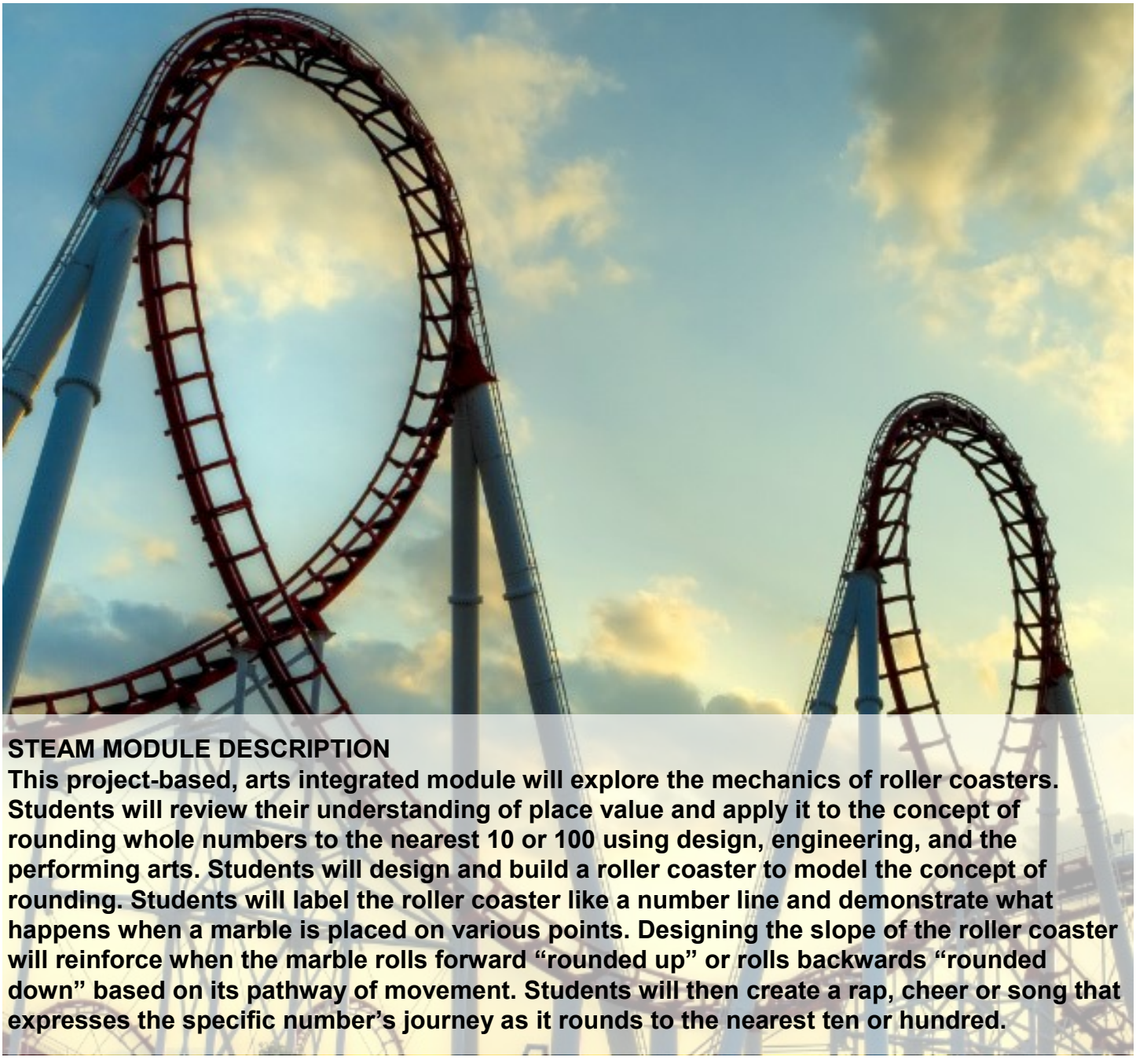
ArtsNow®
Teaching and Learning Across the Curriculum

Grade 3 STEAM Module

# Rounding Roller Coasters

Greater Than • Less Than • Place Value



**STEAM MODULE DESCRIPTION**

**This project-based, arts integrated module will explore the mechanics of roller coasters. Students will review their understanding of place value and apply it to the concept of rounding whole numbers to the nearest 10 or 100 using design, engineering, and the performing arts. Students will design and build a roller coaster to model the concept of rounding. Students will label the roller coaster like a number line and demonstrate what happens when a marble is placed on various points. Designing the slope of the roller coaster will reinforce when the marble rolls forward "rounded up" or rolls backwards "rounded down" based on its pathway of movement. Students will then create a rap, cheer or song that expresses the specific number's journey as it rounds to the nearest ten or hundred.**

| Description | Learning Targets |
|---|---|
| This project-based, arts integrated module will explore the mechanics of roller coasters. Students will review their understanding of place value and apply it to the concept of rounding whole numbers to the nearest 10 or 100 using design, engineering, and the performing arts. Students will design and build a roller coaster to model the concept of rounding. Students will label the roller coaster like a number line and demonstrate what happens when a marble is placed on various points. Designing the slope of the roller coaster will reinforce when the marble rolls forward "rounded up" or rolls backwards "rounded down" based on its pathway of movement. Students will then create a rap, cheer or song that expresses the specific number's journey as it rounds to the nearest ten or hundred. | "I Can…"<br>● Apply my understanding of place value to the concept of rounding whole numbers<br>● Determine when a multi-digit whole number should be rounded up and when it should be rounded down<br>● Use materials to design and engineer a roller coaster that models the concept of rounding whole numbers to the nearest 10 or 100<br>● Create a rap, cheer or song that expresses my overall understanding of the concept of rounding |

**ESSENTIAL QUESTIONS**

- How can I design a roller coaster that models the concept of rounding multi-digit whole numbers to the nearest 10 and 100?
- How does place value relate to rounding multi-digit whole numbers?

**STANDARDS**

| Curriculum Standards | Arts Standards |
|---|---|
| GA Performance Standards:<br>**3.NBT.A.1.** Use place value understanding and properties of operations to perform multi-digit arithmetic.<br>**1.** Use place value understanding to round whole numbers to the nearest 10 or 100.<br><br>National Standards:<br>**CCSS.MATH.PRACTICE.MP1.** Make sense of problems and persevere in solving them. | GA Performance Standards:<br>**VA3PR.3.** Understands and applies media, techniques, and processes of three-dimensional works of art (sculpture) using tools and materials in a safe and appropriate manner to develop skills.<br>**b.** Creates sculpture using a variety of methods (e.g. cutting, folding, found objects).<br><br>**VA3C.2.** Develops life skills through the study and production of art.<br>**a.** Manages goals and time.<br>**b.** Adapts to change.<br>**c.** Works in teams.<br>**d.** Guides and leads others.<br>**e.** Directs own learning.<br>**f.** Demonstrates persistence.<br><br>**M3GM.5. Composing and arranging music within specified guidelines**<br>**a.** Create rhythmic motives to enhance literature. **b.** Compose rhythmic patterns in simple meter including quarter notes, quarter rests, half notes, paired eighth notes, and whole notes.<br>**c.** Compose simple melodic patterns. |

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| | **d.** Arrange rhythmic patterns creating simple forms and instrumentation.<br><br><u>National Standards:</u><br>Visual Arts<br>**VA:Cr1.1.3.** Elaborate on an imaginative idea.<br>**VA:Cr2.1.3.** Create personally satisfying artwork using a variety of artistic processes and materials. |

**KEY VOCABULARY**

**Content Vocabulary**

- **Place value:** The value of where the digit is in the number. Ex: In 352, the 5 is in the "tens" position, so it shows a value of 50.
- **Thousands place:** One part out of 1,000 equal parts of a whole. Ex: In the decimal 56.781, 1 is in the thousandths place.
- **Hundreds place:** One part out of 100 equal parts of a whole. Ex: In the decimal 2543.978, there are 7 hundredths.
- **Tens place:** The value of where the digit is in the number. Ex: In 352, the 5 is in the "tens" position, so it shows a value of 50.
- **Ones place:** The last or right digit. Ex: In 784, 4 is in the ones place.
- **Rounding:** Making a number simpler but keeping its value close to what it was. The result is less accurate, but easier to use. Example: 73 rounded to the nearest ten is 70, because 73 is closer to 70 than to 80.
- **Whole number:** A number without fractions or decimal parts.
- **Greater than:** A symbol used to compare two numbers, with the greater number given first. Ex: 5 > 3 shows that 5 is greater than 3.
- **Less than:** A symbol used to compare two numbers, with the lesser number given first. For example: 5 < 9 means 5 is less than 9.
- **Number line:** A line with numbers placed in their correct position. Useful for addition and subtraction and showing relations between numbers.

**Arts Vocabulary**

**Theatre Arts**

- **Lyrics:** The words of a song.
- **Tempo:** This is the speed of the beat.
- **Rhythm:** These are long and short sounds.
- **Design:** To conceive and plan out in the mind.
- **Architecture:** The art or science of building; specifically: the art or practice of designing and building structures and especially habitable ones.
- **Engineer:** To lay out, construct, or manage as an engineer.
- **Mechanics:** The practical application of mechanics to the design, construction, or operation of machines or tools.

**Visual Arts**

- **Form:** Is a term used to describe three-dimensional artwork. Forms can be geometric or organic. Three-dimensional art has volume, which is the amount of space occupied by the form. The form also has mass, which means that the volume is solid and occupies space.
- **Design process:** A process that designers and engineers use to arrive at a solution: brainstorm, design, build, test, evaluate, and redesign.

http://www-tc.pbskids.org/designsquad/pdf/parentseducators/DS_TG_DesignProcess.pdf

**ASSESSMENTS**

| Formative | Summative |
|---|---|
| • Teacher anecdotal notes during small group collaboration when designing and engineering the roller coaster<br>• Student's experimentation with the marble and the roller coaster | • Roller coaster design and creation (see Appendix for **Design Process Rubric**)<br>• Song, cheer, or rap created that describes the design process and how it relates to rounding |

**MATERIALS**

**Visual Arts/Design**
Marbles
Duct tape
Scrap cardboard, cardboard tubes
Plastic cups
Index cards
Black marker
Foam pipe insulation: each small group is given a 4-6 ft. long piece (cut tubing in half to create tracks)
((http://www.homedepot.com/p/MD-Building-Products-3-8-in-x-3-4-in-x-6-ft-Tube-Pipe-Insulation-Kit-50150/100665768)

**Theatre Arts**
Rubber Ball (light weight, size of basketball)

**THEATRE ARTS & VISUAL ARTS:**

**Activating Strategy**

**Zip-Zap-Zop:**
- Place students in a circle.
- One student passes the word "Zip" to another student by making eye contact and throwing the ball.
- The student that catches the ball passes the word "Zap" to another student in the circle by making eye contact and throwing the ball.
- The third student catches the ball and does the same thing with the word "Zop."
- It repeats again with three new players saying the phrase again.

**Apply this game to rounding to the nearest ten:**
- The game works the same except this time the first person throwing the ball will call out a two digit number.
- The student catching the ball must determine if the number should be rounded up or rounded down to the nearest ten by stating "round up!" or "round down!"
- The third student catching the ball will do the actual rounding and then throw the ball to a new person giving the new person a new two digit number.

*This game could also be used to Round to the Nearest Hundred if time permits.

| **Main Activity** |
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**Part 1**

- Announce to the class that today we will be taking our understanding of rounding whole numbers to the nearest ten and hundred and applying it to designing roller coasters.
- Review our prior knowledge of rounding and the rules of rounding whole numbers.
- Watch the **video of the roller coaster simulation.** (see Additional Resources) Encourage students to count when on the slope so they begin to understand how the concept of rounding connects to the slope of a roller coaster.
- Introduce students to the **History of Roller Coasters**, the engineering and problem solving that is present in the design. (see Additional Resources)
- Introduce **The Design Process** to students. (see Additional Resources for handout)
- Explain that the coaster design should express form and function (aesthetically pleasing and functional).

**Part 2**

- Give directions on how we will work in small groups to design our own innovative roller coaster that models the concept of rounding.
- Students are to work together to engineer their coaster.
- Give each group a different multi-digit number (differentiate these numbers based on leveled groups).
- Students are to use index cards, tape and black markers to label the coaster with a multi-digit starting and ending number determined after considering the number they are rounding up or down.
- Model this for the whole group by drawing the roller coaster and labeling it. Ex: If you model the number 18 and you are rounding to the nearest ten, then the range of numbers labeled on the roller coaster track would be numbers 10-20. If your example is 127 and you are rounding to the nearest hundred, then the range of numbers would be 100-200 (labeling by tens: 110, 120, 130, etc.)

**Part 3**

- Students will work in their small groups to design and engineer their roller coasters. Students should create a sketch of their design plan, labeling the parts and expressing the concept of rounding specific to their number.
- Students will use foam pipe insulation, tape, cardboard and plastic cups to build an innovative coaster.
- Students will label their coaster demonstrating the concept of rounding.
- Students will test out the mechanics of their roller coaster by using a marble.
- Encourage students to redesign if needed.

**REFLECTION**

| **Reflection Questions** |
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- *How did the roller coaster help you understand the concept of rounding?*
- *How could we have used this same roller coaster to round to the nearest thousand or ten thousand?*
- *What are you most proud of after completing this lesson?*
- *If you could do this lesson again,what would you do differently?*

## ADDITIONAL RESOURCES & EXTENSION ACTIVITIES

- Video of roller coaster simulation/ride: https://www.youtube.com/watch?v=dwT5JoN6mHM
- Design process: http://www-tc.pbskids.org/designsquad/pdf/parentseducators/DS_TG_DesignProcess.pdf
- Design Thinking: http://www.designthinkingforeducators.com/design-thinking/
- History of the roller coaster: http://www.pbs.org/wgbh/amex/coney/sfeature/history.html
- How roller coasters work: http://science.howstuffworks.com/engineering/structural/roller-coaster1.htm

**Books:**

- *Rounding Rescue, a Rounding Numbers Story* by Eric Lostorto
- *Numbers Elementary: Rounding* by Mike Shuck

**Extensions:**

- Ask students to name their roller coaster and create a brand based on characteristics.
- Ask students to write a story about the process of designing and creating as part of a team.
- Ask students to describe the type of energy used in their coaster. Potential energy as energy at rest and Kinetic energy as energy in motion.

## APPENDIX

- **Design Process Rubric**

# Design Process Rubric for Rounding Roller Coasters STEAM Module

| Task | 4 | 3 | 2 | 1 |
|---|---|---|---|---|
| **Design Plan** | Students created a detailed, fully developed sketch of their roller coaster's design plan, labeling all of the parts and expressing the concept of rounding specific to their number. Students conducted this planning by taking turns speaking and listening to their peers and contributing to the overall group plan. | Students created a mostly developed sketch of their roller coaster's design plan, labeling most of the parts and expressing the concept of rounding specific to their number. Students conducted this planning by taking turns speaking and listening to their peers most of the time. | Students created an under-developed sketch of their roller coaster's design plan, labeling some of the parts and unclearly expressing the concept of rounding specific to their number. Students conducted this planning by sometimes taking turns speaking and listening to their peers. | Student rarely were on task developing a sketch of their roller coaster's design plan. The coaster was not accurately labeled and concept of rounding was not apparent. Students rarely took turns speaking and listening to their peers. |
| **Innovative Use of the Materials** | Students accurately and appropriately used materials (foam pipe insulation, tape, cardboard and plastic cups) to build an innovative coaster. Student shared materials appropriately and gave positive feedback to their peers in the building process. | Students used most of the materials in their design (foam pipe insulation, tape, cardboard and plastic cups) to build an innovative coaster. Students most of the time shared materials appropriately and gave positive feedback to their peers in the building process. | Students used some of the materials in their design (foam pipe insulation, tape, cardboard and plastic cups) to build. Students sometimes shared materials appropriately and gave positive feedback to their peers in the building process. | Students rarely used the materials appropriately (foam pipe insulation, tape, cardboard and plastic cups) to build. Students rarely shared materials appropriately and overall the process of designing and building lacked positive peer feedback. |
| **Demonstrates Rounding Principles** | Students clearly and accurately labeled their coaster demonstrating the concept of rounding. Students labeled the coaster within a multi-digit starting and ending number and a 10 number range, equidistant apart. | Students labeled their coaster demonstrating the concept of rounding with accuracy most of the time. Students mostly labeled the coaster within a multi-digit starting and ending number and a 10 number range, equidistant apart. | Students labeled their coaster demonstrating the concept of rounding with accuracy some of the time. Students some of the time labeled the coaster within a multi-digit starting and ending number and a 10 number range, equidistant apart. | Student's did not accurately label their coaster demonstrating the concept of rounding. The range of numbers was inaccurate and the starting and ending numbers were inaccurate. |
| **Overall Design Process** | Students tested, evaluated thoroughly and then redesigned as needed to lead to sound mechanics of their roller coaster. Ultimately the marble on the track demonstrated motion that clearly expressed how a number would round up or down on each curve. | Students tested, evaluated and then redesigned as needed to lead to mostly sound mechanics of their roller coaster. Ultimately the marble on the track demonstrated motion that most of the time expressed how a number would round up or down on each curve. | Students tested, evaluated and then redesigned as needed to lead to somewhat sound mechanics of their roller coaster. Ultimately the marble on the track demonstrated motion that some of the time expressed how a number would round up or down on each curve. | The design process was not applied with fidelity. This led to inconsistent mechanics of their roller coaster. Ultimately the marble on the track demonstrated motion that rarely expressed how a number would round up or down on each curve. |