Quadratic Relations: Unit Overview

MPM2D, Grade 10 Principles of Mathematics (Academic), Unit 3. 11 classes of 75 minutes, plus one class for the unit test (about two and a half weeks).

The big question

What makes a parabola, and how does each number in its equation change its shape and position?

Students collect quadratic data from a string-loop experiment and from secondary sources, and fit curves of best fit with technology. They discover that quadratic relations have constant second differences and parabolic graphs, and they name the key features of a parabola. They compare $y = x^2$ with $y = 2^x$ and use patterns and exponent rules to explain zero and negative exponents. In Desmos, they investigate the effects of k, h and a separately, then combine them in vertex form, $y = a(x - h)^2 + k$. They sketch parabolas by hand with the step pattern and determine equations from graphs, vertices and points. Applications include kicks, dives, arches and fountains. The summative, Parabola Hunt, models drawn and real parabolas in vertex form, checks a model with differences, and contrasts parabolas with exponential curves.

Lessons

#	Lesson	Classes	Question	Expectations	What's inside
1	**Collecting Quadratic Data**	1	What shape does the data make?	QR1.1	String-loop rectangles; a tossed ball; stopping distances
2	**Second Differences**	1	How can a table show a parabola?	QR1.2	First and second differences; a tile pattern
3	**Key Features of a Parabola**	1	How do we describe a parabola?	QR1.3	Vertex, axis, zeros, y-intercept, max or min
4	**Comparing $y = x^2$ and $y = 2^x$**	1	Which grows faster, and when?	QR1.4	Tables, graphs and two pay plans
5	**Zero and Negative Exponents**	1	What do 2^0 and 2^{-3} mean?	QR1.4	Patterns, exponent rules, halving, metric prefixes
6	**Translations of $y = x^2$**	1	How do h and k move a parabola?	QR2.1	Desmos sliders; $y = x^2 + k$ and $y = (x - h)^2$
7	**Stretches, Compressions and Reflections**	1	What does a do?	QR2.1	$y = ax^2$; widest to narrowest; finding a
8	**Vertex Form**	1	What does each parameter do?	QR2.2	$y = a(x - h)^2 + k$; vertex, axis, max or min
9	**Sketching from Vertex Form**	1	How can we sketch quickly?	QR2.3	The step pattern; a diver's height

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#	Lesson	Classes	Question	Expectations	What's inside
10	**Finding the Equation of a Parabola**	1	What is the equation of this curve?	QR2.4	Vertex plus a point; arches and fountains
11	**Parabolas in Our World and Review**	1	Where do parabolas appear?	QR1.1–QR2.4	Modelling a jump; unit review

Assessment

Type	In this unit
Assessment for learning	Loop Rectangles, Difference Tables, Read the Features, Two Curves, Evaluate, Slide the Parabola, The Effect of a, Read Vertex Form, Sketch It, From Graph to Equation, Model the Jump, quick checks and exit tickets
Assessment as learning	Self-checks, Secondary Data, Patterns and Predictions, Which Plan?, Exponents in Context, Check and Apply, Unit Review
Assessment of learning	Summative task (Parabola Hunt) with a rubric, and a unit test with full solutions

Materials

Included:

- **Original data and drawings:** every data set, graph and picture was created for this unit (all data is fictional)
- **Experiment:** string-loop rectangles, needing only string and rulers
- **Start Here:** unit overview, summative task and rubric, unit test, and teacher solutions for both

Free tools only: string, rulers, graph paper, calculators and Desmos (free). In the summative, students use their own photos or public-domain images, with no photos of people.

What's in each lesson

- Teacher lesson plan with expectations, timed sequence, differentiation, look-fors and answer guides
- Slides with speaker notes
- Student handouts and organizers
- Editable Word and PowerPoint files, plus PDFs

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