



STEMS² Unit Plan Template

Paste your unit plan information into this doc, keep the headers for accessibility

BACKGROUND:

Background:

This section is for teacher use. Please answer these questions in the text.

- Why is the unit designed this way?
 - **This unit was designed to involve students with both place and community-based education opportunities by utilizing their own backgrounds and cultures to explore higher-level mathematical coursework in order to make it more relevant in real life.**
- How did you select your community partners?
 - **The community partner chosen (Councilmember Augie T) was someone who is both knowledgeable about the community which our students come from (in this case Ewa Beach) and understanding about the various issues and problems which exist in said community (passed bills and supported the community around topics like ebike safety). Other community partners such as someone from the school (principal, vice-principal) or other non-profit/advocacy leaders can also be another choice if the topics are relevant to these individuals.**
- Is there relevant or special content knowledge or background information that you think is required to implement the unit. For example background info on lō'i.
 - **The relevant content knowledge that students would need to be successful in this unit would be for students to have an idea or think about the issues or topics which they're involved in. Topics could include things that are serious matters like poverty, homelessness, income, or more basic topics like price of foods, school services, money they spend, etc.**
 - **Other knowledge they would need to know is the mathematical concepts of the unit (in this case, Polynomial Functions) but that is covered within the unit itself.**
- How is the teaching and learning environment, context and content of this unit, designed to incorporate the concept of Sense of Place via the implementation of Na Hopena A'ō, STEMS² Pedagogy and other frameworks as appropriate?
 - **By choosing a topic which has relevance to them, students are able to build a better understanding of both their sense of place and culture. Through the unit and mathematical content itself, students are able to learn about how to analyze data which they collect and identify current trends to predict future ones.**

Unit Overview:

500 character (max) abstract providing a summary of your unit

- What is the overall purpose and real world problem/challenge of the unit?



- What is the basic design of the unit?
- What is the basic content addressed in the unit?
 - **This place-based mathematics project (a project which incorporates both the place/community of an individual and mathematical skills from the classroom) focuses on creating an Algebra 2 unit plan on the topic of Key Features of Polynomial Functions at James Campbell High School under the observation of my mentor. Within this unit, I will work with 10th through 12th graders on developing a personal connection and understanding with the mathematical concepts presented within the given unit according to the Hawaii Common Core Standards. Additionally I will also introduce various ideals and theories from both the STEMS² masters program and Nā Hopena A‘o Framework, which encourage student participation within the land they live in and the content which they learn. After going through this unit, I will survey my students on whether or not the place and community-based lessons had helped my students understand how higher level math can be relevant to their own personal lives.**

STAGE 1:

Reflections before completing Stage I: (note: you do not have to write answers to these questions here)

- What is important for students to understand and be able to do?
- What do students already know and are already able to do?
- What are students curious about?
 - **Students will be doing a method of data collection (surveys, interviews, etc.) in order to collect data based on a topic of their choice.**
 - **Students need to know how to look up data and information about the topics they chose and how to do the necessary mathematical skills in order to analyze and draw conclusions from their data using polynomials.**
 - **Students should already know various issues or ideas they want to explore which have relevance to their lives in addition to mathematical skills from previous math courses like how to read/interpret various parts and key features of a graph, combining terms, inputting data, and more.**
 - **Students will utilize credible resources to research information about their topic to compare with the data they’ve collected.**
 - **Students are curious about why they need to learn about various mathematical concepts and if they even have any relevance to their own lives. Aka where would they ever use the skills learned within my class in real life.**

Unit Plan Title: **Community and Place-Based Learning Through Polynomial Functions**

Essential Question:

- Open-ended (how or why Qs best)



- Pushes students to inquire about something real and relevant
- Gratifying (to them and / or the community)
- Inspires activity or movement, and evokes emotion or controversy
 - **How can we use data analysis from higher level Algebra 2 skills to address place and community-based problems that occur within our daily lives?**

Enduring Understanding(s):

- Write 2 - 3 main ideas that students will remember for the long term.
- Introduce these early and touch on them often.
- Form the foundation of the authentic culminating assessment.
 - **Students understand the relationship between mathematics and how they can collect data and study patterns within the world around them.**
 - **Students understand that mathematics is a tool that can be applied to address problems within their own lives.**

Standard Benchmarks and Values

- Select standard benchmarks (HCPS III, CCSS, NGSS)
- Identify values to reinforce (culture-based, such as NHMO or other).
- Notate if students will be introduced to, will practice, or will demonstrate mastery of the standard during this unit.
- All assessed standards should be demonstrated mastery
- STEMS² Units are interdisciplinary and should address a minimum of standards across three content areas. Please list all standards addressed (i.e. introduced to and will practice) and assessed (demonstrate mastery) in the table below.

Science	Technology	Engineering	Mathematics	Social Science	Beyond
<p><u>Standards Addressed</u></p> <ul style="list-style-type: none"> ● S-ESS3-6 Earth and Human Activity <ul style="list-style-type: none"> ○ Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity. ● HS-ETS1-4 Engineering Design <ul style="list-style-type: none"> ○ Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem. ● Nā Hopena A'ō <ul style="list-style-type: none"> ○ Strengthened Sense of Belonging <ul style="list-style-type: none"> ■ Know about the place I live and go to school. ■ Build relationships with many diverse people. ■ Communicate with clarity and confidence. ■ Understand how actions affect others. ○ Strengthened Sense of Responsibility 					

- See self and others as active participants in the learning process.
 - Question ideas and listens generously.
 - Reflect on the quality and relevancy of the learning.
- Strengthened Sense of Excellence
 - Define success in a meaningful way.
 - Explore many areas of interests and initiate new ideas.
 - Utilize creativity and imagination to problem-solve and innovate.
 - Assess and make improvements to produce quality work.

Standards Assessed

- D4.8.9-12
 - Apply a range of deliberative and democratic strategies and procedures to make decisions and take action in their classrooms, schools, and out-of-school civic contexts.
- D4.1.9-12
 - Construct arguments using precise and knowledgeable claims, with evidence from multiple sources, while acknowledging counterclaims and evidentiary weaknesses.
- D2.Civ.7.9-12
 - Apply civic virtues and democratic principles when working with others.
- ISTE for students
 - Computational thinker
 - Creative communicator
 - Global collaborator
- CCSS.Math.Content.HSA.APR.A.1
 - Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.
- CCSS.Math.Content.HSA.APR.B.3
 - Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial.
- CCSS.Math.Content.HSA-SSE.A.2
 - Use the structure of an expression to identify ways to rewrite it. *For example, see $x^4 - y^4$ as $(x^2)^2 - (y^2)^2$, thus recognizing it as a difference of squares that can be factored as $(x^2 - y^2)(x^2 + y^2)$.*
- CCSS.Math.Content.HSF-IF.C.7c
 - Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.
- CCSS.ELA-LITERACY.W.9-10.7
 - Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject demonstrating understanding of the subject under investigation.
- CCSS.ELA-LITERACY.SL.9-10.4



- Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose, audience, and task

Critical Skills and Concepts:

- List what you want students to know and be able to do by the end of the unit.
- Link these skills and concepts to what students need to fully grasp the Enduring Understandings and answer the EQ.
- Delineate broad skills and concepts to be specific about what students are "getting good at."
 - **Concepts:**
 - **Identifying problems which they have relevance to.**
 - **Collecting data from a list of approved topics.**
 - **Mathematical modeling through graphing and tables.**
 - **The process of graphing polynomial equations.**
 - **How to use various graphing utilities (desmos, graphing calculator, etc.).**
 - **Analyzing polynomial graphs and drawing conclusions.**
 - **Probability using data and predicting future trends.**
 - **Creating possible ideas to address these problems.**
 - **Designing a report to list the data they've collected and other key pieces of information from the project (graph, table, trends, etc.).**
 - **Designing an end product to showcase the work they did (poster, presentation, video, etc).**
 - **Skills:**
 - **Various mathematical Skills from the unit such as:**
 - **Factoring, solving for zeros, identifying specific values, drawing/graphing data coordinates, etc.**
 - **Researching data through:**
 - **Online, through present research, collecting their own.**
 - **Ways to record and present found data such as:**
 - **Using a table, a graph, through words.**
 - **Analyzing data and drawing conclusions such as:**
 - **current trends, future predictions, solutions.**
 - **Designing a research poster with the problem they are addressing, the data found, and their possible solutions.**

STAGE 2:

Reflections before completing Stage II: (note: you do not have to write answers to this question here)

- What have students learned and how have they grown?
 - **Students at this point should have learned the basic skills to analyze and answer questions related to polynomial graphing as well as a topic which they find**



interest in and how it affects their own personal lives. They have grown into mathematicians with better understanding about the given topic and with clearer ideas on how one could use them in real life.

Authentic Performance Tasks:

- Describe how a student will show you that they deeply understand and can use / apply the Enduring Understandings.
- Develop a real-world task students can accomplish or problem they can solve to answer the EQ.
- Select some of the standards and values to assess.
 - **Students would research a problem they chose that has relevance to them. They would analyze the data, draw conclusions, and predict future outcomes. From there they would suggest various actions which could be taken to skew the data into a more favorable direction and present their findings to an audience.**
 - **The steps to do so would be as follows:**
 - **Students identify and list various real-world problems within their own lives.**
 - **The class will be surveyed to identify topics of interest or problems which they as students can relate to in their lives or community (increased prices on food, transportation, etc.).**
 - **Using the selected issues, a community partner (or school community partner) was chosen in order to provide possible topics or problems which they could choose as a topic.**
 - **Students would then select a topic they're interested in and do research on.**
 - **Students research and collect data on the problem which they chose.**
 - **Using their data, students would create a graph (polynomial as the baseline) to show their findings.**
 - **Using the data, students can state findings and predict a future trend which would take place.**
 - **Students would then create a written research report talking about various points such as their data and where they got it from, trends they identified, and suggest possible ideas to change this trend to what they would like to see instead.**
 - **Students would then share their findings with our selected community partner showing the information they collected on the topic they chose.**

Authentic Audience:

- Decide on an authentic and relevant audience for this task.
- Who can students show their understanding to in order to make an impact beyond the walls of their classroom?



- o **An authentic audience would be both the community involved (whether that be students, parents, etc.) and the community partner which they got the problems they selected from.**
 - **Students would be able to share their findings with those around them in order to both educate them on things they might have not been aware of as well as show them a new perspective on a problem which they chose to research on.**
 - **The community partner would be able to get more information from sources they may have not reached out to or collected data from in order to learn more about the perspectives of problems within the community and what can be done to help solve or head towards a solution.**
- o **This audience is relevant because the problems which they chose would affect both them and students. It would also show that the students are just as connected and knowledgeable about the topics and the issues that are occurring within their community as others are aware of and can help add to data which may not exist.**

Other Evidence:

- List other evidence and assessments beyond those in the Performance Task that can be used to measure student growth and mastery of benchmarks.
 - o **Other evidence that would be used to identify student growth and mastery of benchmarks would be the various warm-ups and wrap-ups I provide within class to test their understanding of the mathematical concepts as well as a pre and post-survey which would check for students understanding and how they feel about the work which they've done which I will compare to my own observations.**

STAGE 3:

Reflections before completing Stage III: (note: you do write answers to this question here)

- How do students best learn?
 - o **Students learn best through exploration on the topic at hand through their own inferences and experiences. They come up with their own processes and solutions to problems presented to them within the classroom and in turn gain knowledge regarding the way they learn and how to motivate themselves further.**

Learning Plan:

- How are the STEMS² Pillars integrated across your learning plan?
- Identify knowledge and skills students will need to accomplish the Authentic Performance Task.
- Address how lessons will spiral and scaffold to build up to the culminating assessment.
- Notate how you will link to Enduring Understandings and make connections between discrete knowledge and larger themes often.



- Give students a chance to practice all skills needed to accomplish the final assessments several times.
- Offer students a chance to:
 - Think about new knowledge/skills
 - Do /create / make using the knowledge/skills
 - Reflect and receive feedback on knowledge/skills
 - Re-do (several times, if needed) constantly pushing for excellence
- **Students will survey/interview various members within their community (ex. Peers, family, etc.) to collect data on a topic which they found interesting and wanted to learn more about in order to solve future or current issues within their own lives.**
- **The end product of this project will involve students creating an end product using their research (social media, powerpoint, poster, etc.) in order to share the data which they collected, their findings, and what they learned while working through the steps of this project.**
 - **The work will be shared with their Community Partner Council Member Augie T in order to help him learn more about what topic students are interested in learning about and how it's relevant to their own lives.**
- **Students will utilize various forms of technology (graphing utilities, online surveys, etc.) in order to create easy-to-read and visually appealing media to explain the data they've collected.**
- **The main goal of this project is to show students how the skills and content they've learned in their mathematics classes can be used to explore topics within their own lives or even communities.**
- **The project itself is broken up into six parts to explore within 7-8 weeks with lessons/guidance being focused on every Friday.**
 - **Students are given time to work on normal classwork in addition to the project every week, so timelines and what they need to get done is purely on their own schedule.**
 - **Prior to the various parts, I was able to communicate with my community partner to brainstorm some topics in addition to collecting ideas based on the majority of students' interest from a survey earlier to help narrow down things students could do research/data collection on.**
- **Part 1: Creating a Research Question**
 - **Students selected a topic from the ones pre-selected after surveying them initially and conversing with the community partner for their input.**
 - **Topics included Homelessness, Community Parks, Parking in Ewa Beach, and E-Bikes.**
 - **After selecting a topic, students were tasked to make both a research question and a measurable survey question to help with future data collection**
 - **The research question had to be more narrow and focused based on the topic they chose (ex. Instead of simply e-bikes could focus more on E-Bike safety and laws in the area).**



- Measurable survey question is something that gives a numerical value back (ex. On a scale of 1 - 10... and more) in order to help accurately display data using both a table and a graph in the future.
- Students submitted to me their group members, a group name, a research question, and a survey question on a google form.
- Main Goals:
 - Students will demonstrate their understanding of what's required of them by using their own ideas and experiences to come up with a research question they would want to explore deeper into using the community around themselves.
 - Students will refine both their research questions and their measurable survey questions until both them and I are satisfied with what they want to learn about.
- Part 2: Methods of Collecting Data
 - Students will learn about how to make either an appropriate survey or interview to collect data from within their community.
 - Only doing these two forms of data collection due to time constraints.
 - Types of questions, examples, and format of the survey is talked about during the class period.
 - Google Forms are the primary source of data collection, so also showing students how to use them effectively as well.
 - Survey itself will be made up of both free-response questions and measurable questions to see the communities thoughts and opinions on the topic at hand.
 - Students will share the survey with me to look over and give feedback on before distributing it.
 - Students can choose to:
 - Present the work they will be doing to other classes/the community (agreed upon before) in order to collect data and present their findings once the project is completed.
 - Share their survey via social media or through the student bulletin to collect data.
 - Main Goals:
 - Students will use Google Forms in order to create a survey and collect information from their peers, community members, or audience in order to learn more about the topic they have chosen.
- Part 3: Graphing the Data
 - From their measurable survey question, students will create a table utilizing the information they collected (ex. On a scale of 1-10) and the amount of responses they received for each option.
 - Students will then plug their values into a pre-generated table in Desmos and use the Polynomial Regression Formula to create a line of best fit (a polynomial line which passes through each coordinate point).



- The table and Desmos features are created ahead of time so students just need to collect and plug their information in.
 - Students will then write their line of best fit as an equation in order to do the next section (Key Features and Written Report).
 - Main Goal:
 - Students will utilize Desmos in order to create a visual representation of the data they have collected in the form of both coordinate points and a line of best fit.
- Part 4: Identifying Key Features
 - After creating a graph (using the data points and the line of best fit) students will identify various key features of the graphs themselves.
 - These include the following: Relative Minimum & Maximum, Positive & Negative Values, Increasing & Decreasing Values, and other key features if applicable (x-intercepts, y-intercepts, etc.).
 - Besides key features, students will also identify common patterns and conclusions based on the responses they've received and the way the data looks via the table and the graph.
 - Main Goal:
 - Students will analyze all the data that they collected (numerical, questions, graph, etc.) and identify various key features, trends, and draw conclusions based on key elements from the responses gathered.
- Part 5: Constructing a Written Report
 - Once all the data has been collected and analyzed, students will input all of them into one document to organize their thoughts.
 - The document will include the following:
 - Line of Best Fit Equation.
 - Screenshot of Graph (Points & Line of Best Fit).
 - Table of data imputed.
 - Key Features identified (ex. domain, min/max, etc.).
 - Trends and Conclusions identified.
 - Anything else necessary (ex. example responses, other data values, etc.).
 - Students will show me their end product before moving onto the final step
 - Main Goal:
 - Students will compile all their data and conclusions drawn from the previous sections into one document in order to keep track of the information they've collected and to help with the final stage of the project.
- Part 6: Final Presentation
 - Using the information they've collected, students will create an end product in the their choice of format (presentation, poster, video, social media post, etc.) with the following elements:
 - Topic chosen.
 - Data they found.



- **Conclusions and next steps.**
- **Final product will be shared with community partner to show students interests and the information they gathered/learned about**
- **Main Goal:**
 - **Students will create a presentation of their choice in order to summarize the data they've collected and analyzed throughout the project to share with the community, authentic audience, or even classes which they surveyed (if applicable).**