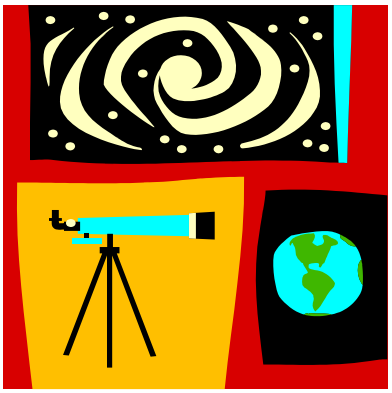
Using the Difference in Daylight to Investigate Linear Relationships.



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CMST Challenge Project

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Albion Central School District

9th Grade Mathematics

Table of Contents

Attachments:

Sunlight – excel worksheet with sheet 1 containing the data for the month of January and sheet 2 containing the data for the year.

Orbit – GSP file showing the Earth orbiting the sun.

Linear Relationships – Power Point presentation for the project.

My group of students was a mix of four ninth grade students enrolled in our Algebra I course. For our project I wanted to look at what was meant by linear and to see if they could tell the difference between linear and nonlinear relationships. I emphasized that there had to be a constant rate of change in order for a relationship to be linear. The relationship we looked at was the difference in amount of sunlight between Juneau Alaska and Albion New York. We started by looking at just the month of January. The students had to put the data into an Excel spreadsheet. They then had to use a formula to find the difference in sunlight. At this point I had them graph their results. The given graph looked almost linear. We then talked about what it meant to be linear (a constant rate of change) and they figured out how to use an Excel formula to find the rates of change for the different values. What they found was that it was not quite linear. The differences were very close to being the same, but at the beginning of the month there were zero, one and two minute differences, at the end of the month there were one, two, and three minute differences. Because of this the group decided that the rate of change for the difference in sunlight might be increasing. We expanded our data to include the whole year by choosing three data points from each month. Upon graphing this difference we could easily see that the relationship is not linear. Now we discussed what kind of relationship it really was and the students had to figure out why. They used Geometer's Sketchpad to model the earth orbiting around the sun to see why it was a cyclical (sinusoidal) relationship.

The software we choose to use was Excel and Geometer's Sketchpad. I wanted to use Excel because our district requires us to include at least one Excel project into our Algebra 1 course and one Excel project into our Geometer's Sketchpad course. I required that they use Excel and I hoped that the Excel portion would go well enough for me to use in my entire class next semester. I also hoped to use Geometer's Sketchpad because I will be starting our Geometry course in January and I wanted to practice teaching students how to use Sketchpad. To be fair I also made sure that we played with Stella a little and Interactive Physics as well. I let the students choose which software to use. The students enjoyed working with Geometer's Sketchpad the most. They admitted that they thought Interactive Physics might be more realistic for a three dimensional model, but they were focusing more on a two dimensional answer. Their comfort level was much higher with Geometer's Sketchpad and my opinion is that they were a little intimidated by Interactive Physics. They went to work on their Geometer's Sketchpad model pretty quickly and had a lot of fun with it. After going to a training session on IP I came back and had them work on it a little which went well, but they had already done their work on GSP.

Meeting One **November 2,2005**

This meeting was a short mandatory meeting just to disseminate information and get a final list of participants. The other students will get one more chance to sign up since so few came today. I talked about the CMST Institute, went over the rubric with them, and told them my idea. We talked about some other things we could investigate but it would have to deal with the concept of rate of change. I also showed them some of the software tools.

Meeting Two **November 9, 2005**

Now that we had our final group we talked specifically about the project and what needed to be done first. They decided to first put the data into Excel. They went on the Internet to a site that had the sunrise and sunset times for both Juneau and Albion. They started putting the data in. None of them had any experience with Excel so we spent most of our day learning how to use Excel's formulas, automatic fills, chart wizard, and cell formatting. We got most of January's data entered.

Meeting Three **November 16, 2005**

Today we looked at Stella briefly, Interactive Physics, and Geometer's Sketchpad. Students really got interested in GSP. They played with it for a while and got very comfortable with it. We then went back to data crunching and finished putting December's data into Excel. We looked at the graph and decided that it was close to linear, but not exactly. They debated for a while but finally decided that they should look at data for the whole year to see what is really going on.

Meeting Four **November 22, 2005**

Only one student showed up today. It is the last day before Thanksgiving break so I am not surprised. She spent the afternoon putting in the values for the rest of the year. She decided to pick the first, tenth, and twentieth of every month because putting every day in would have been too much and unnecessary. She also put in the formulas and the chart. She instantly recognized the graph, but was not sure what it was called.

Meeting Five **November 30, 2005**

Showed them the graph and they discussed the graph and what it looked like. There was a debate over whether or not it was a parabola so they looked at what would happen if they had kept going and decided it was not a parabola. They figured out that it looked like a trigonometric function by using my TI-84 to graph a bunch of different functions that I gave them. We then discussed the periodic nature of the function and why that may be the case. They got on both GSP and IP but opted for GSP. By this time they were much more comfortable with GSP and they felt that the two dimensional model was enough to show what they wanted. They figured out how to get the Earth orbiting and pasted in the pictures. By the end of our meeting today the Excel piece and the GSP piece were done. They decided they wanted to put planets popping out so we got some Styrofoam balls to paint up as the planets.

Meeting Six **December 2, 2005**

Only 2 students showed up. They put finishing touches on GSP and Excel. They finished painting the rest of the planets.

Meeting Seven **December 7, 2005**

We talked about how the sporadic attendance has really slowed us down. We started the Power Point Presentation today and made a little more progress on the poster. They got on the internet to make sure they had the right planets in the right order, put down the black paper and glued on the planets. They tried to make them look realistic but were disappointed by their lack of artistic talent, I thought it came out great though.

Meeting Eight **December 14, 2005**

Two students came today and finished the poster. They also put the last few touches on the Power Point Presentation. They got a lot of work done today trying to tidy up the loose ends.

Meeting Nine **December 21, 2005**

Four students came today. It took pizza to get perfect attendance! Today was mostly just a celebration of what they had done. We looked at their finished products and they got their rubrics for how many extra points they earned.

The problem I choose to address was the understanding, or lack thereof, of slope and its correlation to the type of function we are dealing with. I really wanted them to understand that being linear meant having a constant rate of change. I also wanted them to understand that this is easily investigated just by finding the slope between different data points. One of the main problems our RCT and Math A students have is that they really do not understand how to interpret graphs. I wanted these students to get comfortable looking at graphs and thinking about what the graph was trying to tell them. They need to understand it is not just a bunch of points, but instead see it as a bunch of relationships. The important part is seeing what those relationships are and being able to see the story behind them.

In completing my Challenge Project I had much more difficulty than I expected. First of all, the students that signed up were not the brown nosing geeks I had expected. Three of the four group members were failing my class and looking for some easy extra credit to bump them above passing. The fourth member was a mathematically strong and hard working student who did a great job and ended up doing most of the work. It was also hard to keep the students on task when they were interested in getting help with their regular class work. I had other students from class staying after on the same day as my project group which could be distracting. When I do this project again I am going to be much more structured with our meeting time. I also will not allow other students to stay after with us. They really needed the project to be broken up into individual pieces with separate deadlines for each piece. I do like this project idea, I just need to tweak my meeting style and structure. I often let the students go on their own while I helped other students, now I see that they needed more structure. I also will have an attendance policy when I do this again. Towards the end of the project attendance got to be a big problem. We spent half of our time reviewing what we did last week with the people who were missing.

Despite the above problems, I believe the results of this project were very positive. We had already done our unit on graphing which we talk about linear being a constant rate of change. When the students first met only Rachael could tell me what linear meant. Even after she told them that it meant you had to have a constant rate of change they still did not make the connection that you would look at slope to see that. That is a basic concept they really should have known by then. By the end of the project they were easily picking out linear, quadratic, and sinusoidal relationships. They could talk about the nature of these relationships and give examples of where you might see them in the real world. I was happy to see that final connection. They could look at different graphs and quickly tell me what the graphs were trying to tell them. Their graph interpretation skills improved a lot. I was also happy to see that interest sparked in two of the students towards the software tools. They really enjoyed working with Excel and Geometer's Sketchpad. Angel and Rachael made GSP screen savers for all the desktops in my room. I am very excited about this because I am looking forward to making them group leaders next semester when we get to the GSP lessons.

On a whole completing this challenge project was a great experience. I am disappointed that I got a late start on it. I think it could have been much better if I had gotten a faster start, but I wanted to finish my TI training before starting something else. I learned a lot about the software tools and what it is going to take to teach a lesson to the whole class. I had struggled a little bit trying to teach them GSP and in the end basically let them discover it on their own. I have used it enough to where I am comfortable on it, but I needed to think more about how I would teach it to a class. I am glad to have tried it out on a smaller group first. The same was true for Excel. I have used it so much myself that I really did not put much thought into how I would teach it to my students. I am feeling much more comfortable about trying this with my whole

class now. It was good to be able to sit with just the four of them and see what they got stuck on and what they could intuitively figure out on their own. I found that they really just need the basics on GSP to get started, then show them an example of what it can do. They worked better with GSP and learned a lot more when they were left to figure some of it out themselves. I am looking forward to working on incorporating this project into my regular Math A classes. This summer I am going to formalize it with a more structured rubric involving multiple pieces and deadlines. It will be interesting to see how this works with the full class. I am luck enough to have block scheduling and five desktops in my room so I can set up workstations and have time to rotate the student through.

My main focus for this project was standard four. In my pre-testing this year for both my RCT and Math A students I have found their main weakness to be in interpreting graphs. They can graph points and function, but they really did not understand that the graph is trying to tell them something. Even simple questions pertaining to graphs were missed by most of the students. I tried to focus on looking at the graph and talking about how the points and lines are not just points and lines, but representations of a relationship between the units on the axis'. We talked a lot about his once we got the full year graphs done. They really seemed to have a switch flip where they finally got what the line on the graph was about. In trying to focus on standard for I also touched on standards one and seven. Standard one was inherent in them trying to classify the graphs. They really had to look at the graphs and prove if it was linear or not. They then had to look at the graph of the years data and try to figure out what type of relationship it is. They researched it using my TI-84 and looking at different types of graphs and comparing what happened to their slopes. Standard seven was also easily addressed with this project. They really explored this when talking about why the relationship seemed cyclical. They then talked a lot

about other relationships in nature and how difficult it really is to find a truly linear relationship that occurs naturally. Most of the examples ended up being non-linear. This discussion gave them a better understanding of not only how the functions work, but their relationship to the real world applications. I have listed the three standards below for your reference.

Standard 1 – Mathematical Reasoning

Students use mathematical reasoning to analyze mathematical situations, make conjectures, gather evidence, and construct an argument.

Standard 4 – Modeling/Multiple Representation

Students use mathematical modeling/multiple representation to provide a means of presenting, interpreting, communicating, and connecting mathematical information and relationships.

Standard 7 – Patterns/Functions

Students use patterns/functions to develop mathematical power, appreciate the true beauty of mathematics, and construct generalizations that describe patterns simply and efficiently.