

Teacher: Tiffany Hee
Grade: 9 – 12
Subject: CC Algebra 2

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Question:

How is the rate of change of the tourist growth impact the population growth in Dunhuang?

What is the best representation (Linear, exponential, or polynomial) of a certain data?

How do you write an equation best representing a set of data?

Introduction:

I have collected data on Dunhuang's population and the number of tourists. I would like to use these data for different units in my Common Core Algebra classes. This particular lesson will last for three days. First, I would like students to conduct a research on Dunhuang and write three things they have learned about Dunhuang and post their findings on class wiki for homework. During class, students will compare the data [given by the teacher] to find the rate of changes between the years of population growth, determine if the rate of change has a common difference/ratio, and explain their findings. Then I will have my students use the rate of change to construct a linear and/or exponential functions based on the given data. The lesson below is intended for my CC Algebra 2 students after they have learned the difference between linear and exponential functions [arithmetic vs. geometric sequences]. I would like to give the data and have students to find the line/curve/polynomial of best fit. Students will first graph the data on a coordinate plane and determine which line/curve best represent the data. I will then use Microsoft Excel to graph the data and draw the trend line to verify students' work. After showing students the different trend lines and discuss the one that best represent the data, we will move onto the new lesson of Graphing Polynomials. At the end of the two day lessons, students will be given a range of years where they have to research the incomes brought by tourism in Dunhuang for homework. During class, students will collaborate together to share their data, use their data to make a table, graph the data, and find the trend line that best fit the data.

Materials:

Mogao Cave pictures
Powerpoint
Map of Dunhuang
Handouts
Data of Dunhuang's tourist population
Video clip of the Mogao Caves

Equipment: Computer with projector, document camera, laptop, audio, video, paper, and pencils/pens

Common Core State Standards:

HSF-LE.A.1c Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.

HSF-LE.A.3 Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).

Standards for Mathematical Practices

4 Modeling with Mathematics

Learning Targets: At the end of this lesson, students will be able to do the following:

- **Solve** real world problems involving exponential growth and decay.
- **Compare and contrast** the correlations between population growth and economic growth in Dunhuang.
- **Find** the rate of change and determine if the data is linear, exponential, or other functions.
- **Justify** their rationales on why a given data is linear, exponential, or other functions.
- **Graph and determine** the line/curve of best fit for the data.
- **Identify** polynomial functions.
- **Graph** polynomial functions using tables and end behaviors.

Timeline: This particular lesson on Introduction to Polynomial functions is intended for three 57 minute classes.

Teacher Preparation:

1. Homework from previous day: Post the question of “List three things you’ve learned about Dunhuang” on the class wiki. Read all students’ responses before the start of the class.
2. Do Now: Provide assistance for students that needed help. Ask students to think about the question and answer any questions students might have.
3. Find Youtube videos on Dunhuang that can serve as a hook into the lesson.
4. Make sure students’ Chromebooks are fully charged and are functioning properly before the start of the class.
5. Go over how to use Excel Documents to do a scatter plot and trend lines.

Day 1 Lesson:

| Agenda | Time | Description |
|-----------------------------------|-------|---|
| Do Now | 5 min | Students will be given a table on Dunhuang’s population and the total number of tourists. Students will make a prediction on the population and the total number of tourists in the next year and justify their reasons. |
| P~S~J | 5 min | Students will pair up with a neighbor to share their quick write and justify their rationales. A few students will then be selected randomly to go over their quick write. |
| Hook & Intro to Lesson | 5 min | A mini video on Dunhuang will be shown to students. In addition, a PowerPoint presentation will be shown to show my trip to Dunhuang. I will introduce the history of Dunhuang, and go over why Dunhuang is special to China and to me. |

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|--|--------|---|
| IBE: Investigation before Explanation | 7 min | I will show the data for the Tourists in Dunhuang again. This time, I will ask students to graph the data on a coordinate plane. Base on the points plotted, students will determine whether the graph represent linear, quadratic, exponential, or other functions. Students will also need to explain their rationale. During this time, students will also be asked to think about why the tourist population in Dunhuang decreased. |
| P~S~J | 5 min | Students will pair up with a neighbor or two neighbors to share their findings. They will justify their work using academic vocabulary. |
| Excel Demonstration | 10 min | I will ask students to use their Chromebooks to open up their Excel documents. I will demonstrate how to do a scatter plot on excel and how to do a trend line using Excel. Students will explore all the trend line possibilities to see which one best represent the data. |
| Intro to Polynomial Lesson | 15 min | Teacher go over the Learning Objectives with students. I will discuss polynomial functions with students by formally defining polynomial. I will go over 2 examples with students. Example 1 gives students the opportunity to assess their understanding of the definition of a polynomial by determining whether a function is polynomial. Example 2 gives students the opportunity to assess their understanding of graphing polynomial functions using a table and its end behaviors. |
| Exit Slip | 5 min | Students will be giving a writing prompt: To determine whether a table is a polynomial function. Students copy down homework. |

Assessment: Exit Slip, students' notebook

Data on Dunhuang's Tourist Growth

| Year | # of Tourists in Dunhuang |
|------|---------------------------|
| 2000 | 72,500 |
| 2007 | 1,400,000 |
| 2008 | 1,000,000 |
| 2012 | 3,120,400 |
| 2013 | 3,970,000 |
| 2014 | 5,070,000 |

Day 2: Continue with Graphing Polynomials.

Day 3: Students collect data on income brought by tourism in the past 10 years. Students will collaborate in groups to share, graph and plot their data, and determine the trend line for their data.