Parts and more Parts-- Parabola Fun

This is an entry lesson into quadratic functions and their shapes. Students see many real-life representations of parabolas. This lesson provides important vocabulary associated with quadratic functions and their graphs in an interactive manner. Students create a foldable and complete a worksheet using their foldable notes.

General Information

**Subject(s):** Mathematics
**Grade Level(s):** 9, 10
**Intended Audience:** Educators
**Instructional Time:** 45 Minute(s)
**Resource supports reading in content area:** Yes
**Keywords:** quadratic function, parabola
**Instructional Component Type(s):** Lesson Plan
**Resource Collection:** CPALMS Lesson Plan Development Initiative

Suggested Technology: Document Camera, LCD Projector, Overhead Projector
Freely Available: Yes

Attachment

- CPalms F.IF 2.4 Lesson VISUALS.pdf
- CPALMS F.IF2.4formativeassessmentpart1.pdf
- CPALMS F.IF 2.4SummativeAssessmentpart1.pdf
- Quadratic foldableCPALMS.docx
- foldable1.jpg
- foldable2.jpg
- foldablenotes.jpg
- CPALMSQuadraticfoldable.pdf

Lesson Content

**Lesson Plan Template:** General Lesson Plan

**Learning Objectives:** What should students know and be able to do as a result of this lesson?

Students will:

1. Demonstrate an understanding of key features of a quadratic function and the associated parabola.
2. Label given parts of a parabola.
3. Explain differences between quadratics that have negative and positive leading terms.

**Prior Knowledge:** What prior knowledge should students have for this lesson?

Students should have knowledge of:

- linear functions
- different forms of linear functions
- intercepts (x and y)
Guiding Questions: What are the guiding questions for this lesson?
The following questions will guide the lesson:

- How are quadratic functions similar/different from linear functions?
- What pertinent information can be gained about a quadratic from its Standard Form?
- What do _______ represent?
- What happens to a parabola when the leading term is negative?
- What do we notice about the Domain and Range of each quadratic?

Teaching Phase: How will the teacher present the concept or skill to students?

1. Teacher begins by presenting the class with the Warm-up in the "Formative Assessment section" (5 minutes)
2. Following warm-up, teacher:
   - Reviews the term "function" and why linear functions are functions.
   - Presents students with Sample Visuals:
     - ball being hit
     - soccer ball being kicked
     - Angry Birds screen shot
     - ballistic trajectories (mortar, howitzer, gun)
   - Explain that these are examples of a type of function we discuss in Algebra.
3. Introduce the idea that this type function is a “quadratic” function, reminding students that they have factored quadratics.
4. Ask students to identify differences between simple linear functions and quadratic functions. Students should be able to identify that these have similar variables, but the quadratic has a “squared” term.
5. Relate quadratic equations to the visuals the teacher showed them.
6. Hand out the ISN (Interactive Student Notebook) note-taking sheets (attached).
   - More information about how to use ISN (Interactive Student Notebooks) https://interactive-notebooks.wikispaces.com/
   - Suggest copying parts of these in different colors and have student cut and paste parts onto the foldable while working through the notes. Students will need scissors and glue.
   - Students may also like to use makers/highlighters to help organize their notes.
   - Students may use their own materials or materials the teacher provides them.
7. Teacher will distribute the Foldable Template. (Sample Foldable).
8. Teacher now has students hand write Notes in their foldables.
   - Start with the "Standard Form" and then go to "Looks Like"
   - Next, students will move to the Parts of a parabola.
   - It is important to help students understand that quadratics that have a positive leading term will OPEN UP; those that have a negative leading term will open DOWN.
   - Be sure to have students determine DOMAIN and RANGE of the samples. This should lead them to "discover" the Domain being consistently "all real numbers" and finding out only the Range changes for each function.
   - Here is an example of what the complete foldable may look like: Foldable Notes Answers.
9. Teacher should revisit with students the attached Formative questions throughout the note-taking sections, to ensure comprehension of material.
10. At the conclusion of the note-taking activity, the teacher should take up (collect) scissors, glue, etc.

Guided Practice: What activities or exercises will the students complete with teacher guidance?

Students will complete notes with teacher guidance as described in teaching phase of the lesson.

Students will be asked two of the "formative" questions during note taking phase. All students should be given time to develop and write down an answer to these questions. Teacher calls on a student to give answers.

Teacher may also refer BACK to the visuals used in the Lesson Introduction and have students identify, whole group, important parts of each parabola.

Independent Practice: What activities or exercises will students complete to reinforce the concepts and skills developed in the lesson?

Students will be given a “practice” worksheet after the note taking activity.

Quadratic worksheet-student copy
Peers may check each other, and the teacher should walk around the room to assist where needed.

Quadratic worksheet - ANSWERS
If students appear to be getting “stuck” stop the process and call attention back to the front of class to clarify misconceptions. However, with well written foldable notes, students should be able to use them to answer the questions given.

Closure: How will the teacher assist students in organizing the knowledge gained in the lesson?

At lesson closure, teacher should ask questions regarding their “practice” worksheet.

Hand out “exit” summative assessment.
Summative Assessment

Students will complete a worksheet during & after the direct instruction portion of the lesson.

Teacher may use a summative assessment to measure student learning. Summative

Formative Assessment

Lesson warm-up:

- Provide students with these equations: [equation 1] and [equation 2].
- Have students identify how these equations are SIMILAR and how they are DIFFERENT. (Students will identify the like terms of (x) and (y), but should be pushed further to identify what KIND of equations they are.)
  - Important SIMILARITIES are that they are linear equations. Guide students to use the words Linear FUNCTIONS. The lesson that follows will focus on FUNCTIONS.
  - Important DIFFERENCES are that they are in different forms. One equation is for slope intercept, the other equation is in standard form.

The teacher will provide notes on vocabulary/parts of a quadratic.

- The ATTACHED problems can be presented as students work through this lesson. Formative questions (includes answers)

Feedback to Students

Students will receive feedback throughout the lesson:

- Following the lesson warm-up to help focus them on “Functions.”
- Teacher will do comprehension checks, as students work through the notes that the teacher hands out.
- Peer feedback can be utilized as well as teacher feedback.
- Students will have an opportunity to work at least two practice problems during presentation of the lesson.

Accommodations & Recommendations

Accommodations:

Special needs students should do well with this lesson, as it is mostly visual. Always consult the individual IEP or 504 plans for your students as you address appropriate accommodations.

- Some student may need peer assistance with the organization of their foldable, especially if the teacher has students cut/paste.
- If students are not cutting and pasting in colors, special needs students should use highlighters to color headings of each area in the foldable. Headings should be the SAME color , as parts should be a different color. This provides organization to their work.
- Peers may assist with independent practice and help focus special needs students on their foldable to “find * answers.

Extensions:

This activity is an introductory lesson on parabola parts.

- It could be extended to identify parabolas in “real-life”, such as those found in architecture , bridges, and satellite dishes.
- Students can impose coordinate planes on pictures of real life parabolas and label parts.

Suggested Technology: Document Camera, LCD Projector, Overhead Projector

Special Materials Needed:

scissors, glue, foldable (printed for students) markers and highlights, as per teacher preference.

Further Recommendations:

- This is an introduction lesson on quadratic functions and their graphs. It is meant to be followed by “Transforming Quadratics - the Basics” or a lesson on transforming quadratic equations.
- This lesson has a small “summative” but is also assessed at the end of “Transforming Quadratics - the Basics.”
- As notes are handed out, the teacher should display them on the overhead.

Source and Access Information

Contributed by: helen crawford connolly
Name of Author/ Source: helen crawford connolly
District/ Organization of Contributor(s): St. Johns
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Aligned Standards

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<thead>
<tr>
<th>Name</th>
<th>Description</th>
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<tbody>
<tr>
<td>Summative</td>
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### MAFS.912.F-IF.2.4:
For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.

### MAFS.912.F-IF.3.7:
Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.

- a. Graph linear and quadratic functions and show intercepts, maxima, and minima.
- b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.
- c. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.
- d. Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior.
- e. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude, and using phase shift.