students will be able to compare and contrast Eukaryotic and Prokaryotic cells.
- Students will be able to compare and contrast Animal, Plant, Bacterium and Protista cells.
-

6-12

Cell Organelles

- Students will be able to summarize the main idea from a video, articles, or books.
- Students will be able to compare and contrast the functions of cell

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	<p>organelles to the functions of the human body system.</p> <ul style="list-style-type: none">• Students will be able to identify the function of cell organelles in Animal, Plant, Bacterium and Protista cells.• Students will be able to identify the structure of cell organelles in Animal, Plant, Bacterium and Protista cells.
13-15	3-D Cell Research <ul style="list-style-type: none">• Students will be able to synthesize information from various mediums.• Students will be able to determine materials that will mimic the structure and function of cell organelles in a given Eukaryotic or Prokaryotic cell.
16-19	3-D Cell Building <ul style="list-style-type: none">• Students will be able to determine materials that will mimic the structure and function of cell organelles in a given Eukaryotic or Prokaryotic cell.
20	3-D Cell Gallery Walk <ul style="list-style-type: none">• Students will be able to compare and contrast Eukaryotic and Prokaryotic cells.• Students will be able to discuss these similarities and differences using Scientific Talk.
21	Conclusion & Wrap-Up <ul style="list-style-type: none">• Students will be able to summarize the structure and function of various cells.• Students will be able to self-reflect and self-assess their learning through the use of a rubric.
22	Test <ul style="list-style-type: none">• Students will be able to assess their knowledge of cells, their structures and their functions through a test.

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Performance Objectives	
1-2	Welcome & Introduction <ul style="list-style-type: none">• Students will be able to access unit materials through Google Classroom and through WordPress.• Students will be able to utilize unit materials through Google Classroom and through WordPress.
3	What Are Cells? <ul style="list-style-type: none">• Students will be able to utilize research tools and materials to compose concise notes.• Students will be able to use notes created from research to summarize the main idea and answer essential questions.
4-5	Types of Cells <ul style="list-style-type: none">• Students will be able to utilize research tools and materials to compose concise notes.• Students will be able to use notes created from research to summarize the main idea and answer essential questions.• Students will be able to label diagrams comparing the differences between Animal, Plant, Bacterium and Protista cells.
6-12	Cell Organelles <ul style="list-style-type: none">• Students will be able to utilize research tools and materials to compose concise notes.• Students will be able to use notes created from research to summarize the main idea and answer essential questions.• Students will be able to label the cell organelles which make Animal, Plant, Bacterium and Protista cells similar and different.

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13-15	3-D Cell Research <ul style="list-style-type: none">• Students will be able to synthesize information to create a concise research paper.• Students will be able to produce a written research paper that follows specific guidelines to discuss the specific organelles of a Eukaryotic or Prokaryotic cell.
16-19	3-D Cell Building <ul style="list-style-type: none">• Students will be able to build a cell model according to scale using diagrams, pictures and notes as reference.• Students will be able to draw a blueprint of their 3-D model.
20	3-D Cell Gallery Walk <ul style="list-style-type: none">• Students will be able to compare and contrast Eukaryotic and Prokaryotic cells from their peers.• Students will be able to discuss these similarities and differences using Scientific Talk.
21	Conclusion & Wrap-Up <ul style="list-style-type: none">• Students will be able to complete a self-assessment using a rubric.

Procedure

This unit will entail a lot of facilitation from the teacher and a lot of group collaboration on the part of the student. Students will be utilizing technology constantly throughout this unit. Assessments and check points will be given throughout the unit to check for understanding of the students. Below is a brief unit timeline for this project. It is estimated to take about 5-7 weeks' worth of class periods lasting about 40 minutes in length. This can be adjusted as the unit progresses. It will be up to the teacher to assess if more information will be needed for their

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classes, or if more time will be needed for these activities. More detailed procedures for students and teachers will be included in lesson plans on the site’s teacher page.

Unit Timeline	
Number of Class Periods (40 minutes)	Description of Lesson
1-2	Welcome & Introduction <ul style="list-style-type: none"> • Introduce the unit • Go over the website • Assign students to groups • Have students decide on roles to take in the group • Set up/Create passport for badges & “notebook” for learning • Review “I Can” Unit Study Guide packet & Unit Checklist
1	What Are Cells? <ul style="list-style-type: none"> • PowerPoint Video & Fill-in-the-blank Notes
1-2	Types of Cells <ul style="list-style-type: none"> • PowerPoint Video & Fill-in-the-blank Notes-Eukaryotic vs. Prokaryotic (Animal, Plant, Bacterium & Protista) • Complete Graphic Organizers to compare and contrast types of cells.
5-6	Cell Organelles <ul style="list-style-type: none"> • PowerPoint Videos & Fill-in-the-blank Notes for every type of organelle • Complete Graphic Organizers to understand the structure and function of the organelles • Complete various sub-projects to check for understanding throughout the organelle section of the unit.
2-3	3-D Cell Model Research & Prep

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	<ul style="list-style-type: none"> • Assign each group a cell to research and turn into their 3-D cell model. • Explain 3-D cell model project requirements & due dates. • Complete Color by Number activities • Color various cell models of ALL cells, not just assigned cell.
2-3	<p>3-D Cell Model Building</p> <ul style="list-style-type: none"> • Build 3-D cell model, in class with their groups. • Materials are brought in from home. • Create “poster” to tie into their model.
1	<p>3-D Cell Gallery Walk</p> <ul style="list-style-type: none"> • View models of their peers. • Take notes and observations of these models.
1	<p>Conclusion & Wrap-Up</p> <ul style="list-style-type: none"> • Participate in a discussion
1	<p>Unit Assessment Test</p> <ul style="list-style-type: none"> • Students will assess their knowledge through a Google Form Test. <ul style="list-style-type: none"> ○ Students will be assessed on their knowledge of: <ul style="list-style-type: none"> ▪ The structure and function of various cell organelles ▪ The layout of each type of cells ▪ The similarities and differences between the various types of cells
TOTAL ESTIMATED NUMBER OF CLASSES	20 (or more, depending on how the unit progresses and student abilities)

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Website Layout

My website will be laid out in a way that will be easy to maneuver through. Students will start on the homepage which will welcome them to their new adventure through cells. There they will also find the link to the unit's YouTube Channel and various playlists used throughout the unit. There will also be a button for students to click which will send them to the next piece in their journey—the "Introduction".

The "Introduction" page will give students a better sense of what will be expected of them at the end of the unit. There will be documents to print out, such as a unit check list and a group work "contract" to keep all group members on task. This page will also include a video tutorial to watch of how to navigate the website. There will be a button to bring them back to the homepage, and a button to lead them to the next section—the "What Are Cells" page.

The "What Are Cells" page will include a fill-in-the-blank notes page and a corresponding PowerPoint video. There will also be extra video resources with questions for students to check their understanding. It will have a button to bring students to the next page called "Types of cells"

The "Types of Cells" page will actually branch off into two pages. The "Types of Cells" homepage will give a brief overview into the two main types of cells-Eukaryotic and Prokaryotic cells. It will also include a short video tutorial on how to navigate this portion of the site. Students will be able to click links to bring them to a page for Eukaryotic cells and a page for Prokaryotic cells. These subpages will include PowerPoint videos and fill-in-the-blank notes for students to utilize. After a brief introduction to each type of cell, there will be further subpages for specific types of cells-Animal, Plant, Bacterium and Protista. Each of these subpages will have fill-in-the-blank notes, PowerPoint videos and further activities to engage students in their

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study of cells. There will be buttons to bring them back to their “Types of Cells” homepage.

Then, students will move on to the heart of the unit—the “Cell Organelles” page.

The “Cell Organelles” homepage will look similar to the “Types of Cells” homepage. It will include pictures and links to separate subpages for each of the organelles. On its “homepage” there will be a video tutorial on how to navigate through this portion of the site. Each subpage will be similar to the subpages before, in the other parts of the site. Each Cell Organelle will have a PowerPoint video, fill-in-the-blank notes, and specific projects for students to complete. Students will have to go back to the “Cell Organelles” homepage to continue onto the next organelle. When they have completed all of the “Cell Organelles”, students will click a button to head to the “Conclusion” page.

The “Conclusion” page congratulates students on finishing their journey, but they aren’t quite finished yet! Students will have one final project to complete, to help assess their knowledge of cells and cell organelles—a 3-D cell model! Students will work in groups during class time to complete a 3D model of a given cell—Animal, Plant, Bacterium or Protista. Students will be given detailed instructions and videos to guide them on this project on the “3-D Cell Model” subpage. The “Conclusion” page will also help the class wrap-up the unit. Students will complete some self-reflective work and complete their assignments.

There will be “badges” to earn throughout this journey. Students will be able to access these badges after successful completion of each section—introduction, what are cells, types of cells, Eukaryotic, Prokaryotic, Animal, Plant, Bacterium, Protista and then each Cell Organelle. These badges will go into a “passport” that students will create at the beginning of the unit.

The final page of this site is the “Teacher Page”. This page will house all teacher resources, lesson plans, standards and more. All documents will be available here for teachers to

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use. Answer keys will not be posted to the site, but will be made available at teachers' requests.

Website Pages List

Home Page

Introduction

What Are Cells?

Types of Cells

- Eukaryotic Cells
 - Animal Cells
 - Plant Cells
- Prokaryotic Cells
 - Bacterium Cells
 - Protista Cells

Cell Organelles

- Nucleolus & Nucleus
- Cell Wall
- Cell Membrane
- Mitochondria
- Ribosomes
- Smooth & Rough ER
- Cytoplasm
- Vacuole
- Lysosome
- Chloroplast
- Chlorophyll
- Golgi bodies/Golgi Apparatus

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- Genetic material-DNA & RNA
- Plasmid
- Flagellum
- Cilia
- Capsule
- Plasma membrane

Conclusion

- 3-D Cell Model
- Student Reflection & Wrap-Up

Teacher Page

Software and Internet Resources

This project will be based out of a WordPress site. As my school also uses Google Classroom, my unit would be given out through Classroom as well. Students will be using YouTube to access video tutorials and PowerPoint videos. They will be using Google Drive to access any and all documents needed. Students can access these documents and print them out to handwrite in them or use Google to access and edit them online. Students will also use Google Docs, Google Sheets, Google Slides and Google Forms to create databases, presentations and more throughout the unit. As a teacher, I will utilize Microsoft PowerPoint to make videos to have students access their learning at home. These videos will then be posted to YouTube to make them accessible to everyone. They will also be embedded on the unit webpage. Students and teacher will also utilize Bubbl.us, a concept mapping tool to help unify all of their learning throughout the unit. Prezi will also be used to help students better access their information.

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Software and Internet Resources List	
Software/ Internet Site	Utilization
<i>WordPress</i>	<ul style="list-style-type: none"> • Home base for the Unit work
<i>Google Classroom</i>	<ul style="list-style-type: none"> • Where all assignments will be turned in • Second home base for unit work
<i>Google Drive</i>	<ul style="list-style-type: none"> • Where students will access all documents needed during unit
<i>Google Docs</i>	<ul style="list-style-type: none"> • Where students can edit and complete written notes and assignments
<i>Google Forms</i>	<ul style="list-style-type: none"> • Students will complete surveys through forms
<i>Google Sheets</i>	<ul style="list-style-type: none"> • Students will create a database through Google Sheets
<i>Google Slides</i>	<ul style="list-style-type: none"> • Students will create a way to inform others about the parts of a cell
<i>Bubbl.us</i>	<ul style="list-style-type: none"> • Students will create a concept map of their learning throughout the unit
<i>Prezi</i>	<ul style="list-style-type: none"> • Teacher will utilize this site to help convey information to students about cell organelles
<i>Microsoft PowerPoint</i>	<ul style="list-style-type: none"> • Teacher will utilize this program to create videos for students about cell organelles
<i>YouTube</i>	<ul style="list-style-type: none"> • Teacher will post videos and tutorials to the site for students to access with ease. • Teacher will show videos from various other channels to further enhance learning

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Grade levels

This activity is primarily geared towards upper level 4th and 5th grade students. However, it can be used for middle school students as well, even though the standards that apply to this activity are geared more towards the middle school students. Students in a gifted and talented type of program as well as students with special needs will be able to use this project with guidance from teachers and push-in instructors.

Standards

While this activity focuses mostly on a middle school level Next Generation Science Standards listing, it can be used for upper level students in Elementary School settings-grades 4th and 5th. It encompasses many different standards across various curriculum topics-technology, writing, reading, speaking and listening, science, engineering, and mathematics- just to name a few. While every standard is not addressed at every page, these are the standards addressed throughout the entire site. There are upper elementary and middle school standard correlations provided for reference for all teachers.

Next Generation Science Standards-Objective Statements⁴

MS-LS1-1	Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells.
MS-LS1-2	Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function.

Next Generation Science Standards-Science and Engineering Practices⁵

Developing and Using Models	Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.
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⁴ <http://www.nextgenscience.org/dci-arrangement/ms-ls1-molecules-organisms-structures-and-processes>

⁵ <http://www.nextgenscience.org/dci-arrangement/ms-ls1-molecules-organisms-structures-and-processes>

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	<ul style="list-style-type: none"> • Develop and use a model to describe phenomena. (MS-LS1-2) • Develop a model to describe unobservable mechanisms. (MS-LS1-7)
Planning and Carrying Out Investigations	<p>Planning and carrying out investigations in 6-8 builds on K-5 experiences and progresses to include investigations that use <u>multiple variables</u> and provide evidence to support explanations or solutions.</p> <ul style="list-style-type: none"> • Conduct an investigation to produce data to serve as the basis for evidence that meet the goals of an investigation. (MS-LS1-1)
Constructing Explanations and Designing Solutions	<p>Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific knowledge, principles, and theories.</p> <ul style="list-style-type: none"> • Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students’ own experiments) 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. (MS-LS1-5),(MS-LS1-6)
Engaging in Argument from Evidence	<p>Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s).</p> <ul style="list-style-type: none"> • Use an oral and written argument supported by evidence to support or refute an explanation or a model for a phenomenon. (MS-LS1-3) <ul style="list-style-type: none"> • Use an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. (MS-LS1-4)
Obtaining, Evaluating, and Communicating Information	<p>Obtaining, evaluating, and communicating information in 6-8 builds on K-5 experiences and progresses to evaluating the merit and validity of ideas and methods.</p> <ul style="list-style-type: none"> • Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence. (MS-LS1-8)

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Scientific Knowledge is Based on Empirical Evidence	Science knowledge is based upon logical connections between evidence and explanations. (MS-LS1-6)
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Next Generation Science Standards-Disciplinary Core Ideas⁶

LS1.A	Structure and Function <ul style="list-style-type: none">• All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular). (MS-LS1-1)• Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell. (MS-LS1-2)• In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions. (MS-LS1-3)
LS1.B	Growth and Development of Organisms <ul style="list-style-type: none">• Animals engage in characteristic behaviors that increase the odds of reproduction. (MS-LS1-4)• Plants reproduce in a variety of ways, sometimes depending on animal behavior and specialized features for reproduction. (MS-LS1-4)

⁶ <http://www.nextgenscience.org/dci-arrangement/ms-ls1-molecules-organisms-structures-and-processes>

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- Genetic factors as well as local conditions affect the growth of the adult plant. (MS-LS1-5)

Next Generation Science Standards-Crosscutting Concepts⁷

Cause and Effect	<ul style="list-style-type: none">• Cause and effect relationships may be used to predict phenomena in natural systems. (MS-LS1-8)• Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. (MS-LS1-4),(MS-LS1-5)
Scale, Proportion and Quantity	<ul style="list-style-type: none">• Phenomena that can be observed at one scale may not be observable at another scale. (MS-LS1-1)
Systems and System Models	<ul style="list-style-type: none">• Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. (MS-LS1-3)
Structure and Function	<ul style="list-style-type: none">• Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the relationships among its parts, therefore complex natural structures/systems can be analyzed to determine how they function. (MS-LS1-2)
Interdependence of Science, Engineering and Technology	<ul style="list-style-type: none">• Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems. (MS-LS1-1)

⁷ <http://www.nextgenscience.org/dci-arrangement/ms-ls1-molecules-organisms-structures-and-processes>

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Science is a Human Endeavor	<ul style="list-style-type: none"> Scientists and engineers are guided by habits of mind such as intellectual honesty, tolerance of ambiguity, skepticism, and openness to new ideas. (MS-LS1-3)
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Next Generation Science Standards-Connections Across Grade Bands⁸

4-LS1-1	Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.
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NJ Student Learning Standards - Science and Engineering Practices-Connections Across Grade Bands⁹

Developing and Using Models	<p>Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.</p> <ul style="list-style-type: none"> Use a model to test interactions concerning the functioning of a natural system. (4-LS1-2)
Engaging in Argument from Evidence	<p>Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s).</p> <ul style="list-style-type: none"> Construct an argument with evidence, data, and/or a model. (4-LS1-1)

NJ Student Learning Standards- Disciplinary Core Ideas- Connections Across Grade Bands¹⁰

LS1.A	<p>Structure and Function</p> <ul style="list-style-type: none"> Plants and animals have both internal and external structures that serve
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⁸ <http://www.nextgenscience.org/dci-arrangement/ms-ls1-molecules-organisms-structures-and-processes>

⁹ <http://www.nextgenscience.org/dci-arrangement/ms-ls1-molecules-organisms-structures-and-processes>

¹⁰ <http://www.nextgenscience.org/dci-arrangement/4-ls1-molecules-organisms-structures-and-processes>

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various functions in growth, survival, behavior, and reproduction. (4-LS1-1)

NJ Student Learning Standards - Crosscutting Concepts- Connections Across Grade Bands¹¹

Systems and System Models	<ul style="list-style-type: none"> A system can be described in terms of its components and their interactions. (4-LS1-1),(4-LS1-2)
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NJ Student Learning Standards - Science¹²

5.3.4.A.2	Essential functions required for the well-being of an organism are carried out by specialized structures in plants and animals.
5.3.6.A.2	Essential functions of plant and animal cells are carried out by organelles.

Common Core English Language Arts/Literacy Connections to Next Generation Science Standards-Middle School Level¹³

RST.6-8.1	Cite specific textual evidence to support analysis of science and technical texts. (MS-LS1-3),(MS-LS1-4),(MS-LS1-5),(MS-LS1-6)
RST.6-8.2	Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions. (MS-LS1-5),(MS-LS1-6)
RI.6.8	Trace and evaluate the argument and specific claims in a text, distinguishing claims that are supported by reasons and evidence from claims that are not. (MS-LS1-3),(MS-LS1-4)
WHST.6-8.2	Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-LS1-5),(MS-LS1-6)
WHST.6-8.7	Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (MS-LS1-1)

¹¹ <http://www.nextgenscience.org/dci-arrangement/4-ls1-molecules-organisms-structures-and-processes>

¹² <http://www.state.nj.us/education/cccs/2009/5.pdf>

¹³ <http://www.nextgenscience.org/dci-arrangement/ms-ls1-molecules-organisms-structures-and-processes>

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WHST.6-8.9	<u>Draw evidence from informational texts to support analysis, reflection, and research.</u> (MS-LS1-5),(MS-LS1-6)
SL.8.5	Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-LS1-2),(MS-LS1-7)

Common Core English Language Arts/Literacy Connections to Next Generation Science Standards-Elementary Level¹⁴

W.4.1	Write opinion pieces on topics or texts, supporting a point of view with reasons and information. (4-LS1-1)
SL.4.5	Add audio recordings and visual displays to presentations when appropriate to enhance the development of main ideas or themes. (4-LS1-2)

ISTE Technology Standards for Teachers¹⁵

1.a	Facilitate and inspire student learning and creativity. Promote, support, and model creative and innovative thinking and inventiveness
1.b	Facilitate and inspire student learning and creativity. Engage students in exploring real-world issues and solving authentic problems using digital tools and resources
2.a	Design and develop digital age learning experiences and assessments. Design or adapt relevant learning experiences that incorporate digital tools and resources to promote student learning and creativity
2.c	Design and develop digital age learning experiences and assessments. Customize and personalize learning activities to address students' diverse learning styles, working strategies, and abilities using digital tools and resources
3.d	Model digital age work and learning. Model and facilitate effective use of current and emerging digital tools to locate, analyze, evaluate, and use information resources to support research and learning
5.d	Engage in professional growth and leadership. Contribute to the effectiveness, vitality, and self-renewal of the teaching profession and of their school and community

¹⁴ <http://www.nextgenscience.org/dci-arrangement/4-ls1-molecules-organisms-structures-and-processes>

¹⁵ <https://www.iste.org/standards/standards/standards-for-teachers>

ISTE Technology Standards for Students¹⁶	
1.a	Empowered Learner Articulate and set personal learning goals, develop strategies leveraging technology to achieve them and reflect on the learning process itself to improve learning outcomes.
1.c	Empowered Learner Use technology to seek feedback that informs and improves their practice and to demonstrate their learning in a variety of ways.
1.d	Empowered Learner Understand the fundamental concepts of technology operations, demonstrate the ability to choose, use and troubleshoot current technologies and are able to transfer their knowledge to explore emerging technologies.
2.b	Digital Citizen Engage in positive, safe, legal and ethical behavior when using technology, including social interactions online or when using networked devices.
3.a.	Knowledge Constructor Plan and employ effective research strategies to locate information and other resources for their intellectual or creative pursuits.
3.b	Knowledge Constructor Evaluate the accuracy, perspective, credibility and relevance of information, media, data or other resources.
3.c	Knowledge Constructor Curate information from digital resources using a variety of tools and methods to create collections or conclusions.
6.c	Creative Communicator Communicate complex ideas clearly and effectively by creating or using a variety of digital objects such as visualizations, models or simulations.
7.b	Global Collaborator Use collaborative technologies to work with others, including peers, experts or community members, to examine ideas and problems from multiple viewpoints.
7.c	Global Collaborator Contribute constructively to project teams, assuming various roles and responsibilities to work effectively toward a common goal.

NJ Student Learning Standards- Technology¹⁷	
8.1.5.A.1	Understand and use technology systems. Select and use the appropriate digital tools and resources to accomplish a variety of tasks including solving problems.

¹⁶ <https://www.iste.org/standards/standards/for-students-2016>

¹⁷ <http://www.state.nj.us/education/cccs/2014/tech/8.pdf>

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8.1.5.A.2	Select and use application effectively and productively. Format a document using a word processing application to enhance text and include graphics, symbols and/or pictures.
8.1.5.A.3	Select and use application effectively and productively. Use a graphic organizer to organize information about problem or issue.
8.1.5.A.5	Select and use application effectively and productively. Create and use a database to answer basic questions.
8.1.8.A.1	Understand and use technology systems. Demonstrate knowledge of a real world problem using digital tools.
8.1.5.C.1	Communicate information and ideas to multiple audiences using a variety of media and formats. Engage in online discussions with learners of other cultures to investigate a worldwide issue from multiple perspectives and sources, evaluate findings and present possible solutions, using digital tools and online resources for all steps.
8.1.5.D.2	Advocate and practice safe, legal, and responsible use of information and technology. Analyze the resource citations in online materials for proper use.
8.1.5.D.3	Demonstrate personal responsibility for lifelong learning. Demonstrate an understanding of the need to practice cyber safety, cyber security, and cyber ethics when using technologies and social media.
8.1.5.D.4	Exhibit leadership for digital citizenship. Understand digital citizenship and demonstrate an understanding of the personal consequences of inappropriate use of technology and social media.
8.1.5.E.1	Plan strategies to guide inquiry. Locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media. Evaluate and select information sources and digital tools based on the appropriateness for specific tasks. Use digital tools to research and evaluate the accuracy of, relevance to, and appropriateness of using print and non-print electronic information sources to complete a variety of tasks.
8.1.5.F.1	Identify and define authentic problems and significant questions for investigation. Plan and manage activities to develop a solution or complete a project. Collect and analyze data to identify solutions and/or make informed decisions. Use multiple processes and diverse perspectives to explore alternative solutions. Apply digital tools to collect, organize, and analyze data that support a scientific finding.
8.2.5.C.1	The attributes of design. Collaborate with peers to illustrate components of a designed system.

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Assessment

Students will be assessed both formally and informally. Some of the assessments will be simple and others more complex. All assessments will use rubrics for teacher's guidance and for student reference. In the first part of this unit, students will be asked to create summaries of information given or to complete teacher directed fill-in-the-blank notes. The fill-in-the-blank notes are based off of PowerPoints and videos created by myself. The videos and PowerPoints are easy to follow. Students know that important information to copy is highlighted in yellow.

In the second section of this unit students will be asked to create models of a Eukaryotic or Prokaryotic cell. They will also be asked to complete a research paper through Google Docs on their cell. They will have to divide tasks in their groups to accomplish their projects successfully. Students will be given detailed information and handouts to help guide them through this process. Finally, students will be asked to self-assess themselves as well as their group throughout the unit. This will help the students and teacher know who contributed and who slacked off. Students with disabilities and students who are English language learners are able to complete all assignments and assessments with modifications and with help from their peers. From modified notes, to help during classroom assignments all students' needs will be met.

Creative Commons and Duplication

This entire website and all materials within the module are under a creative commons license. Adaptations of my work can be shared as long as it is similar and credit is given. Teachers can make copies of documents provided, and then modify them if needed as long as they are not then commercially sold elsewhere.

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Brainy Bits & Pedagogy Pieces

I will incorporate many various pedagogical theories into my unit. I will apply sense and meaning to students' lives through the unit by making the information relatable, relative and interesting. This unit and module will also stimulate my students' brains by accessing the various lobes. The Frontal Lobe is used when the students reason with their peers and when they gather and retrieve information. The Parietal Lobe will be stimulated when students use their senses to interact with the 3-D models, computers and each other. The Occipital Lobe will be stimulated when the students view videos, look at diagrams and read information on cells. Their Temporal Lobe will be stimulated when they hear their teacher's voice on videos, hear other videos and listen to their peers. Below you will find more information on how Gregorc's Mind Styles (1984) will be affected during the online learning module as well as more information on how the brain will be affected during the activities.

Mind Styles	
Style	Activity
Concrete Sequential	<ul style="list-style-type: none">• Students will have step-by-step instructions so they can follow along.
Concrete Random	<ul style="list-style-type: none">• Students will receive a general time-frame to complete each section of the online learning module.• Students will receive extra time to complete work (home, recess, lunch, before or after school).
Abstract Random	<ul style="list-style-type: none">• Students will have class discussions and will be graded on participation and behavior during class.• Students will write and verbally communicate their thoughts about

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	cells and their organelles.
Abstract Sequential	<ul style="list-style-type: none"> Students will utilize video tutorials that will describe the procedures for completion of activities and use of the website.

Neurons	
Neuron	Activity
Working Neurons	<ul style="list-style-type: none"> Working Neurons will help students experience various forms of stimuli such as listening, discussing, touching, writing, drawing, painting and visually observing during this project unit. Neurons will transmit signals which will help students complete classroom tasks.
Sensory Neurons	<ul style="list-style-type: none"> Sensory Neurons will help students view visual examples of artworks created by various artists from around the world. Students will use their sensory neurons to view videos and visuals regarding geographical placements of continents around the world.
Motor Neurons	<ul style="list-style-type: none"> Motor Neurons will help students design, draw, sculpt, weave or paint their artworks.

Limbic System	
Part of System	Activity
Amygdala	<ul style="list-style-type: none"> The amygdala will help students store names of cells and cell organelles in their memory. It will also help students store information in their memory about their structures and functions.
Cingulate Gyrus	<ul style="list-style-type: none"> Students will use their Cingulate Gyrus when they feel excitement and eagerness to create their models. Students will also feel challenged when creating their 3-D model.
Hippocampus	<ul style="list-style-type: none"> Students will use their Hippocampus to retrieve memory of cell organelles when presented with a diagram.

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	<ul style="list-style-type: none"> Students will use their Hippocampus to retrieve information of past lessons.
Hypothalamus	<ul style="list-style-type: none"> Students will use their Hypothalamus when displaying excitement for the lesson. Students will also use it when displaying emotions of pride and confidence in their completed models.
Olfactory Cortex	<ul style="list-style-type: none"> Students will use their Olfactory Cortex in order to view video tutorials and PowerPoint presentations. Student's Olfactory Cortex will receive sensory information when students view diagrams and models.
Thalamus	<ul style="list-style-type: none"> The Thalamus in the student's brain will relay sensory signals when they create their model.

Differentiated Instruction

This unit offers a variety of activities for a variety of learners. It touches on Gardner's theory of multiple intelligences (1991). It also uses Bloom's Taxonomy (1956). Bloom's Taxonomy allows students to scaffold their learning, and for teachers to really see if students have a grasp of the information. The following charts give more details on how Gardner's Multiple Intelligences and Bloom's Taxonomy are used in this unit.

Gardner's Multiple Intelligences	
Intelligence	Activity
Mathematical-Logical	<ul style="list-style-type: none"> Students will enjoy measuring their organelles to make them accurate and to scale for their 3-D model.
Musical	<ul style="list-style-type: none"> Students will enjoy listening to parody songs from Mr. Parr on YouTube

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Verbal-Linguistic	<ul style="list-style-type: none"> • Students will enjoy the reading aspects of the unit. • They will also enjoy conducting the research and writing a paper.
Existential	<ul style="list-style-type: none"> • Students will enjoy seeing how cells fit together in the “big picture” of biology and in the natural world.
Naturalist	<ul style="list-style-type: none"> • Students will enjoy learning about cells in the natural world and how they interact with each other.
Interpersonal	<ul style="list-style-type: none"> • Students will enjoy working in groups throughout the unit.
Intrapersonal	<ul style="list-style-type: none"> • Students will enjoy being able to self-reflect on their own contributions to the group throughout the unit.
Bodily/Kinesthetic	<ul style="list-style-type: none"> • Students will enjoy building the 3-D cell.
Visual-Spatial	<ul style="list-style-type: none"> • Students will enjoy the coloring of the cells. • They will also enjoy the visuals and videos on the website.

Bloom's Taxonomy

Level	Activity
1- Knowledge	<ul style="list-style-type: none"> • Students will define vocabulary terms. • Students will complete fill-in-the-blank notes to learn about cells.
2- Comprehension	<ul style="list-style-type: none"> • Students will paraphrase their learning in their summaries.
3- Application	<ul style="list-style-type: none"> • Students will apply their knowledge of cells to answer questions posed by the teacher.
4- Analysis	<ul style="list-style-type: none"> • Students will compare and contrast the various types of cells. • Students will determine the various structures of the cells and their

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	purposes.
5- Synthesis	<ul style="list-style-type: none">• Students will construct a 3-D model of a cell.• Students will design the model by creating a blueprint model first.• Students will plan their design and model collaboratively in their groups.
6- Evaluation	<ul style="list-style-type: none">• Students will evaluate the evidence collected through the unit to create an argument as to which cell is the most important.• Students will defend their argument and opinion using evidence collected.

Teacher Tips

There are several things that a teacher who wants to implement this module into their classroom should do to prepare, modify and enhance this learning experience in their classroom.

Teacher Preparation

First, teachers should make sure that their district has YouTube unblocked. This is critical in making sure that students will have access to all video tutorials. Secondly, if the teacher has a word wall, teachers will need to have terms and definitions written on note cards or in other forms to have available and accessible for students. Third, teachers need to have enough computers and a strong enough internet access to be able to accommodate the work. Students will also need access to Google suite and have Gmail accounts. Finally, having hard copies of documents and “passports” will be up to the discretion of the teacher. Making those copies, or having them available will need to be done prior to each day’s session.

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Lesson Outline

The following is a suggested outline of how to run each lesson. This can be modified according to each teacher's district and classroom set up.

1. Focus and Review

Students will discuss each cell and cell organelle in a separate lesson. Students will view video tutorials that will describe the use of the unit web quest and its navigation. Students will also view videos that will describe each cell and its organelles. Students will complete the research and use class time in order to discuss their findings with a group of student peers.

2. Teacher Instructional Process

The teacher will utilize the videos in the web quest as well as diagrams and visual reproductions of cells in order to bring the topic to life for the students. Students will be asked one essential question at the start of each portion of the unit and then again asked follow-up questions regarding specific themes that were discussed throughout each unit portion.

3. Guided Practice

The teacher will walk around the classroom/computer lab and answer any questions, as well as motivate students by offering ideas that will further their art making process and push students to challenge themselves. The teacher will consistently ask student questions that they will need to provide an answer through their research. The teacher will also provide students with rubrics and clear project guidelines for each project.

4. Independent Practice

Students will complete their initial research on the different types of cells first. Then students will continue to learn more in depth about the cell organelles, their structures and functions, and how they work within a specific cell. Students will utilize the information that

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they gathered in order to make a decision on which type of cell they would like to create for the final project for that portion of the unit. Lastly, students will reflect upon their science experience as well as their final product. Students will self-reflect, self-evaluate and will also write a scientist's statement describing their experience. Students will repeat this process with each cell and cell organelle.

5. Closure

When complete, students will create one last scientist statement discussing their work as one large body of work. Students will showcase their models in an exhibition for the entire class.

Alternate Outline & Accommodations

Students who are below/above grade level will be presented with many ways of completing their written work (individually and collaboratively in groups). Students who are below grade level will have an opportunity to complete written assignments verbally as well in order to gain a grade for those assignments if they are struggling with lower writing skills. Students will have an opportunity to have additional time to complete their work. Students will be able to complete their work before or after school, during lunchtime and at home over a weekend utilizing family's help. Students who are above grade level will be able to challenge themselves by completing more assignments for each section, and to increase their knowledge by conducting research using higher end websites.

English Language Learners will have the opportunity to work in groups and complete research and models in a group environment. Students will utilize friends who can translate and help them complete their written assignments. Students will have an opportunity to complete written assignments verbally as well in order to gain a grade for those assignments if they are struggling with lower writing skills. Finally, students will have an opportunity to have additional

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time to complete their work. Students will be able to complete their work before or after school, during lunchtime and at home over a weekend utilizing family's help.

Field Testing Procedures

This online learning module unit will be field tested with my own fifth grade students during the course of the semester. Sometime in March, after our state testing, I will begin our Cell Unit. As a part of this unit, my students will use the school Chromebooks to help test this module out. I envision testing this website in sections. Some of it will be teacher driven and some will not be. I will also be asking for student feedback on this website. I will have a Google Form for students to complete after each "beta test" session in class. They are eager to help me in my graduate studies and will enjoy being a part of this capstone project.

Impact

This unit and module will have an impact on many people involved with the project. Firstly, it impacts myself as a teacher and as the creator of this website. Working as closely to the materials and technology as I am, I am able to have a greater sense of pride when it comes to the module and unit. Next, this project impacts my students. My students are already so excited any time I teach them something new. Adding this unit to my arsenal will be yet another way that I can activate my students' learning. They will have a greater sense of pride in their learning and in their work knowing that I worked hard to create something they would all enjoy.

Thirdly, this unit and online learning module will impact my personal learning network (PLN) of colleagues and peers. By creating this unit and website, I will be able to share it with my PLN. My PLN will be able to share it with their PLNs, and so on. Blogging about this project will also be beneficial. The more eyes that look at this product, the better. My work may be able to help many other students learn about cells and cell organelles. Teachers within my "district"

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will also be impacted. I can share this resource within the Archdiocese to be able to reach more students in a way that is unique and fun. I feel that teachers anywhere in the country will be able to easily implement my module into their classroom, especially with the help of the Teacher

Page portion of the site.

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Endnotes