Think Like a Scientist

Scientific Investigations for Rising 4th/5th Graders

7/20/2017

Duke University-Academically/Intellectually Gifted Licensure Program
Unit Created By: Katrina Edmond

Rationale

The purpose of this unit is to provide opportunities for learners to explore and gain a deeper understanding of the process associated with scientific investigations. This unit is based around the essential understanding "investigation ignites discovery". Learners will use a logical, consistent, and systematic method of investigation by applying the scientific method. Learners will construct their own knowledge for themselves through inquiry and discovery. This unit has been designed to allow learners to develop and demonstrate their science knowledge. Learners will take the role of a research scientist by making observations, selecting testable questions, conducting research, forming hypotheses, testing hypotheses, and reporting the results.

This unit will also allow students to identify and use relevant scientific tools such as beakers, graduated cylinders, goggles, stop watches, microscopes, hand lens, and metric rulers in order to observe, describe, and quantify the world around them. Learners will make sense of the rules of ethics that scientists are to follow when they are conducting investigations. The learners will also develop a range of personal, thinking, and learning skills through various learning opportunities.

Differentiation for Gifted Learners

This is a one week unit that is comprised of lessons that are intended to be used with identified gifted rising fourth and fifth graders. Since gifted learners often master new concepts quickly, in this unit, they will delve more deeply into the concepts of investigation and discovery. Each lesson has been planned with a conceptual lens of investigation and was developed with the emphasis of curriculum models that challenge gifted learners in their classrooms. The planned learning experiences throughout the unit have been modified to meet the needs of gifted learners in the following ways:

Content - Gifted learners will have access to a more complex text about scientists.

Process - Students will engage in in-depth critical thinking as they analyze the concept of investigation through grouping and labeling.

- Students will engage in answering questions that require high level thinking.

- Students will participate in a Socratic Seminar. Students will facilitate the seminar themselves and will be responsible for crafting questions which maintain the integrity of the seminar.

Product - Students will decide on how to show what they learned about what scientists do and how important observations are when working as a scientist. Students may decide to demonstrate what they learned as a written response, graphic/visual response, oral/auditory response, or dramatic/performance response.

Learning Environment - Students will be organized into groups of similar interests.

Population of Gifted Learners

This unit has been planned for a diverse group of rising fourth and fifth graders who attend Durham Public Schools and have been identified as gifted learners. As gifted learners, these students often have rich background knowledge and exhibit higher level thinking, creativity, inquiry skills, and independence in learning. Research indicates that cooperative learning enhances the learning of high ability students, therefore, the students will engage in many group work opportunities.

Goals and Outcomes

Content Goal and Outcomes:

GOAL 1: Scientific investigation involves questioning, hypothesizing, experimentation, analyzing, and conclusion.

The students will be able to….

A. Research and study specific topics in order to make discoveries.
B. Understand that observations are basis for inference.
C. Determine that the scientific method is a road map that scientists use in order to understand how things work and why they work the way they do.
D. Identify the tools scientists use to observe, describe, and quantify their world.

Process Goal and Outcomes:

GOAL 2: Design a scientific investigation

The students will be able to….

A. Work collaboratively in a group
B. Observe, form a hypothesis, collect data, analyze information, make conclusions, and report results.
C. Problem-solve to provide solutions.
D. Observe and analyze evidence.

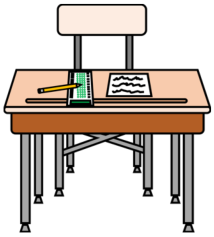
Concept Goal and Outcomes:

GOAL 3: Investigation ignites discovery.

The students will be able to….

A. Use inquiry to make connections
B. Craft questions and maintain an inquiry based dialogue which deeply examines ideas and concepts.
C. Identify and explain the purpose of investigation and identify examples of discovery.
D. Draw conclusions and make generalizations about how investigation ignites discovery.

ASSESSMENT PLAN



Formative Assessments

The following formative assessments have been included in this unit: teacher observation, strategic questioning, conferencing, exit tickets, quick writes, think-pair-share, student's work analysis, and self-assessment.

Performance Task—Summative Assessment

Scientific investigation is the way in which scientists and researchers use a systematic approach to answer questions about the world around us. Scientific investigation is a quest to find the answer to a question using the scientific method. The Massachusetts Institute of Technology (MIT) will be providing free lab space to support the next greatest discovery. You and your research team members are putting together a proposal to test a highly anticipated research question that will lead to one of the most ground-breaking discoveries of the decade.

In order to be considered for a free lab space at MIT, you and your team members must submit the following to the MIT analysts:

- A question that can be tested through scientific investigation and will lead to one of the most ground-breaking discoveries of the decade
- Research and a hypothesis
- A practical and reproducible plan that includes detailed procedures for a scientific investigation

	Performance Task Scoring Guide	
4	*Forms a testable question and hypothesis that ***clearly*** guides the design of a scientific investigation *Designs a practical and reproducible plan and ***detailed*** procedures for an investigation that addresses the question. *Describes a ***logical*** procedure that identifies the relevant variables for collecting ***accurate and reliable data***. *Presents a detailed, systematic plan and procedure incorporating ***consistent multiple trials*** or observations.	4
3	*Forms a testable question and hypothesis that can be used to guide the design of a scientific investigation. *Designs a practical plan and procedures for an investigation that addresses the question. * Describes a ***logical*** procedure for collecting ***appropriate data***. *Presents a plan and procedure incorporating multiple trials or observations.	3
2	*Selects a question and forms a hypothesis that is of ***partial*** use in the design of a scientific investigation. *Designs a plan that includes ***limited*** procedures which do not adequately address the question. *Describes a procedure which would result in the collection of ***incomplete data.***	2
1	*Selects a question that ***cannot be used*** to design a scientific investigation or form a hypothesis. *Designs a plan that ***does not address*** the question. *Describes a procedure which would result in ***inaccurate data***.	1

TEACHER NAME			Lesson #
Katrina Edmond			1
MODEL	**CONTENT AREA**	**GRADE LEVEL**	
Taba	Science	4	

CONCEPTUAL LENS	LESSON TOPIC
Investigation	Scientific Investigation

LEARNING OBJECTIVES *(from State/Local Curriculum)*

- **RI.4.1 Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text.**
- **RI. 4.3 Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text.**
- **4.P.3 Recognize that energy takes various forms that may be grouped based on their interaction with matter.**
- **4.L.1 Understand the effects of environmental changes, adaptations and behaviors that enable animals (including humans) to survive in changing habitats.**

THE ESSENTIAL UNDERSTANDING *(What is the overarching idea students will understand as a result of this lesson?*	THE ESSENTIAL QUESTION *(What question will be asked to lead students to "uncover" the Essential Understanding)*
Investigation ignites discovery.	*How does investigation ignite discovery?*

CONTENT KNOWLEDGE (What factual information will students learn in this lesson?)	PROCESS SKILLS (What will students be able to do as a result of this lesson?)
▪ Scientific investigation involves questioning, hypothesizing, experimentation, analyzing, and conclusion. ▪ Scientists research and study specific topics in order to make discoveries. ▪ A botanist makes discoveries about plants. ▪ A microbiologist makes discoveries about microscopic organisms. ▪ Wildlife technicians help scientists in their research of physical adaptations. ▪ A volcanologist is a scientist who studies volcanoes. ▪ Fire investigators begin their careers as scientists or firefighters. ▪ French physicists Antoine Henri Becquerel and Marie Curie made discoveries about uranium.	▪ Identify and explain the purpose of investigation. ▪ Identify examples of discovery. ▪ Draw conclusions and make generalizations about how investigation ignites discovery. ▪ Categorize ideas and determine relationships.

GUIDING QUESTIONS

What questions will be asked to support instruction?

Include both "lesson plan level" questions as well as questions designed to guide students to the essential understanding

Pre-Lesson Questions:	During Lesson Questions:	Post Lesson Questions:

➢ What is investigation? ➢ What is discovery? ➢ How is a discovery different from an invention? ➢ How do scientists use investigation? ➢ Why do scientists use the scientific method when they perform scientific investigations?	➢ What are some items from the text that relate to investigation? ➢ What are some items from the text that relate to discovery? ➢ Which items from your list are alike in some aspect of discovery? ➢ Which items from your list are alike in some aspect of investigation? ➢ How can you label the groups you formed? ➢ What are the reasons why you grouped these together?	➢ Why is scientific investigation important? ➢ How does investigation ignite discovery? ➢ What scientific question would you like to investigate by conducting an experiment? ➢ How does investigation ignite discovery?

DIFFERENTIATION

(Describe how the planned learning experience has been modified to meet the needs of gifted learners. Note: Modifications may be in one or more of the areas below. Only provide details for the area(s) that have been differentiated for this lesson.

Content	Process	Product	Learning Environment
Gifted learners will have access to a more complex text about scientists.	Students will engage in in-depth critical thinking as they analyze the concept of investigation through grouping and labeling.		

PLANNED LEARNING EXPERIENCES

(What will the teacher input? What will the students be asked to do? For clarity, please provide detailed instructions)

Engage and Connect- *This phase focuses on piquing students' interest and helping them access prior knowledge. This is the introduction to the lesson that motivates or hooks the students.*
*Pre Lesson questions will be asked during this time.

To begin, the teacher will ask the students why scientists use the scientific method when they conduct a scientific investigation. Next, the teacher will tell the students to look for more reasons why scientists use the scientific method in the following video from GoNoodle.com: "Think Like a Scientist"-- https://app.gonoodle.com/channels/blazer-fresh/think-like-a-scientist?s=Search&t=Think%20like%20a%20scientist

Explore - *In this phase, the students have experiences with the concepts and ideas of the lesson. Students are encouraged to work together without direct instruction from the teacher. The teacher acts as a facilitator. Students observe, question, and investigate the concepts to develop fundamental awareness of the nature of the materials and ideas.*

Teacher will ask during lesson questions.
Listing
Teacher will tell students to make note of all things that are related to investigation and/or discovery as they watch the video ***Discovering Solar Energy*** and read the articles from *Science a-z* (see attachment). The students will read independently and discuss the texts in groups of 3-4. The video and articles can be found on the following website: https://www.sciencea-z.com/main/ScienceSearch/?searchTerms=discovery. The students will also receive a more challenging text titled *Curious Marie Curie* also from *Science a-z*. When the students are done reading, the teacher will give each group post-it notes and have them write on each post-it note a person, place, or thing from the video and articles that relate to investigation and/or discovery. **Students should compile a list of at least 20 words.** After students have created their list and shared it, the teacher will make a thorough list on the board.

Explain - *Students communicate what they have learned so far and figure out what it means. This phase also provides an opportunity for teachers to directly introduce a concept, process, or skill to guide students toward a deeper understanding.*

Grouping and Labeling
Students will collaborate with their group members in order to minimize their word list by grouping similar items together based on their aspect of investigation and labeling the newly defined groups. **The students must create at least four different groups, at least 3 items in each group, and none of the items can be used twice**. As students collaborate with their group members, the teacher will check in with each group and facilitate as needed by asking questions such as "Do any of these items belong together?" "What would you call these groups you have formed?" "What are the reasons why you grouped these together?"

Elaborate —*Allow students to use their new knowledge and continue to explore its implications. At this stage students expand on the concepts they have learned, make connections to other related concepts, and apply their understandings to the world around them in new ways*

Regrouping
1. Students will collaborate with their group members again in order to regroup the items into at least 3 new groups with new categories based on investigation. The students can use the items again, categories must be new, and each category needs at least three items.
2. All student groups will share their categories.

Evaluate: *This phase assesses both learning and teaching and can use a wide variety of informal and formal assessment strategies.*
Teacher will ask post lesson questions.

The teacher will bring the lesson to a close by revisiting the essential question. The students will answer the question by turning and talking with a partner. Teacher will have students take out their notebook and write a brief response to the following question: How does investigation ignite discovery?

Scientific Method--Teacher will revisit the Scientific Method with a focus on observation. Students will understand what an observation is and distinguish an observation from an inference. Teacher will tell students to make note of examples from the video that helped them have a deeper understanding of the difference between an observation and an inference. https://www.youtube.com/watch?v=fBlR7taW9jk Next, students will work in groups of 3 to 4 students. Students will practice making observations and inferences by completing the attached activities (*Making Observations and Inferences Data Sheets 1 & 2*). At the completion of this activity, the students will reflect in their "Investigation Log" by answering the following questions: How is an observation different from an inference? Was it harder to make observations or inferences? Why? Should scientists focus more on observations or inferences? Why?

Introduce Performance Task--Scientific investigation is the way in which scientists and researchers use a systematic approach to answer questions about the world around us. Scientific investigation is a quest to find the answer to a question using the scientific method. The Massachusetts Institute of Technology (MIT) will be providing free lab space to support the next greatest discovery. You and your research team members are putting together a proposal to test a highly anticipated research question that will lead to one of the most ground-breaking discoveries of the decade. In order for you and your team members to be considered for a free lab space at MIT, you all must provide the following to the MIT analysts:

- A question that can be tested through scientific investigation and will lead to one of the most ground-breaking discoveries of the decade
- Research and a hypothesis
- A practical and reproducible plan that includes detailed procedures for the highly anticipated research question.

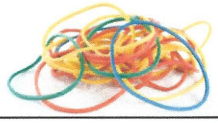
Conduct an Experiment Whole Group—How to Make Slime with Elmer's Glue https://www.stevespanglerscience.com/lab/experiments/glue-borax-gak/ Teacher will model how to conduct a scientific investigation while performing the slime experiment. After conducting the experiment, there will be a class discussion about any discoveries gained.

Name _____ Date _____

Part 1: Observing Objects

Directions: Observe each object using your senses of sight, smell, touch, and hearing (do not use taste). Record your observations in the space provided. Be sure to consider the way it looks, feels, smells, and sounds.

Collect Data

Object		Observations
jellybeans		
eraser		
popcorn		
paper clips		
rubber bands		
rock		
chocolate candies		
marbles		

Name _____ Date _____

Part 2: Making Inferences

Directions: Use your observations from Data Sheet 1 to infer the contents of each bag. Once your team has completed the list, open each bag to discover and record what was actually inside each bag.

Collect Data

Bag #	Inference about the contents of each bag	Observation of the contents in each bag
#1		
#2		
#3		
#4		
#5		
#6		
#7		
#8		

TEACHER NAME			Lesson #
Katrina Edmond			2
MODEL	**CONTENT AREA**	**GRADE LEVEL**	
Bruner	Science	4th	

CONCEPTUAL LENS	LESSON TOPIC
Investigation	Researchers use specific tools and methods.

LEARNING OBJECTIVES *(from State/Local Curriculum)*

- **4.P.2.1 Compare the physical properties of samples of matter (strength, hardness, flexibility, ability to conduct heat, ability to conduct electricity, ability to be attracted by magnets, reactions to water and fire).**
- **4.W.7 Conduct short research projects that build knowledge through investigation of different aspects of a topic.**
- **RI.4.1 Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text.**
- **RI. 4.3 Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text.**

THE ESSENTIAL UNDERSTANDING *(What is the overarching idea students will understand as a result of this lesson?*	THE ESSENTIAL QUESTION *(What question will be asked to lead students to "uncover" the Essential Understanding)*
Investigation ignites discovery.	*How does investigation ignite discovery?*

CONTENT KNOWLEDGE (What factual information will students learn in this lesson?)	PROCESS SKILLS (What will students be able to do as a result of this lesson?)
• **Observations are basis for inference.** • **The scientific method is a road map that scientists use in order to understand how things work and why they work the way they do.** • **Scientific investigation involves questioning, hypothesis, experimentation, analyzing, and conclusion.** • **Scientists might use the following tools to observe, describe, and quantify their world: beakers, graduated cylinders, goggles, scales, thermometers, stop watch, Bunsen burner, microscopes, petri dishes, hand lens, telescopes.** • **Scientists are required to follow rules of ethics when they are conducting investigations.**	**Students will be able to….** • **Observe, form a hypothesis, collect data, analyze information, make conclusions, and report results** • **Gather evidence to make inferences** • **Identify and use scientific tools** • **Work collaboratively in a group**

GUIDING QUESTIONS

What questions will be asked to support instruction?
Include both "lesson plan level" questions as well as questions designed to guide students to the essential understanding

Pre-Lesson Questions:	During Lesson Questions:	Post Lesson Questions:

➢ **What is a scientist?** ➢ **What does a scientist do?** ➢ **What are some of the tools that scientists might use?** ➢ **Where might scientists work?** ➢ **What is an observation?** ➢ **What is an inference?** ➢ **What actions** ➢ **What actions do scientists take in order to form a hypothesis?** ➢ **What actions do scientists take to determine a question that can be answered through scientific investigation?**	➢ **What did you learn about scientists and observations from the video?** ➢ **What are some examples of tools used for scientific observation?** ➢ **What do you think will happen while conducting this experiment?** ➢ **What did you observe while conducting this experiment?** ➢ **What question does this experiment answer?**	➢ **What did you learn about being a scientist?** ➢ **What strategies and/or methods did you use during your observations?** ➢ **What strategies and/or methods did you use to determine a question and form a hypothesis?** ➢ **How important is observation when working as a scientist?** ➢ **How did you reach conclusions from your observations?** ➢ **How does investigation ignite discovery?**

DIFFERENTIATION

(Describe how the planned learning experience has been modified to meet the needs of gifted learners. Note: Modifications may be in one or more of the areas below. Only provide details for the area(s) that have been differentiated for this lesson.

Content	Process	Product	Learning Environment
Gifted learners will have access to a more complex text about scientists and their discoveries.		**Students will decide on how to show what they learned about what scientists do and how important observations are when working as a scientist. Students may decide to demonstrate what they learned as a written response, graphic/visual response, oral/auditory response, or dramatic/performance response.**	

PLANNED LEARNING EXPERIENCES

(What will the teacher input? What will the students be asked to do? For clarity, please provide detailed instructions)

Engage and Connect-*This phase focuses on piquing students' interest and helping them access prior knowledge. This is the introduction to the lesson that motivates or hooks the students.*

Teacher will ask the Pre-Lesson Questions listed above during this stage of learning.
As students enter the classroom, the following website will be projected on the white board--***Science Tools Slideshow***:
http://mrswarnerarlington.weebly.com/unit-1-scientific-methods.html
Each student will receive a lab coat, notebook, and a pencil. The teacher will tell the students that scientists are constantly conducting scientific investigations in order to make discoveries about the world around them, and today they will act as scientists by applying the scientific method. There will be a brief discussion about the examples of the scientific tools pictured in the slideshow and how they are used. Next, the students will be instructed to create independent lists of what they know about scientists. The lists should include: types of scientists, What scientists do, what tools scientists might use, where scientists might work, and what skills scientists should possess.

After five minutes of listing, students will share their ideas with the class. The teacher will record the students' ideas so that the list is visible to the class. The teacher will show a video from the Discovery Education digital resources about how scientists have tracked the steady loss of ice at Antarctica's Larsen Ice Shelf. The teacher will tell the students to make note of the type of scientists, where the scientists work, the tools used, and how the scientific method is used.

Video: Dr. Kelly Brunt(Glaciologist) https://dps.discoveryeducation.com/

After watching the video, the class will revisit their lists and add information gained about scientists.

Explore - *In this phase, the students have experiences with the concepts and ideas of the lesson. Students are encouraged to work together without direct instruction from the teacher. The teacher acts as a facilitator. Students observe, question, and investigate the concepts to develop fundamental awareness of the nature of the materials and ideas.*

Teacher will ask the "During Lesson" questions during this stage of learning.

The teacher will tell students now it is their turn to be scientists. The students will be divided into groups. They will collaborate with their group members while conducting the experiments below. The students will rotate to each station and the procedures to the experiments will be posted at each station. The students will record the following information in their "investigation log" while conducting each experiment: **Hypothesis**: What I think will happen…, **Observation**: What I see…, **Question**: What question does this experiment answer? **Analysis/Collection of Data:** What happened? Record outcome of experiment
Experiments:
***Pendulum Experiment--**http://electronics.howstuffworks.com/gadgets/clocks-watches/clock3.htm
***Use a microscope to observe specimens--**http://www.microscope-microscope.org/activities/school/microscope-use.htm
***Water Walk Experiment--**http://www.kidspot.com.au/things-to-do/activities/walking-water-science-experiment?ref=collection_view%2Cscience-experiments
***Lava Lamp Experiment--**http://www.sciencefun.org/kidszone/experiments/lava-lamp/

Explain - *Students communicate what they have learned so far and figure out what it means. This phase also provides an opportunity for teachers to directly introduce a concept, process, or skill to guide students toward a deeper understanding.*

Teacher will ask the Post Lesson Questions during this stage of learning.

After students have conducted all experiments, the teacher will ask students to share the ideas in their "Investigation Logs". The teacher will give the students a book from Reading A to Z titled *What do you Think About Climate Change?* *https://www.sciencea-z.com/main/ScienceSearch/?searchTerms=scientific%2Bmethod*

The students will read the book independently and employ close reading strategies such as highlighting, underlining, and composing their own questions. In this book, the students will read about evidence that scientists discovered about global warming. Next, the students will discuss any new learning they received from the book with a partner. The teacher will ask students to share their new learning with the class and they will revisit the class list from the beginning of the lesson and add any new insights gained.

Elaborate —*Allow students to use their new knowledge and continue to explore its implications. At this stage students expand on the concepts they have learned, make connections to other related concepts, and apply their understandings to the world around them in new ways*

Now that students have had an opportunity to act as scientists, the teacher will have them share which rules and skills do they think are most important? Which tools are most helpful? The students will decide how to show their new learning about types of scientists, What scientists do, what tools scientists might use, where scientists might work, and what skills scientists should possess. Students may decide to demonstrate what they learned as a written response, graphic/visual response, oral/auditory response, or dramatic/performance response.

Evaluate: *This phase assesses both learning and teaching and can use a wide variety of informal and formal assessment strategies.*

Students will be provided an index card. The students will respond to the following question: How does investigation ignite discovery?

After the teacher has collected all index cards, the students will begin their performance task.

- **What is a question you desire to answer that could lead to one of the most ground-breaking discoveries of the decade?**
- **How can a scientific investigation help you discover the answer to your question?**
- **How can you use the scientific method to create an experiment relevant to your daily life?**
- **How can you develop an experiment to answer your question?**
- **What research needs to be done?**
- **What steps will you follow in your procedure to perform your experiment?**
- **What materials will you need?**
- **How will you record data and observations?**
- **How will you determine if the data is reliable?**
- **How will you test your hypothesis?**

Students will use the Scientific Method graphic organizer to plan their scientific investigation (see pages 10-11).

Scientific Method

Intermediate Level

Name: _____

Date: _____

1. Problem

What do you wonder about?

State the question(s) the experiment is trying to solve.

2. Background Research

What do you already know?

Gather information about the problem before the experiment.

3. Hypothesis

What do you predict will happen?

- Predict what will happen in the experiment.
- Identify variables and controls.

Scientific Method (continued)

4. Experiment

- What supplies do you need?
- What steps will you take?

- Materials—List supplies and equipment used to conduct experiment.
- Procedure—Describe the step-by-step process on how the experiment was performed.

5. Results

What happened in your experiment?

- Record and graph quantitative data.
- Report qualitative observations.

6. Conclusion

- What did you learn about your prediction?
- What new questions do you have?

- Summarize results.
- State if hypothesis was supported or not.
- Suggest improvements to the experiment.

PSD Essential Standards for Science

1.1 Predictions and Hypotheses: Students ask questions and state predictions (hypotheses).
1.2 Collecting Data: Students select and use simple devices to gather data.
1.3 Using Data: Students use data based on observations to construct a reasonable explanation.
1.4 Scientific Investigation: Students communicate about investigations and explanations.

TEACHER NAME			Lesson #
Katrina Edmond			3
MODEL	**CONTENT AREA**	**GRADE LEVEL**	
Questioning	Science	5	

CONCEPTUAL LENS	LESSON TOPIC
Investigation	Individuals who made Discoveries

LEARNING OBJECTIVES *(from State/Local Curriculum)*

North Carolina Essential Standards:

- **5.L.1 Understand how structures and systems of organisms (to include the human body) perform functions necessary for life.**

English Language Arts Common Core Standard:

- **RI 5.3 Explain the relationships or interactions between two or more individuals, events, ideas, or concepts in a historical, scientific, or technical text based on specific information in the text.**
- **W.5.7 Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic.**

THE ESSENTIAL UNDERSTANDING *(What is the overarching idea students will understand as a result of this lesson?*	THE ESSENTIAL QUESTION *(What question will be asked to lead students to "uncover" the Essential Understanding)*
Investigation ignites discovery	*How does investigation ignite discovery?*

CONTENT KNOWLEDGE (What factual information will students learn in this lesson?)	PROCESS SKILLS (What will students be able to do as a result of this lesson?)
• There are more than 50 different kinds of scientists! However, all of these scientists work within three main branches of science: Earth science - the study of the Earth and space, Life science - the study of all living things, and Physical science - the study of the physical world around us. • The scientific method is a road map that scientists use in order to understand how things work and why they work the way they do. • Scientific investigation involves questioning, hypothesis, experimentation, analyzing, and conclusion. • Scientists use the following tools to observe, describe, and quantify their world: beakers, graduated cylinders, goggles, scales, thermometers, stop watches, Bunsen burners, microscopes, petri dishes, hand lens, telescopes. • ¾ of what we taste is related to what we smell. • The "Von Frey Device" is a research tool which scientists use to measure the smallest sensation necessary for the nerves in our skin to feel something. • The diaphragm is a muscle that allows air to move in and out of the lungs. • The circulatory system uses blood to move nutrients, wastes, and gases (oxygen and carbon dioxide) around the body.	Students will be able to…. • Observe, investigate, form a hypothesis, collect data, analyze information, make conclusions, and report results • Use research skills to gain knowledge • Use inquiry to make connections • Identify and use scientific tools • Work collaboratively in a group

GUIDING QUESTIONS

What questions will be asked to support instruction?
Include both "lesson plan level" questions as well as questions designed to guide students to the essential understanding

Pre-Lesson Questions:	During Lesson Questions:	Post Lesson Questions:
➢ What does a scientist do? ➢ Why do scientists investigate the natural world that surrounds them? ➢ How do scientists investigate the mysteries of the universe? ➢ What is the scientific method? ➢ Why is it important for scientists to use the scientific method? ➢ What do scientists use to help observe, describe, and quantify their world? ➢ What is a heartbeat? ➢ What is the heart's role in the circulatory system? ➢ What would happen if a heart stops beating?	➢ What did each scientist want to find out through conducting his/her scientific investigation? ➢ What do you think will happen? ➢ Why did your results support your hypothesis? ➢ What unexpected results did you experience? ➢ What evidence did a scientist use to support his/her hypotheses? ➢ How does forming a hypothesis help during a scientific investigation? ➢ What science tools did the scientists use? ➢ How did the science tools help them investigate? ➢ What did you discover from their investigations? ➢ How was a scientist's experiment similar / different from another scientist? ➢ Why is it important for scientists to share their investigations?	➢ What is a question you desire to answer? ➢ How can a scientific investigation help you discover the answer to your question? ➢ How can you use the scientific method to create an experiment relevant to your daily life? ➢ How can you develop an experiment to answer your question? ➢ What steps will you follow in your procedure to perform your experiment? ➢ What materials will you need? ➢ How will you record data and observations? ➢ How will you determine if the data is reliable? ➢ How will you test your hypothesis? ➢ How does investigation ignite discovery?

DIFFERENTIATION

(Describe how the planned learning experience has been modified to meet the needs of gifted learners. Note: Modifications may be in one or more of the areas below. Only provide details for the area(s) that have been differentiated for this lesson.

Content	Process	Product	Learning Environment
Gifted learners will have access to a more complex text.	Students will engage in answering questions that require high level thinking.		Students will be organized into groups of similar interests.

PLANNED LEARNING EXPERIENCES

(What will the teacher input? What will the students be asked to do? For clarity, please provide detailed instructions)

Engage and Connect - *This phase focuses on piquing students' interest and helping them access prior knowledge. This is the introduction to the lesson that motivates or hooks the students.*

Teacher will ask the Pre-Lesson Questions listed above during this stage of learning.
As students enter the classroom, the following website will be projected: http://list25.com/25-biggest-scientific-discoveries-in-history-of-mankind/ The teacher and students will have a discussion about the discoveries and how they have improved the quality of our lives and helped us to understand the world around us. Students will make note in their "Science Log" any ideas from the website and discussion that supports the essential understanding—Investigation ignites Discovery. Teacher will tell students today they will read about a young scientist's discovery and will act as a scientist while conducting experiments?

The teacher will ask the students why is it important for scientists to use the scientific method when conducting scientific investigations. The teacher will model how to use the scientific method by conducting an experiment along with the class that answers the question "What is the heart's role in the circulatory system?" and "How many heartbeats do it take to pump blood through a 5th grade child's heart?" Before conducting this experiment, the students will watch the following video in order to gain background knowledge about how the circulatory and respiratory systems transport materials through the human body: https://www.youtube.com/watch?v=oHMmtqKgs50

Experiment: *For each group of 7-10 students, prepare six 16-oz cups full of water, and dye the water with red food coloring. Each group also gets six empty 16-oz cups and one plastic teaspoon per student. Ask students, how many cups full of blood they think they have in their body? (On average a 5th-grade child has approximately 3 liters of blood in his/her body. In our activity, six 16-oz cups filled with water will represent the approximate volume of blood in a students' body.) Ask students, how many spoons full of blood do they think the heart moves in each pump? (With each contraction, a 5th-grade child's heart pumps approximately 40mL. In our activity, 7-10 teaspoons will represent the volume of blood moved in one heartbeat.) Have students count the number of "beats" it takes to move the entire volume of "blood" from the full cups to the empty cups. Time them so they can compare how long it took them to how long it takes a real heart (it takes about one minute for the heart to move the entire blood volume through the body).*
Teacher will bring the students together to discuss what they noticed from the activity. Teacher will ask the following: "What is the heart's role in the circulatory system? What is the blood's role? What would happen if a heart stopped beating? Sometimes the pathways for blood – the arteries and veins – become clogged. What would happen if blood was moving too slowly or not at all? How do the circulatory system and respiratory system interact?" As a result of your investigation, what did you discover about the circulatory system?

Explore - *In this phase, the students have experiences with the concepts and ideas of the lesson. Students are encouraged to work together without direct instruction from the teacher. The teacher acts as a facilitator. Students observe, question, and investigate the concepts to develop fundamental awareness of the nature of the materials and ideas.*

The teacher will give students the following article to read: https://www.sciencenewsforstudents.org/article/plant-extract-mutes-germs-fight-infections The teacher will tell students to make note of the teen scientist's characteristics, dispositions, processes used in her research, and her discovery. Students will also view the following YouTube video and make note of the marine biologist's characteristics, dispositions, processes used in his research, and his discovery. **YouTube Video** https://www.youtube.com/watch?v=NKfyfIhnLdg

Explain - *Students communicate what they have learned so far and figure out what it means. This phase also provides an opportunity for teachers to directly introduce a concept, process, or skill to guide students toward a deeper understanding.*

Teacher will ask the During Lesson Questions listed above. Students are called on for responses to teacher questions and are encouraged to ask one of their own questions or make connections to one of their questions when answering the teacher's questions.

Elaborate —*Allow students to use their new knowledge and continue to explore its implications. At this stage students expand on the concepts they have learned, make connections to other related concepts, and apply their understandings to the world around them in new ways*

The students will engage in planning a scientific investigation (the performance task). The teacher will remind the students of their task----*The Massachusetts Institute of Technology (MIT) will be providing free lab space to support the next greatest discovery. You and your research team members are putting together a proposal to test a highly anticipated research question that will lead to one of the most ground-breaking discoveries of the decade.* The teacher will also ask the "Post Lesson Questions" to help guide the students as they develop their scientific investigation. The students will be asked to share their plans and why they chose their specific scientific investigation. During this time, students may ask any clarifying questions and utilize resources. The students will only plan their investigations. The students will use their graphic organizer from the previous day to continue planning their investigation.

Evaluate: *This phase assesses both learning and teaching and can use a wide variety of informal and formal assessment strategies.*

The class will have a discussion about what they learned today and share something they discovered through their investigations. The students will be asked to take out their "Science Log" and write an answer the following question: How does investigation ignite discovery?

Stations with Experiments:

The teacher will remind the students they are going to follow a series of steps called the scientific method. The students will review the scientific method process by completing the first and second column of the Scientific Method Flocabulary graphic organizer as they watch the Flocabulary video. https://www.flocabulary.com/unit/scientific-method/

The students will work in groups of 3-4 to conduct a scientific investigation. The students will choose from the following experiments: Taste Test Science-- Fool Your Tongue! (How are the taste and smell senses related?), Skin Science (What parts of our skin are most sensitive?), Measure Your Pulse with a Straw! (How many times does the heart beat in a minute?), Lung Model (How does the human lung works?) See following link for more details: **https://www.education.com/activity/fourth-grade/science/** As a group, the students will follow the scientific method—*Choose a question.*Research-Each group will have access to the online articles listed below.*Form a hypothesis. *Conduct the experiment. *Record the results. *Conclusion. Teacher will circulate to facilitate groups.

Articles:

http://www.ducksters.com/science/smelling_and_tasting.php
http://www.ducksters.com/science/breathing.php
http://kidshealth.org/en/kids/heart.html
http://www.ducksters.com/science/skin.php

https://www.ck12.org/book/CK-12-Life-Science-Concepts-For-Middle-School/section/11.49/
https://www.ck12.org/life-science/Processes-of-Breathing-in-Life-Science/lesson/Processes-of-Breathing-MS-LS/?referrer=concept_details
https://www.ck12.org/biology/Circulatory-System/lesson/Circulatory-System-BIO/?referrer=concept_details
https://www.ck12.org/biology/Skin/lesson/Skin-BIO/?referrer=concept_details

After conducting the experiments, the students will answer the following questions: What did you discover about your body after conducting these investigations?

If time permits, students will be allowed more time to work on their performance task -- Students will be reminded of the following: In order to be considered for a free lab space at MIT, you and your team members must submit the following to the MIT analysts:

- A question that can be tested through scientific investigation and will lead to one of the most ground-breaking discoveries of the decade
- Research and a hypothesis
- A practical and reproducible plan that includes detailed procedures for a scientific investigation

Name: _____ Date: _____

Flocabulary
Scientific Method in Everyday Life

The **Scientific** Method 

There are six steps in the scientific method. Use Flocabulary's scientific method video to review the steps and fill in the names in the first column. In the second column, explain what each step means. Use the last column to organize your own experiment.

STEPS	**What do you do at this step? Why do you do it?**	**Example of this step** (You can use this to review an experiment or plan your own!)
1.		
2.		
3.		
4.		
5.		
6.		

TEACHER NAME			Lesson #
Katrina Edmond			4
MODEL	**CONTENT AREA**	**GRADE LEVEL**	
Socratic Seminar	Science	4th	

CONCEPTUAL LENS	LESSON TOPIC
Investigation	Robot Scientist Makes A Discovery

LEARNING OBJECTIVES *(from State/Local Curriculum)*

- **RI.4.1 Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text.**
- **4.E.2 Understand the use of fossils and changes in the surface of the earth as evidence of the history of Earth and its changing life forms.**
- **W.4.4 Produce clear and coherent writing in which the development and organization are appropriate to task, purpose, and audience.**

THE ESSENTIAL UNDERSTANDING *(What is the overarching idea students will understand as a result of this lesson?*	THE ESSENTIAL QUESTION *(What question will be asked to lead students to "uncover" the Essential Understanding)*
Investigation ignites discovery.	*How does investigation ignite discovery?*

CONTENT KNOWLEDGE (What factual information will students learn in this lesson?)	PROCESS SKILLS (What will students be able to do as a result of this lesson?)
▪ Forensic scientists examine evidence from many angles to assist law enforcement officials in solving crimes. ▪ Anthropology is the study of humans and their culture. ▪ Forensic scientists must be competent in analyzing evidence. ▪ Some forensic scientists travel to the scene of a crime to collect evidence, and other forensic scientists perform analysis of objects brought to them in a laboratory. ▪ The scientific method is applied to forensic science.	▪ Craft questions and maintain an inquiry based dialogue which deeply examines ideas and concepts ▪ Use problem solving to provide solutions ▪ Observe and analyze evidence ▪ Design a scientific investigation

GUIDING QUESTIONS

What questions will be asked to support instruction?
Include both "lesson plan level" questions as well as questions designed to guide students to the essential understanding

Pre-Lesson Questions:	During Lesson Questions:	Post Lesson Questions:
▪ What is forensic science? ▪ What does a forensic scientist do? ▪ What is an anthropologist? ▪ What was happening in the video? ▪ How does the video relate to investigation and discovery?	▪ How does the Robot scientist "Adam" apply the scientific method? ▪ What skills have Adam been programmed to possess? ▪ What type of experiments does Adam perform? ▪ Why does Adam perform these types of experiments? ▪ What scientific tools does Adam use? ▪ What discoveries have been made as a result of the investigations perform by the robot scientist "Adam"?	▪ What concepts did you explore as a result of this seminar? ▪ How did this seminar experience help deepen your knowledge about scientists and investigations? ▪ What challenges did you experience through the seminar? ▪ How does investigation ignite discovery?

DIFFERENTIATION *(Describe how the planned learning experience has been modified to meet the needs of gifted learners. Note: Modifications may be in one or more of the areas below. Only provide details for the area(s) that have been differentiated for this lesson.*			
Content	**Process**	**Product**	**Learning Environment**
	Students will participate in Socratic Seminar. Students will facilitate the seminar themselves and will be responsible for crafting questions which maintain the integrity of the seminar.		

PLANNED LEARNING EXPERIENCES *(What will the teacher input? What will the students be asked to do? For clarity, please provide detailed instructions)*

Engage and Connect - *This phase focuses on piquing students' interest and helping them access prior knowledge. This is the introduction to the lesson that motivates or hooks the students.*
***Teacher will ask pre-lesson questions.**

Students will watch a video about learners acting as forensic anthropologists. Students will make note of how forensic anthropologists use investigation to make discoveries.
https://www.youtube.com/watch?v=tqFQWDf4NyM&list=PLqgi494HrpTHjZdlOwIU8oYwDvK-CHLuP

Explore - *In this phase, the students have experiences with the concepts and ideas of the lesson. Students are encouraged to work together without direct instruction from the teacher. The teacher acts as a facilitator. Students observe, question, and investigate the concepts to develop fundamental awareness of the nature of the materials and ideas.*
Students will each be provided with the following article:
Article-*Self-directed Robot Scientist Make Discovery*
http://www.nbcnews.com/id/30016175/ns/technology_and_science-science/t/self-directed-robot-scientist-makes-discovery/#.WUQ4aWjyu00

Each student will be asked to read the article silently and to make note of examples of investigation and discovery. Students will also write down questions they have while reading the text. Once all students have read, the students will be divided into groups of three or four and the groups will discuss notes and questions they wrote while reading. Each group should craft five questions as a result of the close reading. Questions should represent questions requiring higher order levels of thinking. (These questions along with the notes resulting from close reading will be used during Socratic Seminar.)

Explain - *Students communicate what they have learned so far and figure out what it means. This phase also provides an opportunity for teachers to directly introduce a concept, process, or skill to guide students toward a deeper understanding.*
The teacher will share with students the expectations during a Socratic Seminar. Each student will receive a copy of the guidelines (see attachment-Socratic Seminar Guidelines-page 20)

Students will respond to the questions orally. Multiple responses representing different perspectives are allowed.

Elaborate —*Allow students to use their new knowledge and continue to explore its implications. At this stage students expand on the concepts they have learned, make connections to other related concepts, and apply their understandings to the world around them in new ways*

**Teacher will ask "During Lesson" Questions during this phase of learning*

Students will be divided into two groups. One group will compose the inner circle of the Socratic Seminar and one group will form the outer circle. The inner circle members will begin the dialogue while the outer circle members take notes about the dialogue, craft questions they have about the dialogue, and observe one participant of the inner circle (their partner for the seminar). The leader, one student designated by the teacher will begin the seminar with a stimulating question. Inner circle students will respond in a dialogue fashion throughout the Seminar.
Opening Question: (If designee does not have one or if dialogue falters during the seminar.)
*What impact does robots have on the world?

Students will dialogue for 10 minutes. Then, the inner and outer circle members will switch locations and roles. The outer circle will use an observation form while observing their partner (see attachment page 21). After 10 minutes of dialogue, the **teacher will ask the Post Lesson Questions**.

Evaluate: *This phase assesses both learning and teaching and can use a wide variety of informal and formal assessment strategies.*

Students will go back to their desk and complete the questions at the bottom of their observation form. Teacher will then have students finalize their performance task and share/present.

Performance Task:
Scientific investigation is the way in which scientists and researchers use a systematic approach to answer questions about the world around us. Scientific investigation is a quest to find the answer to a question using the scientific method. The Massachusetts Institute of Technology (MIT) will be providing free lab space to support the next greatest discovery. You and your research team members are putting together a proposal to test a highly anticipated research question that will lead to one of the most ground-breaking discoveries of the decade.
In order to be considered for a free lab space at MIT, you and your team members must submit the following to the MIT analysts:

- **A question that can be tested through scientific investigation and will lead to one of the most ground-breaking discoveries of the decade**
- **Research and a hypothesis**
- **A practical and reproducible plan that includes detailed procedures for a scientific investigation**

STUDENT ACTIVITY

SOCRATIC SEMINAR GUIDELINES

Before the Socratic Seminar

1. Read and prepare your text the evening before the seminar. Be ready to discuss the text like the scholar you are! You should make notes in one of the following ways:
   - Highlight important passages/ideas and make notes in the margin of the text.
   - Use post-it notes to note specific passages and write your thoughts and/or questions on the post-its.
   - Use Cornell notes or a dialectical journal to keep track of your thoughts, paying close attention to noting passages, page numbers, etc. You want to be able to easily reference the text.

2. Prepare three opening questions that have no single right answer. Things to consider:
   - Ask about viewpoint, perspectives (realist, pessimist, optimist, etc.)
   - Examine the title, or tone of the story, or connect to current issues, theme, etc.
   - Ask, "If the author were alive today, how would s/he feel about...?"
   - Ask questions that explore your own interpretation of the reading.
   - Ask about importance: "So what . . . ?" "What does it matter that . . .?" "What does it mean that . . . ?"

During the Seminar

RULES FOR PARTICIPATION

1. Be courteous. No put-downs or sarcasm.
2. Allow each speaker enough time to begin and finish his or her thoughts—don't interrupt.
3. Involve others in the discussion and ask others to elaborate on their responses.
4. Build on what others say: ask questions, re-state and add, clarify, synthesize a variety of different views in your own summary.
5. Use your best active listening skills: nod, make eye contact, provide feedback, and listen carefully to others.
6. Participate openly, knowing you may pass whenever you need to.
7. Support your opinions with evidence from the text.
8. Remember the goal is EXPLORATION—keep an open mind and push for deeper and deeper interpretations.

PROPER RESPONSES TO THE STATEMENTS OF OTHERS INCLUDE:

- I agree with... but would like to add...
- I disagree with... and would like to add...
- I am confused by...
- My feeling about this piece ties right back to (such and such a line)
- The author has clearly stated in line 22 that...
- It may not say this in the text, but we can conclude...because in the past...
- Could you restate that? Or could you clarify that?
- Paraphrases of other students: "Nicole, what did you understand Amy to say?"

Observation Form
Inner-Outer Discussion Circle

Your Name:	Partner:
DIRECTIONS: Each time your partner does one of the following, put a check in the box.	
SPEAKS IN THE DISCUSSION:	
LOOKS AT THE PERSON WHO IS SPEAKING:	
REFERS TO THE TEXT:	
ASKS A QUESTION:	
RESPONDS TO ANOTHER SPEAKER:	
INTERRUPTS ANOTHER SPEAKER:	
ENGAGES IN SIDE CONVERSATION:	
AFTER DISCUSSION: What is the most interesting thing your partner said?	
AFTER DISCUSSION: What would you like to have said in the discussion?	

Unit Resources

Lesson 1:

https://www.gonoodle.com/

- The GoNoodle website contains the music video *Think Like a Scientist* for students to watch and sing along. This music video explains the scientific method process that is used during experimentation.

https://www.sciencea-z.com/main/ScienceSearch/?searchTerms=discovery

- The website above contains the video *Discovering Solar Energy* for students to watch and articles and books at varying reading levels for students to read and make note of ideas that relate to discovery and investigation. Reading A-Z contains supplemental reading materials that cover all the skills necessary for effective reading instruction.

https://www.youtube.com/watch?v=fBlR7taW9jk

- The above link shows a YouTube video that will help the students gain a deeper understanding of an observation and inference. Students will be able to distinguish between an observation and inference.

https://www.stevespanglerscience.com/lab/experiments/glue-borax-gak/

- The teacher will use this website to model how to conduct a scientific investigation. The teacher will identify the steps of the scientific method while performing the slime experiment.

Lesson 2:

http://mrswarnerarlington.weebly.com/unit-1-scientific-methods.html

- The teacher will use the above website lead a brief discussion about the tools pictured in the *Scientific Tools* slideshow and how they are used.

http://www.discoveryeducation.com/

- The teacher will show a video from the Discovery Education digital resources about how scientists have tracked the steady loss of ice at Antarctica's Larsen Ice Shelf.

- The students will collaborate with their group members while conducting the experiments on the following websites:

http://electronics.howstuffworks.com/gadgets/clocks-watches/clock3.htm

http://www.kidspot.com.au/things-to-do/activities/walking-water-science-experiment?ref=collection_view%2Cscience-experiments

http://www.sciencefun.org/kidszone/experiments/lava-lamp/

https://www.sciencea-z.com/main/ScienceSearch/?searchTerms=scientific%2Bmethod

- Reading A-Z contains supplemental reading materials that cover all the skills necessary for effective reading instruction. The students will read the appropriate leveled book of the story titled *What do you Think About Climate Change?* and make note of discoveries made by scientists about global warming.

Lesson 3:

http://list25.com/25-biggest-scientific-discoveries-in-history-of-mankind/

- Teacher will use the above website to lead a whole group discussion about the 25 biggest discoveries and how they have improved the quality of our lives and helped us to understand the world around us.

https://www.youtube.com/watch?v=oHMmtqKgs50

- The above link shows a YouTube 3D video of how the heart works.

https://www.youtube.com/watch?v=NKfyfIhnLdg

- The students will view this YouTube video make note of marine biologist Dan Costa's characteristics, dispositions, processes used in his research, and his discovery.

https://www.flocabulary.com/unit/scientific-method/

- Flocabulary is a learning program for grades K-12 that uses educational hip hop songs and videos to expand students' vocabulary.

Perkins, S. (2017, June). Plant extract mutes germs to fight infections. *Science News for Students.* Retrieved from https://www.sciencenewsforstudents.org/article/plant-extract-mutes-germs-fight-infections

- *Science News for Students* is an online publication dedicated to providing age-appropriate science news.

- The students will collaborate with their group members while conducting the experiments on the following website:
  https://www.education.com/activity/fourth-grade/science/

- Articles for students to access for research purposes:

https://www.ck12.org/book/CK-12-Life-Science-Concepts-For-Middle-School/section/11.49/

https://www.ck12.org/life-science/Processes-of-Breathing-in-Life-Science/lesson/Processes-of-Breathing-MS-LS/?referrer=concept_details

https://www.ck12.org/biology/Circulatory-System/lesson/Circulatory-System-BIO/?referrer=concept_details

https://www.ck12.org/biology/Skin/lesson/Skin-BIO/?referrer=concept_details

Lesson 4:

https://www.youtube.com/watch?v=tqFQWDf4NyM&list=PLqgi494HrpTHjZdlOwIU8oYwDvK-CHLuP

- This YouTube video explains how forensic anthropologists use investigation to make discoveries.

Bland, E. (2009, April). Self-directed robot scientist makes discovery. *Discovery News*. Retrieved from http://www.nbcnews.com/id/30016175/ns/technology_and_science-science/t/self-directed-robot-scientist-makes-discovery/#.WUQ4aWjyu00

- This article is about a self-directed robot scientist named Adam who designed, carried out, and discovered new gene functions.