Roller Coaster Craze

Miss Catherine Northup

SPARK Camp 2019

Rising 4th and 5th graders

Roller Coaster Craze

Introduction

I. **Rationale** – The purpose of this unit is to introduce and enhance students' knowledge about the concept invention in a fun and unique way that is conducive to advanced learning styles. This unit is designed for a four-day period including 8 hours of instructional time. It is intended for fourth and fifth graders who have been identified as academically and intellectually gifted. They will be learning the concept through the invention of their very own product, roller coasters. Students will go through different lesson types all with a focus on the essential understanding that "invention utilizes structure". Students will be starting at the basics and gathering information about engineers and the engineering process. They will use this information to analyze the structure in two paintings pertaining to roller coasters and then they will have a chance to become an engineer with a spaghetti structure, challenging them to build the tallest tower. Each lesson builds on the previous lesson and deepens the students understanding that invention utilizes structure. At the end of the unit is where they will be designing, building, and advertising their own roller coaster.

II. **Differentiation for Gifted Learners** – Differentiation is very important. The students intended to be reached by this unit have all been identified as academically and intellectually gifted in rising fourth and fifth grade. There are four different dimensions that can be differentiated and all of them have been addressed in some way through this unit. I was able to truly challenge the students and enhance the complexity of each lesson through the content and process. When it comes to the creativity, and acceleration, that was shown through the product and learning environment. Students were able to show their creativity through the creative problem-solving lesson where they were able to design and build their own roller coaster as a group.
    a. **Content** – The content giving to the students throughout this unit is sophisticated with advanced vocabulary words related specifically to engineering and roller coasters.
    b. **Process** – The four lessons taught are all a different model lesson plan that is intended and directed for students who are academically above grade level. These lessons allow students to process higher-ordered thinking questions and formulate answers to open-ended questions that match Bloom's Taxonomy and Costa's

levels of inquiry. Each of the models allows students to think in a variety of ways.

c. **Product** – Students were able to demonstrate their learning through a variety of ways. Students were given a variety of tools to learn with. They were able to be hands on with supplies, use technology for research, and learn through group discussions. The biggest way to show that differentiation was achieved through this dimension was that students were required to complete their own roller coaster that was up to group interpretation.
d. **Learning Environment** – The learning environment was differentiated in many of these lessons. The students were learning in a variety of ways and circumstances. There were many small group learning opportunities and well as whole group, and independent work. Students were able to get up and move around and had station work in one lesson which allowed for many forms of differentiation of learning environment.

III. **Population of Gifted Children** – The students served in "Roller Coaster Craze" would be for all rising fourth and fifth graders that have already been identified as academically and/or intellectually gifted. Even though these students are gifted, there is a range of gifted children, including twice exceptional and students are at the higher end of the gifted spectrum and students that are at the lower end. This unit is intended for all backgrounds and walks of life. I am intending that this unit will interest those from various backgrounds to the point where they can share and learn from each other. Even though there are many students who may not have ridden a roller coaster, my intent is that students will be excited and interested even if they have not. The talents of these students is far beyond any that I have experienced before. These students have a mindset of always reaching far beyond expectations. These students are capable and will reach as far as we push them. These students need multiple ways to research, learn, and discuss the knowledge that they have learned. Including multiple settings, different products and processes and enhanced content. Among these students we had many different social situations. Some students were very loud, center of attention, and confident. Then we had the other side where the students were more shy, stay towards the back, and does best independently. I also had the pleasure in seeing many students who would be outcasts in their original setting but then learning this unit excelled because everyone was very similar. I also saw the opposite side of this where there was one

particular student who felt very uncomfortable and after much thought and listening ears from the rest of the class, this student was constantly bullied throughout the school year and she was very fearful of continuously being bullied here.

Goals and Outcomes develop

Goal 1: To cultivate an understanding between the relationship of force and motion.

- Students will be able to...
  - design a roller coaster using force and motion to make a marble get from point A to point B.
  - devise a plan or a blueprint of an invention of a roller coaster
  - build and construct their roller coaster based on their original plan of their invention

Goal 2: Develop higher ordered thinking skills applying it to invention and physics.

- Students will be able to...
  - analyze an invention and explain where structure is found
  - infer based on previous information
  - problem-solve when an invention fails
  - collaborately effectively to come to a common consensus.

Goal 3: To understand the concept invention.

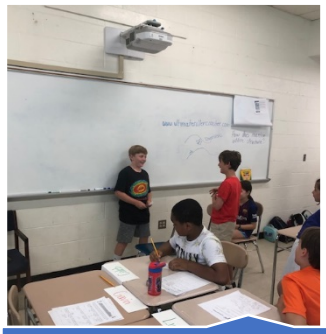
- Students will be able to...
  - inference based on previous knowledge learned about roller coasters
  - interpret new information that is given to them and relate it to invention
  - explain how invetion utilizes structure
  - transfer their knowledge about invention and relate it to structure

Assessment Plan

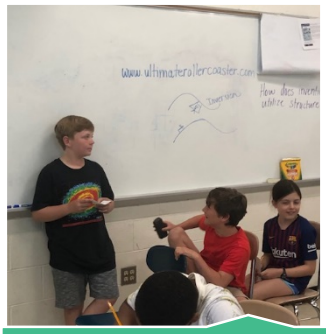
Each lesson has its own established assessment for understanding. Some may be question and answer, some is the daily reflective journal entry, and others is the success of a product that is built.

Lesson 1: Questioning Lesson

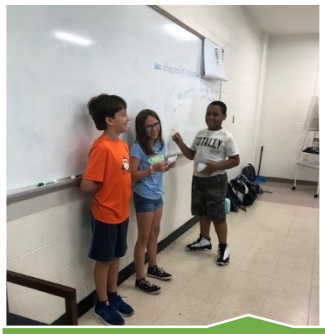
This lesson was the first lesson in the unit. It had a large amount of higher ordered thinking questions that students were required to answer. There was a whole group session of questioning to begin to get a general idea where the students were with the idea of roller coasters and the essential understanding that "invention utilizes structure". Then the students had an opportunity for computer research to research roller coasters in order to answer some of the questions pertaining to this. The students were able to do this independently or in their small groups at their tables. This guide was collected and reviewed as a formative assessment to see if the students were understanding not only the facts about roller coasters but the idea that invention utilizes structure. Once those were collected, they had one final assessment of understanding and that was for students to write their own slogan for a roller coaster given. This slogan had to play off of the structure that the roller coaster has in order to entice people to ride that roller coaster. The students were able to work in groups of 3-4 to complete this task. At the end of the day the students had a reflective journal where they would answer the questions what they learned today, and how invention utilizes structure.



Group 1: Presenting ride descriptions and slogans.



Group 1: Adding acting to enhance their slogan into a commercial.



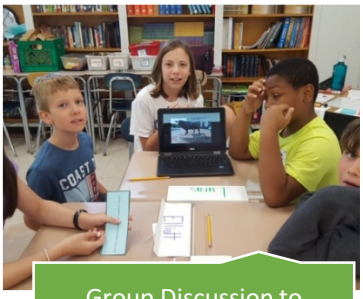
Group 4: Presenting slogans

Lesson 2: Bruner Lesson

This lesson was packed with activities and information to learn by. The students were informally and formally assessed throughout the lesson. The lesson starts by informally gathering knowledge about what students know about engineers. After they learned about engineers and the engineering process, the students are separated into groups with 3 different assessment measures. One assessment is informally gathered through conversation, one assessment is a successful spaghetti structure, and the third is a formal research graphic organizer about a chosen engineer by the student. The students were also able to show the knowledge gained from the day with a question and answer session with a Maritime engineer. The questions presented to the guest speaker reflected solely on the knowledge gained from today's lesson and the previous lesson. At the end of the day the students were required to write in their reflective journal and answer the same question as the day before except this time they had to build on to what the already wrote based on the new information learned.

Spaghetti structure winner for the tallest structure

Computer research



Group Discussion to enhance understanding

Lesson 3: Creative Problem Solving

This lesson was split between three days and the summative assessment was a part of this. The students were designing and building their very own roller coaster. The performance task was given to the students early so that they could design and build their coaster with clear and concise expectations but allows enough creativity. The students had to complete a blueprint of their rollercoaster and this was used as an informal assessment to see if the students had taken what they knew about the concept of invention and used the

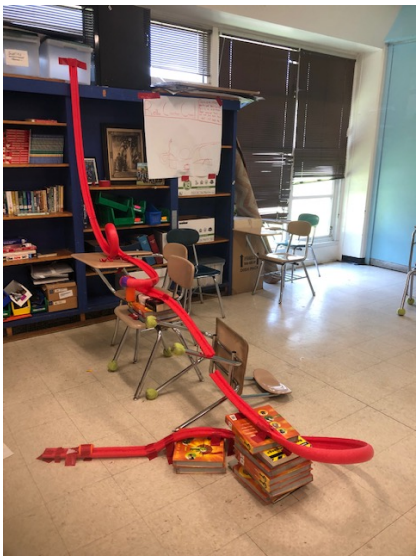
structure as it relates to invention. At the end of the lesson the students had to write in their reflective journal and respond to the same questions as the previous day and continue to build on any new information gained from today's lesson.

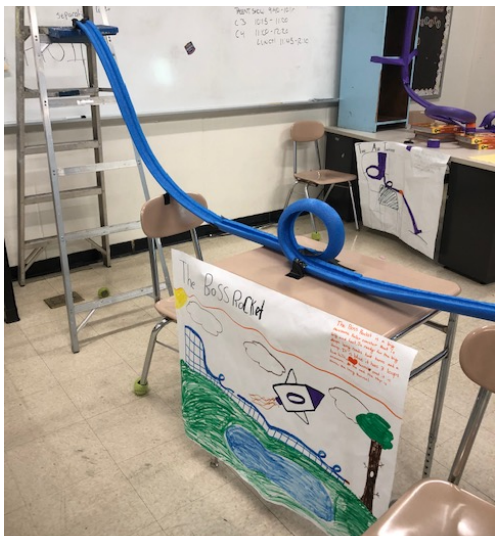
Performance Task: Roller Coaster Craze (Science, Grades 4-5)

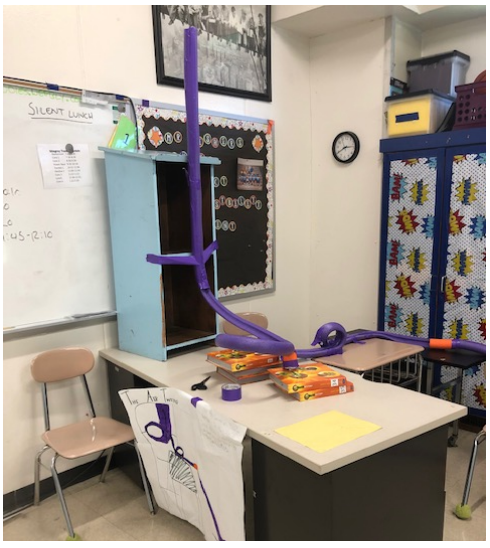
The city council has decided to open up a brand new amusement park in Durham in the year 2020. They are now excepting bids for the construction of roller coasters from engineering firms from throughout the area, including your firm. As head of your engineering firm, you will be required to work with a team to complete this project. In order for your bid to be considered you must submit the following: a blueprint of your roller coaster, a written description of the ride and its thrilling features, and an explanation of how the invention process of creating a new ride utilizes structure. The city council with convene for roller coaster presentations on June 27th, 2019. Good luck!

CATEGORY	3	2	1	COMMENTS/SCORE
Blueprint	The blueprint for the roller coaster is well mapped out and possible errors have been addressed.	The blueprint for the roller coaster is mapped out but the errors have not been addressed.	There is no blue print for the roller coaster and no possible errors have been addressed.	
Description	The roller coaster description is well thought out and makes people want to ride it.	The roller coaster description is lacking either the exciting features or appearance.	The roller coaster is not described.	
Explanation of invention process	The concept that invention utilizes structure is well defined in the process of invention.	The concept of invention is defined but lacks the understanding that it utilizes structure.	There is no evidence of understanding the concept the invention utilizes structure.	
Appearance	Roller coaster is successful from point A to point B and is exciting to look at.	Roller coaster may not successfully run and has minimal.	Roller coaster is not finished.	

Contribution / Participation	Coordinated with group members and provided significant contributions to the group project.	Coordinated with group members often and provided some contributions to the group project.	Coordinated with group members minimally and provided few to no contributions.	







Lesson 4: Visual Thinking Strategy

This lesson plan was the last day combined with the creative problem solving lesson. The students were to compare and contrast the invention and structure of two paintings of roller coasters/theme parks. The students first looked at each

picture and deconstructed the picture into bits and pieces to analyze it. Then the students compared the two pictures focusing on the invention and structure of each one. This lesson plan had an informal observation of student responses. As the students respond, the teacher will address each response and talk through it as a class. At the end of the lesson the students will fill out their reflective journal one final time. They should be building onto the previous three days.

TEACHER NAME			Lesson #
Miss Northup			3 Practicum 1
MODEL	**CONTENT AREA**	**GRADE LEVEL**	
Questioning	ELA /Writing/ Speaking and Listening	Elementary - 4th and 5th	
CONCEPTUAL LENS		**LESSON TOPIC**	
Invention		Roller Coasters	

LEARNING OBJECTIVES *(from State/Local Curriculum)*

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.
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.
RI.4.7 - Interpret information presented visually, orally, or quantitatively and explain how the information contributes to an understanding of the text in which it appears.
W.5.4 - With some guidance and support from adults, use digital tools and resources to produce and publish writing as well as to interact and collaborate with others; demonstrate sufficient command of word processing skills**.**
W.5.5 Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic.
W.5.6 Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
SL.5.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 5 topics and texts, building on others' ideas and expressing their own clearly

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)***
Invention utilizes structure	How does invention utilize structure?
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?)**
Students will know that invention is found everywhere. Students will know that amusement parks are composed of roller coasters, thrill rides, food, shows, pathways, and games. Students will know that a roller coaster is a form of invention. Students will know that roller coasters are a structure with many different parts. Students will know that the most popular roller coaster rides can be found in our country.	Students will be able to analyze. Students will be able to explain. Students will be able to reflect. Students will be able to interpret information. Students will be able to work collaboratively. Students will be able to validate information.

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:**
1.) What roller coasters have you been on? 2.) Where were they? 3.) What makes each roller coaster thrilling? 4.) What is invention? 5.) Where do you see invention in this video? 6.) What is structure? 7.) How is structure used in this video? 8.) How does invention utilize structure? (Pre-Assessment on Unit)	1.) How are roller coasters described in advertising? 2.) What's included? 3.) Who invented the first roller coaster? 4.) What materials go in to making a roller coaster? 5.) How is structure utilized in the design of roller coasters? 6.) How has the structure of roller coasters evolved overtime? 7.) How else have roller coasters evolved overtime? 8.) What is something new that you learned about roller coasters? 9.) What is something that you still want to know about roller coasters? 10.) Why did you pick this slogan? 11.) How does your slogan relate to invention of your roller coaster?	1.) How would you describe a roller coaster to someone who has never seen one? 2.) How would you describe the invention of a roller coaster? 3.) How would you describe the structure of a roller coaster? 4.) What can be done to make a roller coaster more thrilling? 5.) What are some ways to make the structure different on a roller coaster? 6.) What would you need to make the structure different? 7.) What are some different structures that you know of? 8.) What is invention? 9.) What is something that you have learned today? 10.) How does invention utilize structure?

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 be learning content that is sophisticated to the grade level.	Students will be processing higher ordered thinking questioning. This includes open ended questions that match the top of Bloom's Taxonomy and Costa's levels of inquiry.		

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.*

Familiarity with class: Start the lesson with a "*name game*" activity.

- **Name Scavenger Hunt**
  Students will be given a graphic organizer and they will have to go around the room to find people who have done the thing in the selected square.

If time allows: do a "Get to Know You" activity:

- **I Am NOT!**
  Have students think of an object that represents the opposite of themselves. When students think of their items, ask each to describe why the item is *not* like him or her. You'll get a lot of flowers, of course, and students will describe how those flowers are fragrant or soft or otherwise unlike themselves. But you might also get some clever responses, such as the one from a young man who brought in the flip-top from a discarded can; he talked about its decaying outward appearance and its inability to serve a purpose without being manipulated by some other force (and how he was able to serve a purpose on his own).

The teacher will go first: Miss Northup – I am not like glass. I do not break easily. I am not fragile. I am strong.

*The teacher will show the video "**World's Best Roller Coasters – 10 Awesome Roller Coasters**" to the class.*
https://youtu.be/OjoyjbEu2oM

Ask: What roller coasters have you been on? Where were they at?

Move into asking pre-lesson questions:

- What makes each roller coaster thrilling?
- What is invention?
- Where do you see invention in this video?

- What is structure?
- How is structure used in this video?
- How does invention utilize structure?

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.*

Have students get into partners on the computers. Give them each the Roller Coaster Research paper.

During Lesson Questions will be incorporated onto a research guide.
During- Lesson Questions:

1.) How are roller coasters described in advertising? What's included?
2.) Who invented the first roller coaster?
3.) What materials go in to making a roller coaster?
4.) How is structure utilized in the design of roller coasters?
5.) How has the structure of roller coasters evolved overtime?
6.) How else have roller coasters evolved overtime?

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.*

Once students have had enough time to complete the questions, go over the during lesson questions and have each group share and add on to others about the research that they have found.

1.) What is something new that you learned about roller coasters?
2.) What is something that you still want to know about roller coasters?

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*

Have students get into 4 groups. Have each group pick a notecard with an amusement park on it from around the United States.

1.) Walt Disney World
2.) Cedar Point
3.) Hersheypark
4.) Busch Gardens

Each group will research their amusement park and look at the roller coasters that are at each park. They will then each student will pick one roller coaster from the park and focus on finding out the reason for naming it what it was, and come up with a slogan that describes the ride. Say "A slogan is a moto or phrase used in presenting an idea. It needs to represent your roller coaster." Give sufficient time to think of an appropriate slogan and write it down on a notecard.

Why did you pick this slogan?
How does your slogan relate to invention of your roller coaster?

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

Collect the responses to the question answer sheets given to them. This will be a way to assess for understanding.

Ask post lesson questions:

1.) How would you describe a roller coaster to someone who has never seen one?\
2.) How would you describe the invention of a roller coaster?
3.) How would you describe the structure of a roller coaster?
4.) What can be done to make a roller coaster more thrilling?
5.) What are some ways to make the structure different on a roller coaster?
6.) What would you need to make the structure different?
7.) What are some different structures that you know of?
8.) What is invention?

Reflective Journal Entry – done each day

- What did you learn today?
- How does invention utilize structure?

TEACHER NAME			Lesson #
Miss Northup			1 Practicum - 2
MODEL	**CONTENT AREA**	**GRADE LEVEL**	
Bruner	ELA/Writing/ Speaking and Listening	Elementary - 4th and 5th	
CONCEPTUAL LENS		**LESSON TOPIC**	
Invention		Engineering	

LEARNING OBJECTIVES *(from State/Local Curriculum)*

W.5.5 Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic.
W.5.6 Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
SL.5.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 5 topics and texts, building on others' ideas and expressing their own clearly
SL.5.3 Summarize the points a speaker makes and explain how each claim is supported by reasons and evidence

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)***
Invention utilizes structure	How does invention utilize structure?
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?)**
Students will know that engineering is technology concerned with design, building, and structure. Students will know that some of the different fields of engineering include electrical, civil, structural, mechanical, chemical, and automotive engineering. Students will know that each field of engineering has 7 steps to the engineering process. Students will know that many different engineers work together to complete one project. Students will know that structure is an arrangement of components in a logical manner. Students will know that invention takes creativity. Students will know that invention is not concrete.	Students will be able to plan. Students will be able to design. Students will be able to construct. Students will be able to invent. Students will be able to craft high-level questions. Students will be able to interpret new information. Students will be able to work collaboratively.

Students will know that engineers need to fail to succeed.	

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:
1. What do these people have in common? 2. What made you think that these people are engineers? 3. What do engineers do? 4. How do engineers utilize structure? 5. How do engineers utilize invention? 6. How might an engineer be related to roller coasters?	1. What do engineers do? 2. Who can become an engineer? 3. What is the process of becoming an engineer? 4. What types of engineers are there? 5. Where does an engineer work? 6. What tools does an engineer need in order to do his or her job? 7. What type of schooling do you need to become an engineer? 8. What is something interesting that you heard/saw in the video? 9. Why do we need engineers? 10. What step do you think is the most important step in engineering a roller coaster? Why? 11. What step do you think is the least important step in engineering a roller coaster? Why? 12. What engineers do you think would have the most structure? 13. What engineers	1. How do engineers utilize invention in creating structures? 2. How do engineers view invention? 3. Why do engineers think about invention? 4. What types of engineers would be needed to construct a roller coaster? 5. Who would design the loops, railcar, safety features, electrical, etc.? 6. What is the process for invention? 7. How would invention be involved in utilizing structure when designing and building a roller coaster? 8. What makes structure important? 9. How can structure be modified to improve roller coasters? 10. How does invention utilize structure?

	would utilize the most invention? Why? The following will go in the first station (Picture Collaboration): 14. What type of things do you see? 15. What is similar in all of the pictures? 16. What is different in the pictures? 17. How is invention represented in each structure? 18. What is utilized in the invention of each of the pictures? 19. What would be another picture that I could add to the pile that utilizes structure and invention? The following will go in the third station: 20. How might you utilize invention to make the structure taller? 21. How might you utilize invention to make the structure hold weight? 22. How might you utilize invention to make the structure move? These will be whole group discussion after stations: 23. How does using invention to design and build your marshmallow structure help you prepare to design a roller coaster? 24. What is something that you took away from these stations?	

	25. What did you find difficult? 26. After researching all of the engineers, which engineering field would you pick to design a roller coaster and why? 27. Which would be your least likely choice in the field of engineering to build a roller coaster? Why? 28. What is important about your engineering field? 29. Why did you pick your engineering field? 30. How would this field of engineering use invention to utilize structure? 31. How would this field of engineering be used in the invention of structures in a roller coaster? 32. What would an engineer's job look like in the field of engineering?	

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 be learning content that is sophisticated to the grade level.	Bruner is an open-ended instructional model which allows students to understand the structure of the discipline.	Students will be developing a product and they will vary by each students' creativity and invention.	Students will work in a variety of learning environments in this lesson including, independent, small group, and a whole group 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.*

Walk in the room and have looping pictures of various engineers on the board.
(PowerPoint presentation)
What do these people have in common? Answer on a slip of paper and give students 3-5 minutes to answer.

The teacher will ask pre-lesson questions.

- What do these people have in common?
- What made you think that these people are engineers?
- What do engineers do?
- How do engineers utilize structure?
- How do engineers utilize invention?
- How might an engineer be related to roller coasters?

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.*

STEP ONE: FAMILIARITY WITH THE DISCIPLINE

- The teacher will have a picture of a **structural** engineer on the board. Students will then proceed to create a list independently of words that come to mind when thinking of the word "Engineer". Once the students have had enough time to create their own lists, have students share their ideas with the whole group. The teacher will record the responses on the board so that the rest of the class can see the comprehensive list.

STEP TWO: PRACTICING THE DISCIPLINE

- The teacher introduces the video to the students about the process of engineering. The students will need to focus on the actual process itself of becoming an engineer. https://www.youtube.com/watch?v=fxJWin195kU
  The teacher will then ask the students:
  - What is something interesting that you heard/saw in the video?
- What engineers look like?
- What engineers do?
- Where engineers work?
- What schooling engineers need?
- What tools engineers use?
- What it takes to be an engineer (qualities)?
- Why do we need engineering?
- What step do you think is the most important step in engineering a roller coaster? Why?
- What step do you think is the least important step in engineering a roller coaster? Why?

The teacher will go back and add to the list on the board that the class previously made.

Students will be split into 3 groups. They will then rotate through stations. Each station will take about 15 - 20 minutes.

Stations:

Picture Collaboration: Students will look and go through real-time pictures of different structures designed by various fields of engineers based in Durham/Raleigh area. They will then answer questions based on the cards provided. Students will then be making connections on how all of the pictures go together.

- What type of things do you see?
- What is similar in all of the pictures?
- What is different in the pictures?
- How is invention represented in each structure?
- What is utilized in the invention of each of the pictures?
- What would be another picture that I could add to the pile that utilizes structure and invention?

Computer Research – Students will then each individually get a computer and be prompted to get onto kiddle.co Once on, students will be asked to research the different fields of engineering and how to become an engineer. (Students will be provided a graphic organizer to fill out while researching)

Engineering – Students will have a chance to become their own engineers by using invention to create their own structure made from marshmallows, toothpicks, pasta, and different foods to explore with. Students will be provided with clear and concise directions.

- How might you utilize invention to make the structure taller?
- How might you utilize invention to make the structure hold weight?
- How might you utilize invention to make the structure move?

The class will then come back together as a whole and be asked:

1. How does using invention to design and build your marshmallow structure help you prepare to design a roller coaster?
2. What is something that you took away from these stations?
3. What did you find difficult?
4. After researching all of the engineers, which engineering field would you pick to design a roller coaster and why?
5. Which would be your least likely choice in the field of engineering to build a roller coaster? Why?

Then the students will develop a list of different questions to ask the engineer based on the research and knowledge gained from each of the stations.
Say to the students:

"You will need to craft open-ended, high level thinking questions to ask the speaker. Each of you will craft 3 questions. Make certain your questions have to do with "invention" and "structure". Think about our understanding, Invention utilizes structure, as you craft your questions."

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 introduce the guest speaker Mike White who is an engineer in North Carolina. He will be talking about what his job is or an engineer in his field does, the education and process of becoming an engineer, and any other important facts. Students will use what they learned based on the three previous stations to ask the engineer questions at the end of their presentation.

Prompt students as needed to ask their 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*

STEP 3: Reflecting on the Discipline

Teacher will ask the students "After researching all of the engineers, which engineering field would you pick and why?"

Students will take what they chose and make an "All About Page" on construction paper. Students will take old magazines, pictures, and newspapers and be able to cut out something from their field of engineering. They will then write facts about their field of engineering such as:

- Engineering Field:
- Tools Needed:
- Where the "office" is:
- Artifact Designed:
- Etc…

The students will also be given various art tools to create this "All About Page". Once the students have been given enough time to complete this, we will share among the class as a whole group.

Ask:

- What is important about your engineering field?
- Why did you pick your engineering field?
- How would this field of engineering use invention to utilize structure?
- How would this field of engineering be used in the invention of structures in a roller coaster?
- What would an engineer's job look like in the field of engineering?

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

STEP 4: Continued Practice and Reflection

To wrap the lesson up, the teacher will ask the post lesson questions:

- How do engineers utilize invention in creating structures?
- How do engineers view invention?
- Why do engineers think about invention?
- What types of engineers would be needed to construct a roller coaster?
- Who would design the loops, railcar, safety features, electrical, etc.?
- What is the process for invention?
- How would invention be involved in utilizing structure when designing and building a roller coaster?
- What makes structure important to roller coasters?
- How does invention utilize structure?
- How can structure be modified to improve roller coasters?

Reflective Journal Entry – done each day
- What did you learn today?
- How does invention utilize structure?

TEACHER NAME		Lesson #
Miss Northup		2
MODEL	**CONTENT AREA**	**GRADE LEVEL**
Creative Problem Solving	Science	4th-5th
CONCEPTUAL LENS	**LESSON TOPIC**	
invention	Roller Coasters	

LEARNING OBJECTIVES *(from State/Local Curriculum)*

4.P.1 Explain how various forces affect the motion of an object.
5.P.1 Understand force, motion and the relationship between them.
5.P.1.4 Predict the effect of a given force or a change in mass on the motion of an object.
4.V.3 Create art using a variety of tools, media, and processes, safely and appropriately.

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)*
Invention utilizes structure	How does invention utilize structure?
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?)
Students will know… • That a force is a push or pull. • That forces can cause an object to start moving, stop moving, or change direction.	Students will be able to devise a plan. Students will be able to build. Students will be able to analyze. Students will be able to collaborate and

• That an object's size and the amount of force exerted on an object affect its speed and motion • That structure is a result of invention. • That resources may be limited due to environmental factors and that this could minimize creativity. • That invention does not have a set end result.	compromise. Students will be able to evaluate. Students will be able to revise Students will be able to reflect.

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:
1. What processes of invention did the designer of this structure go through when creating this structure? 2. How does each of these puzzles represent structure? 3. What makes each structure alluring? 4. What else is inviting about this structure? 5. How is invention incorporated into this structure? 6. What about the structure of this puzzle did you think would make it easy about to solve? 7. What about the structure of this puzzle did you think would make it difficult to solve? 8. How did the use invention when creating this structure?	**1.** What design features do you want your roller coaster to have? 2. What did you use to support your structure? 3. How does your structure stand out from the rest? 4. How did you use the process of invention in your design features? 5. What other materials would you have wanted? 6. What types of challenges did you face? 7. How are you planning to/ did you solve those challenges? 8. What altercations have you made to your design? 9. How do you feel about your roller coaster and why? 10. What part of invention did you find difficult? Why?	1. What challenges did you come across while creating your structure? 2. What did you do to overcome those challenges? 3. What would you add to your structure if you had more time? 4. What part of your roller coaster showcases invention? 5. What part of your roller coaster shows structure? 6. How does invention utilize structure?

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**
The content for this learning experience is above grade level material for this group of students.	Students will be using the creative problem solving model. This model requires the students to think in a variety of ways.		

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.*

As students come into the room, they will be handed a metal brain teaser. Each student will get their own brain teasers (having multiple different ones given throughout the room). Each of these brain teasers is a form of structure and invention and will require the students to creatively think on how to solve the brain teaser.

Ask the students the *pre-lesson* questions:

- What processes of invention did the designer of this structure go through when creating this structure?
- How does each of these puzzles represent structure?
- What makes each structure alluring?
- What else is inviting about this structure?
- How is invention incorporated into this structure?
- What about the structure of this puzzle did you think would make it easy about to solve?
- What about the structure of this puzzle did you think would make it difficult to solve?
- How did the use invention when creating this structure?

Students share out loud in the group and are encouraged to talk through each of the answers in great detail.

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.*

Step 1: Mess Finding (Objective Finding) – The teacher will tell the students what they are going to be doing today. They will be making roller coasters out of pool noodles and duct tape. The first step will to be to come up with as many designs as they can for their roller coaster. They will need to discuss the problem of making the marble roll through the roller coaster without falling out. The students should also talk about any other problems that they can predict will happen and a general goal for their design.

Step 2: Fact Finding (Data Finding) – Students will be given all rules and expectations of this activity.

RULES

- You may only use the materials provided to you.
- You may work in the space provided to you.
- One person from each group will be in charge of getting the materials off of the materials table.

Students will need to discuss the problem and what they already know about it. They should also talk about the resources and how to solve the problem at hand which is designing and constructing a roller coaster out of pool noodles and making sure a marble gets from point a to point b. They will determine the most important information to guide creative solution development.

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.*

Step 3: Problem Finding – As the students begin to plan for their roller coaster, they should thoroughly talk through and analyze each idea with their group to address any problems that could go wrong with the ideas presented and how to fix it. They should consider many problem statements and select the best one.

Step 4: Idea Finding – Students should pick one specific design and begin to sketch what they want their roller coaster to look like noting the problems and any solutions that they have to fix the problem. The solutions can be varied and unusual. The students will work through the solutions as they use structure in invention. They will also prepare a list of materials that they will need before they can move to the next step of construction.

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*

Step 5: Solution Finding – Students will go through their plan and narrow down where any problems and misconceptions might take place. Every student in the group should have participated in the idea process. Then the students will talk about all of the ideas in their group gathered and select a specific one for building their roller coaster.

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

Step 6: Acceptance Finding – Students will be developing their very own roller coaster out of pool noodles, duck-tape, and various structures throughout the room with a group of peers. The students will be assigned different roles throughout this process. One student will be in charge of gathering the supplies needed for their group. Students will be given 30-40 minutes to construct their roller coaster at a designated spot in the room. The teacher will walk around the room and ask during lesson questions to the groups based upon what they are building. (Questions may change for each group.) The

students will go through their design and make sure that it fits the audience intended for. They will also answer any questions or clear up any resistance that the audience has about their design. (Audience would be the teachers of the room)

During Lesson Questions:

- What design features do you want your roller coaster to have?
- What did you use to support your structure?
- How are you using invention to stand out from the rest?
- What other materials would you have wanted?
- What types of challenges did you face?
- How are you using invention to plan and solve challenges you may face?
- What altercations have you made to your design?
- How do you feel about the structure of your roller coaster and why?
- What part of invention did you find difficult? Why?

Give students the performance task and allow them to construct.

Performance task:

The city council has decided to open up a brand new amusement park in Durham in the year 2020. They are now excepting bids for the construction of roller coasters from engineering firms from throughout the area, including your firm. As head of your engineering firm, you will be required to work with a team to complete this project. In order for your bid to be considered you must submit the following: a blueprint of your roller coaster, a written description of the ride and its thrilling features, and an explanation of how the invention process of creating a new ride utilizes structure. The city council with convene for roller coaster presentations on June 27th, 2019. Good luck!

Once the students are done building, the students will collect any unused material and place it back in the collection spots dedicated for materials. Then the teams will gather together and prepare for judging.

Invited guests (Dr. Stephens, Mrs. Griffith, Mrs. Parrot) will use a rubric to judge each of the groups based on invention, structure, teamwork, height, etc… while they showcase their group rollercoasters.

After the judging students will return to their seats. The students will reflect by answering the post lesson questions.

Post Lesson Questions:

- What challenges did you come across while creating your structure?
- What did you do to overcome those challenges?
- What would you add to your structure if you had more time?
- What part of your roller coaster showcases invention?
- What part of your roller coaster shows structure?
- How does invention utilize structure?

Students will complete the reflective journal entry.

TEACHER NAME		Lesson #
Miss Northup		4
MODEL	**CONTENT AREA**	**GRADE LEVEL**
Visual Thinking Strategy	ELA / Visual Art	Elementary - 4th and 5th
CONCEPTUAL LENS	**LESSON TOPIC**	
Invention	Roller Coasters	

LEARNING OBJECTIVES *(from State/Local Curriculum)*

RI.5.6 Analyze multiple accounts of the same event or topic, noting important similarities and differences in the point of view they represent.
SL.5.4 Report on a topic or text or present an opinion, sequencing ideas logically and using appropriate facts and relevant descriptive details to support main ideas or themes; adapt speech to a variety of contexts and tasks.
5.V.1.1 Use appropriate art vocabulary to describe art movements.
5.V.2 Apply creative and critical thinking skills to artistic expression.

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)*
Invention utilizes structure	How does invention utilize structure?
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?)
Students will know that emotions can be depicted through facial expressions, body language, and other various features of a painting. Students will know that paintings are interpreted by the looker. Students will know that painting can show invention. Students will know that structure can changed based on someone's viewpoint. Students will know the similarities and differences of two paintings with the same topic.	Students will be able to analyze. Students will be able to inference. Students will be able to collaborate effectively. Students will be able to problem-solve. Students will be able to interpret new information.

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:**
1.) What words or phrases come to mind when you think of structure? 2.) What are some ways that structure can vary? 3.) What are some ways invention can vary? 4.) What are the important features in your invention? 5.) How does your invention relate to your group? 6.) If given more time, what would you add to your invention to make the structure stronger and more long lasting? 7.) Why is structure important to invention?	1.) What do you see in this image? 2.) What makes you say that? 3.) What other ways could this be interpreted as? 4.) What else do you see in this image? 5.) Why do you say that? 6.) How do the people in the image feel? 7.) What other feelings are portrayed in this image? 8.) How do you know? 9.) What else could you add to the previous student's comments? 10.) What invention do you see in this picture? 11.) What other uses of invention are there? 12.) Why do you think that? 13.) What structure is used in this picture? 14.) Why do you think that?	1.) What image is the best representation that "invention utilizes structure"? 2.) What makes you say that? Why? 3.) How can a picture/painting/ sketch show invention? 4.) How can a picture/ painting/ sketch show structure? 5.) What part of your illustration shows structure? 6.) How can emotions be depicted in an illustration? 7.) How can interpretation change invention? 8.) How can interpretation change the structure of a roller coaster? 9.) What did you learn today? 10.) How does invention utilize structure?

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**
Content is sophisticated to this grade level with the use of advanced vocabulary and concepts.	Visual Thinking Strategy Model is an open-ended thinking and inquiry strategy which promote inferencing and generalizations.		

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.*

Students will be given a number as they walk in. They will be instructed to sit at their assigned table that displays the number given to them. Each table will be in groups of 4. The groups will be given 10 minutes to create a structure. Each group will select one students to be the supply manager. This student will be in charge of going up to gather supplies to work with. Some supplies but not limited to would be: Ribbon, tape, string, scissors, plates, cups, random materials. Each structure must be standing on their own. When the 10 minutes are complete, students will stop working and then discuss how this structure has importance and what significance it has on their group. (EX. A paper plate tower with four towers could represent the four group members. The tied together cups could represent unity.)

Then the teacher will **ask the pre-lesson questions:**

1.) What words or phrases come to mind when you think of structure?
2.) What are some ways that structure can vary?
3.) What are some ways invention can vary?
4.) What are the important features in your invention?
5.) How does your invention relate to your group?
6.) If given more time, what would you add to your invention to make the structure stronger and more long lasting?
7.) Why is structure important to invention?

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.*

Bring up PowerPoint on the board and display the first picture "Roller Coaster" By: Linda Mears. Allow students to sit and look at the picture for about 3 minutes without talking.

Then the teacher will ask:

1.) What do you see in this image?
2.) What makes you say that?
3.) What other ways could this be interpreted as?

Allow multiple students to answer each of the questions. Guide and prompt to look deeper into the painting as needed. As students respond, restate what the student says to the entire class and paraphrase or ask for clarification as needed on each response.

The ask:

1.) What else do you see in this image?
2.) Why do you say that?

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.*

After students have completed rounds of discussing what they see in the image, ask more questions such as:

1.) How do the people in the image feel?
2.) What other feelings are portrayed in this image?
3.) How do you know?
4.) What else could you add to the previous students' comments?
5.) What invention do you see in this picture?
6.) What other uses of invention are there?
7.) Why do you think that?
8.) What structure is used in this picture?
9.) Why do you think that?

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*

Students will then get into partners. Each partner will sit side by side.
The teacher will project a new image called "Kids on Roller Coaster". Each partner group will go through the same process. They will look at this image silently for 3 minutes. Then the students will turn away from the image and ask each other:

1.) What do you see in this image?
2.) What makes you say that?
3.) What other ways could this be interpreted by?

After a few minutes of talking with a partner not looking at the illustration, allow students to turn back to the illustration with their partner and look at the illustration one more time. Ask the students to add anything that they were missing.

Gather the students back together as a whole group and discuss answers gained.

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

Students will then compare and contrast the two paintings and discuss the similarities and differences as a whole group.

Before closing ask:
Which image is the best representation that "invention utilizes structure"?
What makes you say that?
What else?

Ask Post Lesson Questions:

1.) How can a picture/painting/ sketch show invention?
2.) How can a picture/ painting/ sketch show structure?
3.) What part of your illustration shoes structure?
4.) How can emotions be depicted in an illustration?
5.) How can interpretation change invention?
6.) How can interpretation change the structure of a roller coaster?

Reflective Journal Entry – done each day

- What did you learn today?
- How does invention utilize structure?

Unit Recourses

Websites:

Kiddle.co

Students will be using the kid friendly version of google called kiddle.co to research multiple times throughout this unit.

https://youtu.be/OjoyjbEu2oM

"World's Best Roller Coasters" – This video is being used as an engagement for the students.

https://www.ultimaterollercoaster.com/

This unit is primarily about roller coasters. There will be many times throughout the unit for students to research pictures, slogans, structure, location, and much more.

https://www.youtube.com/watch?v=fxJWin195kU

This YouTube video is being used to introduce students to the engineering process. Students will be using the content from this video to identify the process of constructing their own invention of a roller coaster.

Specific Teacher Resources:

Mike White- Maritime Engineer

Graphic Organizers and Worksheets Used:

Lesson 1	Lesson 2	Lesson 3	Lesson 4
• Find Someone Who • All About Roller Coasters Graphic Organizer • Reflective Journal	• Welcome Ticket • Spaghetti Structure Challenge • Research Organizer • Question Stem Cards • Reflective Journal	• Performance Task Rubric • Reflective Journal	• Two Paintings by Unknown • Reflective Journal