# Coding Calculus

*How Students Derive and Integrate with Coding*

*(Project Explanation)*

**Session Slides: bit.ly/NCTMCodingCalculus**

**Before the session starts.**

- Go to PollEv.com/emilymcdonal702 or QR
- *Question:* On a scale of **1-no experience** to **5-very experienced**, what is your experience level with Google Sheets and Google Apps Script?

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# Coding Calculus

## How Students Derive and Integrate with Coding (Project Explanation)

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# bit.ly/NCTMCodingCalculus

## Session Information:

***Recommended Audience:*** High School (Calculus)

***Time:*** 8:00 - 9:00 AM

Learn how students coded in high school Calculus using Google Apps for Education. For this project, students created a program/code that computed the derivative and integral of a polynomial function using Google Sheets and Google Apps Script with the push of a button. Learn how to implement this project and experience the process as a student.

It is recommended for participants to bring a device.

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LEVEL 2
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Genius!

# Emily McDonald

level one texthelp
Certified User
EquatIO

- Currently teaches Algebra 2 and Pre-Calculus
- This project completed at previous school.
- District is 1:1 with Chromebooks
- Idea inspired after a district Micro:Bit training
- Project first started Fall 2019. Continued through 2023.

edpuzzle
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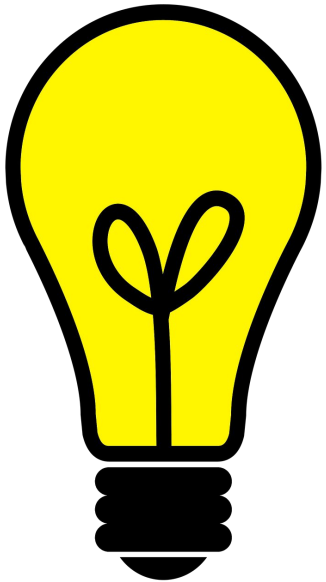
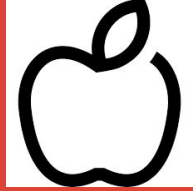
# Different experiences during this session.

Student



Teacher

***Learning Target:*** I can apply the properties of differentiation and integration to create a code using Google Sheets and Google Apps Script to differentiate and integrate a polynomial function.



Completed in four phases, a reflection, and group summary.

- **Phase 1:** Graph the derivative and integral approximation of a function using Google Sheets. Link to Instructions
- **Phase 2:** Introduction to Google Apps Script with basic code and brainstorm program setup. Link to Brainstorm Coding
- **Phase 3:** Use Google Apps Script in Google Sheets to create a button, text box, and evaluate a polynomial function.
  - Link to instructions for button and text-box
  - Link to instructions for custom functions
  - Teacher Example - Google Sheet
- **Phase 4:** Create a code using Google Apps Script to differentiate and integrate a polynomial function from a Google Sheet. Link to scaffolded instructions

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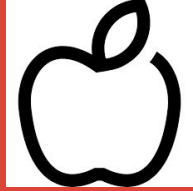


**Reflection:** Students had the option to reflect on the project using any of the following:

- Timeline: Sutori (website)
- Tutorial: iorad - the tutorial builder (Chrome Extension)
- Video Summary: Flipgrid

**Group Summary** - Work in groups to summarize the following:

- Derivative
- Integral
- Google Sheet
- Google Apps Script
- Benefits and drawbacks of the graphing methods for deriving and integrating

# Teacher Reflection: What was most successful?

- This project highlighted many **students' strengths in coding and exposed other students to coding** and G Suite tools (Google Sheets and Google Apps Script) for the first time.
- This project was also successful in utilizing and maximizing the use of technology. The **reflection component allowed students choice** and the group component **allowed students to collaborate on their project and improve their code** (if needed).
- The interactive component of the ROAR (Reflections of Outstanding Academic Rigor) display was successful in helping the public understand the project and engage with the docents.

## Addressed the following TN Standards for Calculus (as of 2022):

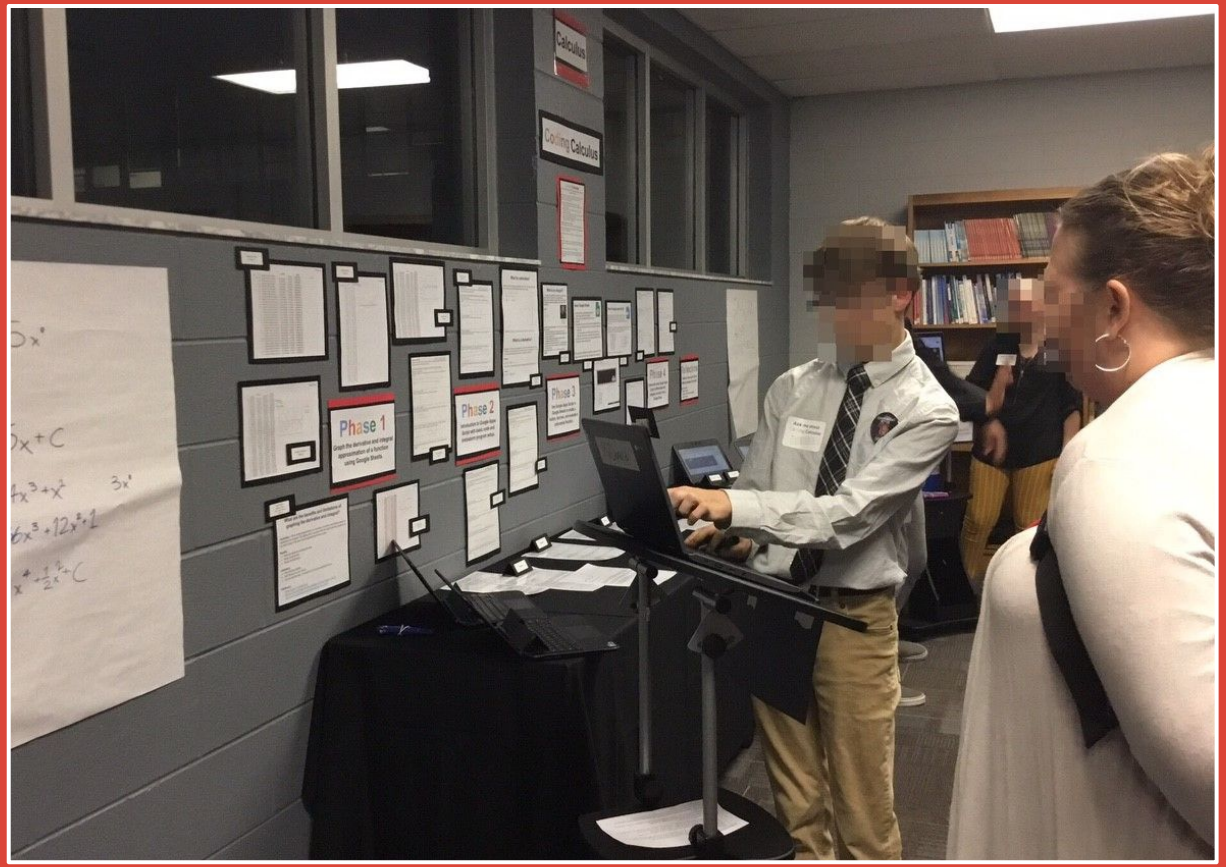
- C.D.CD.A.1 Represent and interpret the derivative of a function graphically.
- C.D.AD.A.2 Calculate the derivative of basic functions (power, exponential, logarithmic, and trigonometric).
- C.D.AD.A.3 Calculate the derivatives of sums, products, and quotients of basic functions.
- C.I.UI.A.3 Use Riemann sums and trapezoidal sums to approximate definite integrals of functions represented graphically, numerically, and by tables of values.
- C.I.UI.B.7 Apply basic properties of definite integrals.
- C.I.AI.A.1 Develop facility with finding antiderivatives that follow directly from derivatives of basic functions (power, exponential, logarithmic, and trigonometric).

# Red Bank High School ROAR Night, Fall 2019

(Reflections of Outstanding Academic Rigor)

# Red Bank High School ROAR Night, Fall 2019

## (Reflections of Outstanding Academic Rigor)



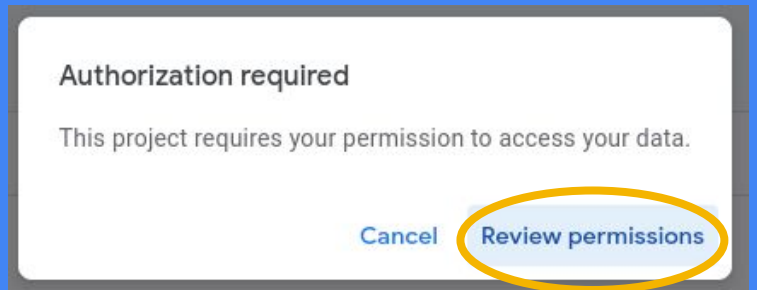
# Phase 3: Use Google Apps Script in Google Sheets to create a button, text box, and evaluate a polynomial function.

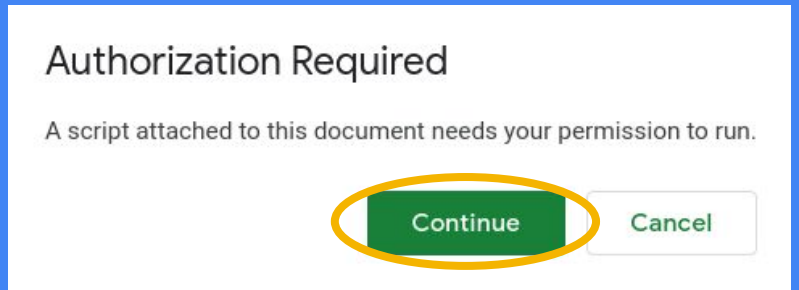
**CLICK HERE** to open an example Student Google Sheet

Teacher Resources:

1. Button and text-box
   - Teacher Instruction Sheet: Link to Google Doc

2. Custom functions - Celsius Converter
   - Teacher Instruction Sheet: Link to Google Doc



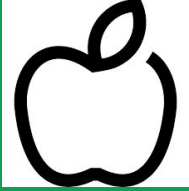
**Phase 4: Create a code using Google Apps Script to differentiate and integrate a polynomial function from a Google Sheet.**

**CLICK HERE** to open an example Student Google Sheet
*(same link as previous slide)*

Teacher Resources:

1. Scaffolded Instructions: Link to Google Doc

# Links to Student Work Examples, Fall 2019



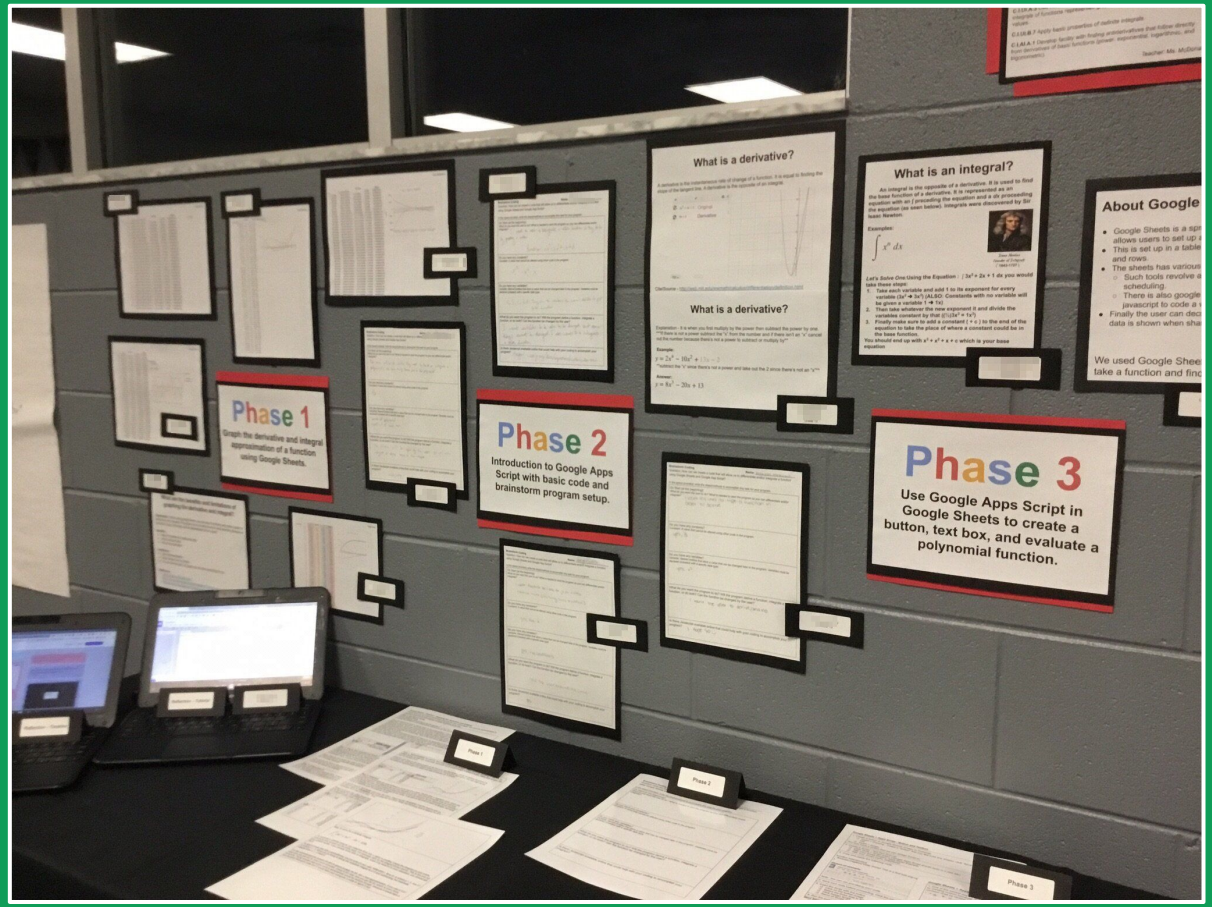
Project:

- Student 1
- Student 2
- Student 3

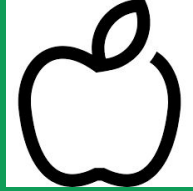
Project Reflection:

- Student 3
- Student 4

# Additional Pictures of Student Work, Fall 2019



# Additional Pictures of Student Work, Fall 2019



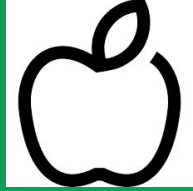
Step 1: Input your function by typing the coefficients on the "Input" row of the chart.
Step 2: Press the button on the bottom left corner to derive and integrate the function.
Step 3: Review your function and the outputs in the box next to the button.

***For fractions, use "=DEVIDE(a, b)"**

| | Sextic Coefficient | Quintic Coefficient | Quartic Coefficient | Cubic Coefficient | Quadratic Coefficient | Linear Coefficent | Constant |
|---|---|---|---|---|---|---|---|
| Input | | 0 | -5 | 8 | -12 | 0 | 3 |
| Derivative | | | 0 | -20 | 24 | -24 | 0 |
| Integral | 0 | -1 | 2 | -4 | 0 | 3 | C |

| |
|---|
| $f(x) = -5x^4+8x^3-12x^2+3$ |
| $d/dx[f(x)] = -20x^3+24x^2-24x$ |
| $\int f(x)dx = -1x^5+2x^4-4x^3+3x+C$ |

# Additional Pictures of Student Work, Fall 2019



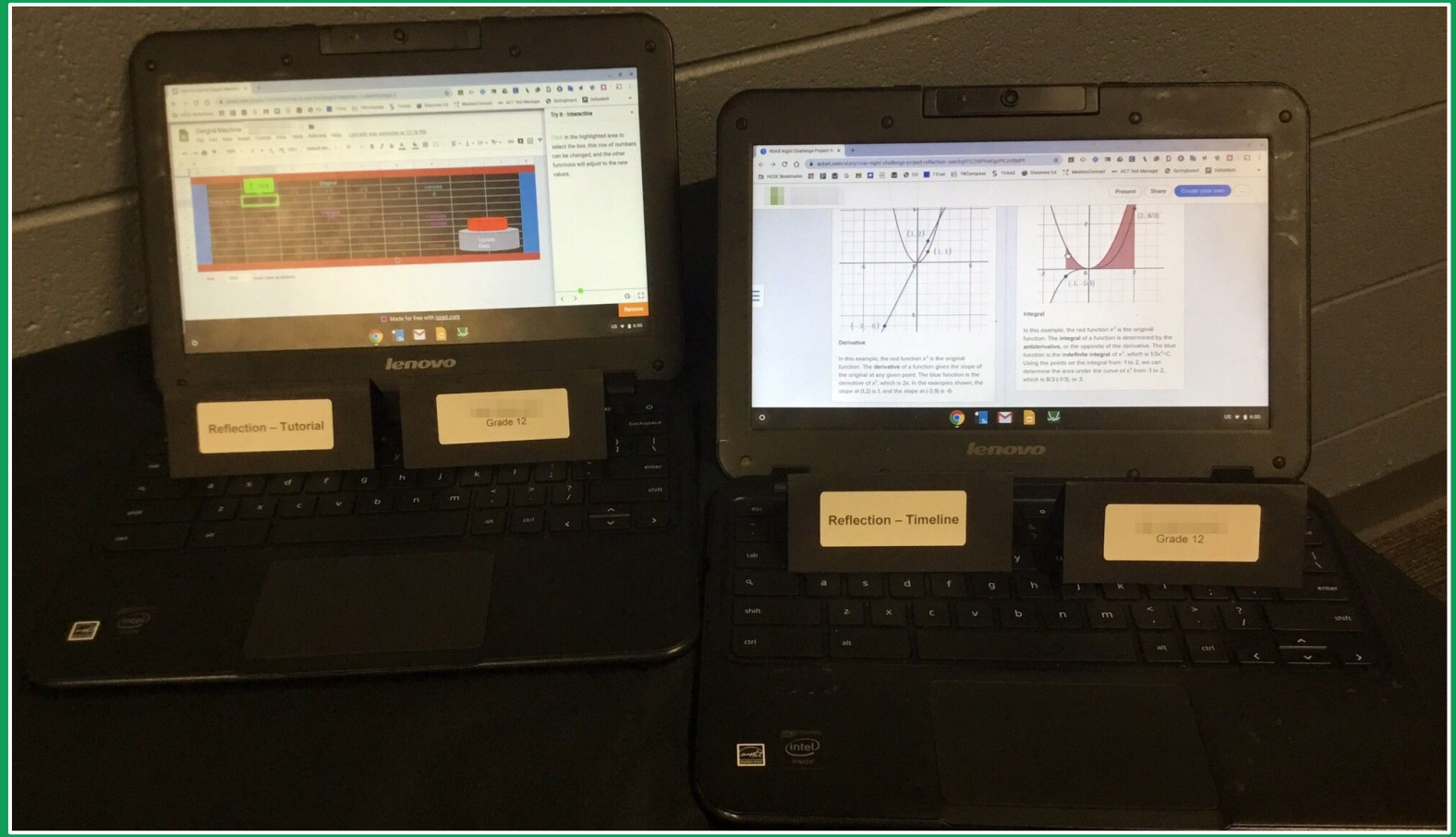
Code.gs

```
function deriveAndIntegrate() {
  var sheet = SpreadsheetApp.getActiveSpreadsheet()
  var n5 = sheet.getRange('E4').getValue()
  var n4 = sheet.getRange('F4').getValue()
  var n3 = sheet.getRange('G4').getValue()
  var n2 = sheet.getRange('H4').getValue()
  var n1 = sheet.getRange('I4').getValue()
  var nc = sheet.getRange('J4').getValue()

  sheet.getRange('F5').setValue(n5*5)
  sheet.getRange('G5').setValue(n4*4)
  sheet.getRange('H5').setValue(n3*3)
  sheet.getRange('I5').setValue(n2*2)
  sheet.getRange('J5').setValue(n1)

  sheet.getRange('D6').setValue(n5/6)
  sheet.getRange('E6').setValue(n4/5)
  sheet.getRange('F6').setValue(n3/4)
  sheet.getRange('G6').setValue(n2/3)
  sheet.getRange('H6').setValue(n1/2)
  sheet.getRange('I6').setValue(nc)
}
```

# Additional Pictures of Student Work, Fall 2019



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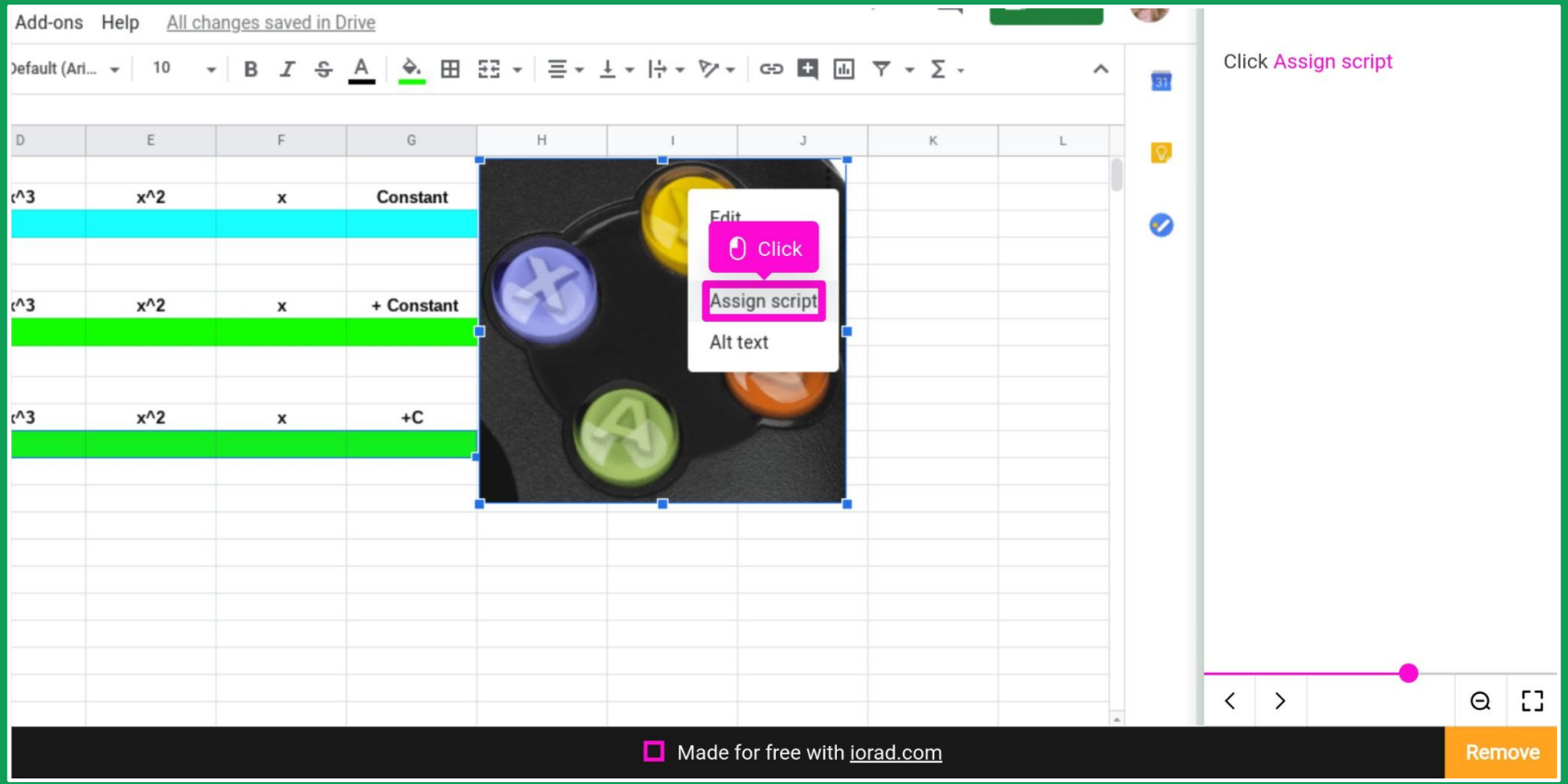
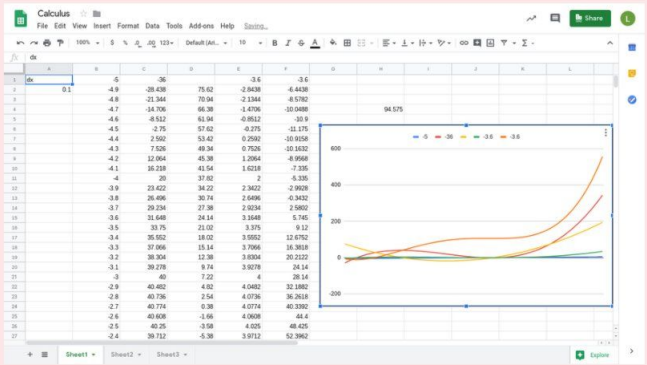


# Additional Pictures of Student Work, Fall 2019

This is how I created a spreadsheet and computer code to produce the integral and derivative of a function.

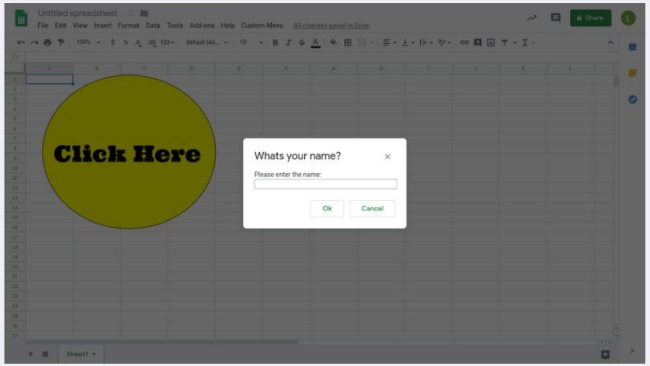



The information was typed to create a basic integral and derivative graph. This was the basic intro to creating something within spreadsheets.

Step 3: Use Google Apps Script in Google Sheets to create a button, text box, and evaluate a polynomial

Step 1: Graph the derivative and integral approximation of a function using Google Sheets.

Step 2: Introduction to Google Apps Script with basic code and brainstorm program setup.



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#NCTMDC23

# Thank You!

## Any questions?

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