Modeling:
You Don't Have to Be 5'10" and 120 Pounds to Do It!

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Desmos activities used during the presentation can be found here:

https://bit.ly/2FS13NB

What do we want for our students?

When your students leave you at the end of their year with you, what do you want them to think/know/feel/care about/be?

What do we want for our students?

- Self-efficacy as a mathematics learner
- Caring and kind and able to interact with others
- Curious and care about the world and community they live in
- Prepared for the next mathematics course
- Expertise with the Standards for Mathematical Practice
- Math can be interesting and beautiful and useful
- Experience joy
- Choose to pursue learning more math and fields/careers that rely on mathematics

What do we want for our students?

- Be critical consumers of information

- Develop the disposition and skills to use mathematics as a tool for understanding and confronting issues that they will face in their lives and their world

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Mathematical Modeling *is a vehicle for helping students achieve these goals.*

Helping Teachers Make Sense of it All
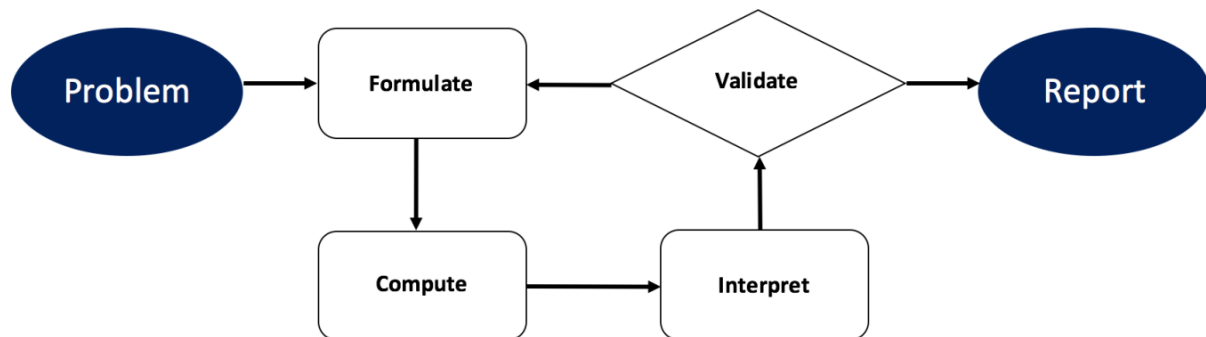
- GAIMME Report (Guidelines for Assessment and Instruction for Mathematical Modeling Education)

- Common Core State Standards Initiative

- PISA (Programme for International Student Assessment)

- NCTM's Catalyzing Change in High School Mathematics

Helping Teachers Make Sense of it All

- Modeling is a *process*
  - Scientific Inquiry
  - Design Thinking
  - Writing a research paper

Modeling is a Process

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┌──────────┐      ┌───────────┐       ◇──────────◇      ┌──────────┐
│ Problem  │ ───▶ │ Formulate │ ◀──── │ Validate │ ───▶ │  Report  │
└──────────┘      └───────────┘       ◇──────────◇      └──────────┘
                        │                   ▲
                        ▼                   │
                  ┌───────────┐       ┌───────────┐
                  │  Compute  │ ────▶ │ Interpret │
                  └───────────┘       └───────────┘
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Developing Expertise with Modeling

Elements of Modeling	Teacher Moves
Identifying Variables	Give *students* the opportunity to identify important variables rather than have it given to them
Formulating Models	Provide guidance for students to create the models they plan to use rather than present formulas, tables, etc.
Performing Operations	Have students compute models by filling in tables or graphs, or solving equations.

Please return to Desmos activity

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Performing Operations	Have students compute models by filling in tables or graphs, or solving equations.
Interpreting Results	Ask students to use the results of the previous operations to produce an answer to the initial question.
Validation Conclusions	Compare the results of the model and the actual results in real life. Discuss how and where the model went wrong.

Penny Circle

https://teacher.desmos.com/modeling

➔ The "Penny Circle" activity is the second lesson listed in the Modeling bundle at teacher.desmos.com

Reflecting and Improving

http://tinyurl.com/trig-modeling-task

Reflecting and Improving

Trigonometry   Name _____
Mathematical Modeling

Part I:

A. Working in groups of three, you will analyze climate data of cities in various geographic locations around the world. With your group members, select 6 cities from the list provided below:
- 3 must lie in the northern hemisphere;
- 2 must lie in the southern hemisphere;
- 1 must be an equatorial city.

Addis Ababa, Ethiopia	Cali, Colombia	Kathmandu, Nepal	Quito, Ecuador
Amsterdam, Netherlands	Cape Town, South Africa	Kuala Lumpur, Malaysia	Sydney, Australia
Apia, Samoa	Chicago, IL (US)	Madrid, Spain	Tokyo, Japan
Budapest, Hungary	Fort Lauderdale, FL (US)	Maputo, Mozambique	Umea, Sweden
Buenos Aires, Argentina	Istanbul, Turkey	Nairobi, Kenya	Wellington, New Zealand

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B. You will research the 24-hour average temperature from January through December for each city you selected.

BEFORE collecting the data, think about a function that might model the data and make a prediction regarding what you think the amplitude, period and vertical shift of each function. Discuss these with your group members and write down your predictions below.

	Predictions		
City	**Amplitude**	**Period**	**Vertical Shift**

Reflecting and Improving

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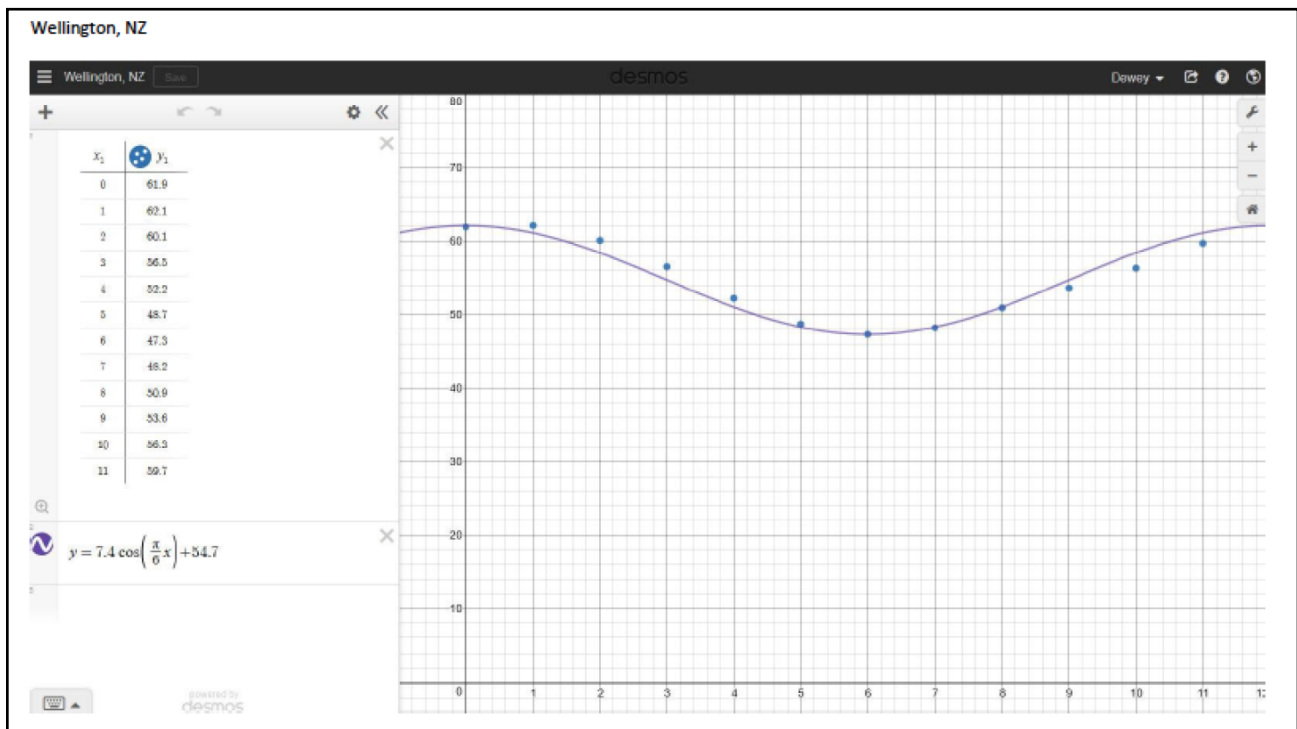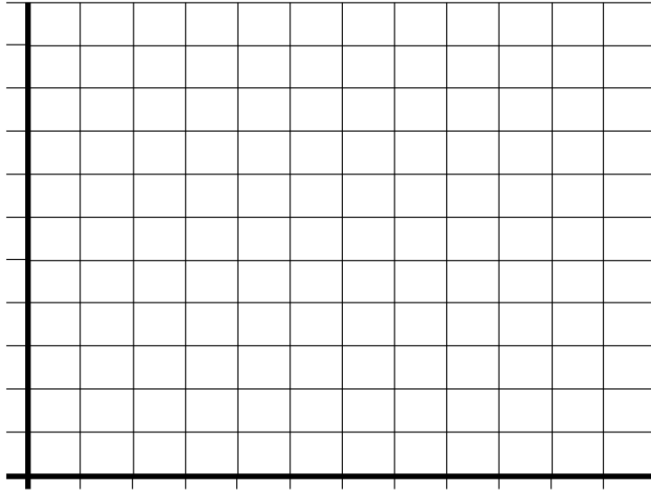| City	Predictions		
	Amplitude	Period	Vertical Shift

Reflecting and Improving

Part II:

A. For each city your group selected, use the worldclimate.com website to research the 24-hour average temperature from January through December. Record your data in the table below.
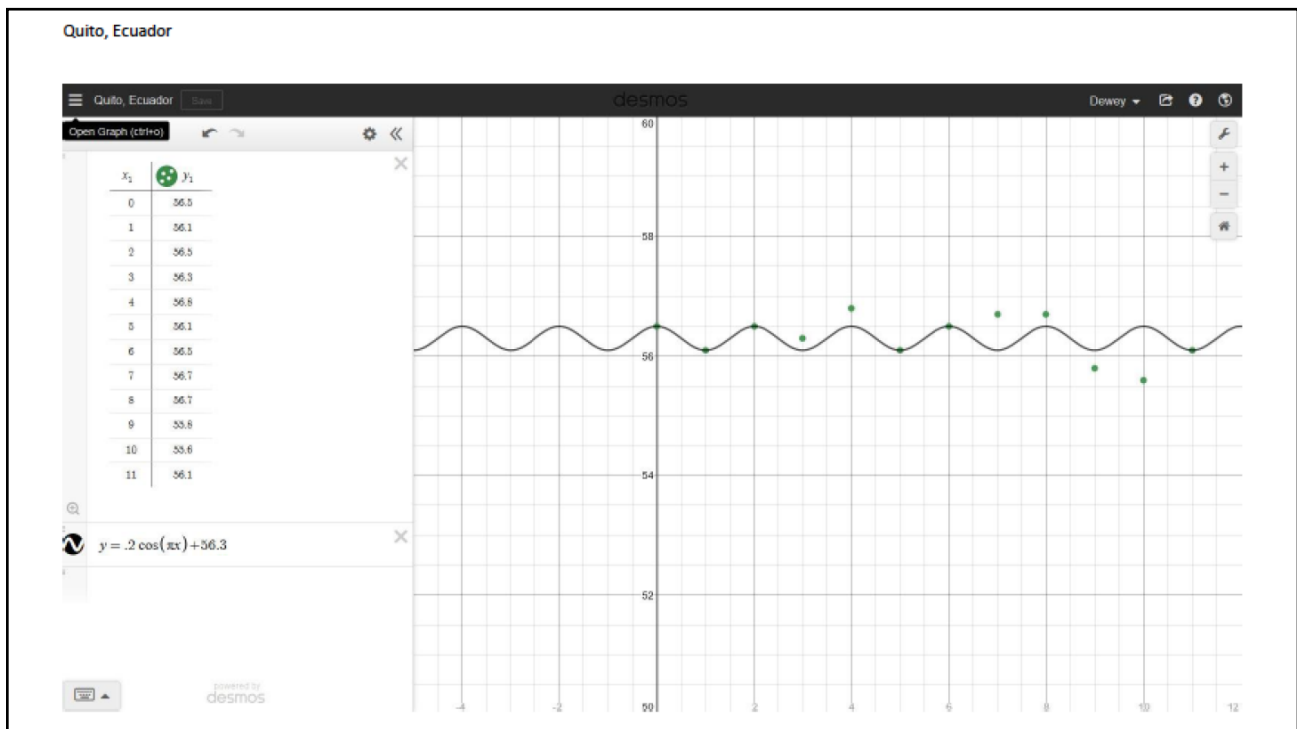
City	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

B. For each city, create a scatterplot of the data and determine a function that appropriately models the data.

Test your model using a graphing calculator (create the scatterplot and graph your model in the same screen). Modify your function if necessary.

City #1: _____   Function: _____

Wellington, NZ

x_1	y_1
0	61.9
1	62.1
2	60.1
3	56.5
4	52.2
5	48.7
6	47.3
7	48.2
8	50.9
9	53.6
10	56.3
11	59.7

$$y = 7.4 \cos\left(\frac{\pi}{6}x\right) + 54.7$$

Umea, Sweden

Quito, Ecuador
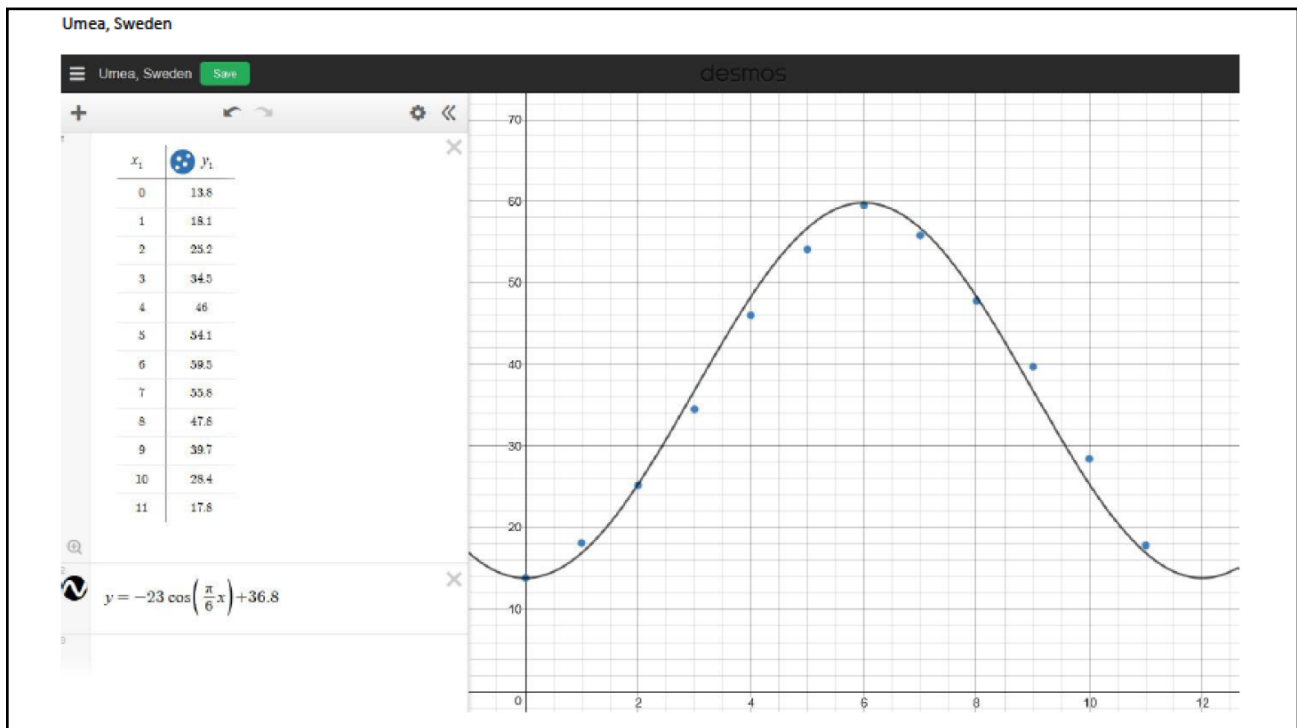
Reflecting and Improving

Part III:

Compare and contrast the scatterplots and the models you created for all six cities. Answer the following questions.

A. Compare the sign of the value of the amplitude in each of your models. What do you notice? Make a conjecture about how you could predict the sign of the amplitude for each model by considering the geographic location of the city. Explain your answer.

B. Based on your answer to question A (above), list any two cities in the world that would have a positive amplitude and two cities that would have a negative amplitude. The cities that you list must be different from the 6 cities you already researched.

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D. How would each of your functions change if you plotted the data starting with the month of March?

I. Review the predictions you wrote at the beginning of this investigation. Discuss how accurate your predictions were. Were any predictions significantly different from the models you created? If so, explain why you think your prediction was significantly different.

F. Compare and contrast the models you created for all six cities you researched. Which city's graph had the greatest amplitude? Which city's graph had the smallest amplitude? What conjecture can you make regarding the relationship between a city's geographic location and the amplitude of its model.

J. What other real-world phenomena can be modeled using periodic functions? List at least 4.

Reflecting and Improving

To what degree did this task genuinely engage students in the mathematical modeling cycle?

Ending Reflection

Has your definition/understanding of modeling changed at all?

How might you build upon what you currently do to better address all elements of the modeling cycle?

We Teach to Inspire

- **MAHALO** for joining us today!

- **MAHALO** for all that you do on behalf of your students!