Function Art

Unleash Your Inner Artsy

Greater Edmonton Teachers' Convention

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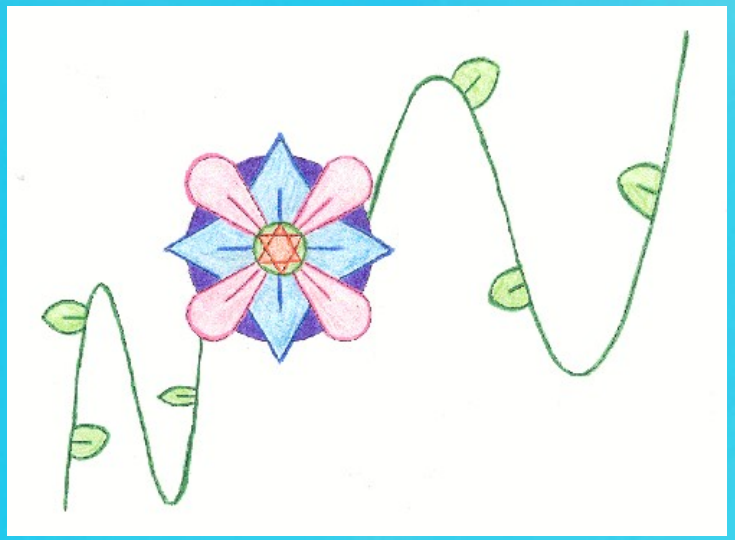
Pictures with Math?

Oh – you mean using the TI-83+

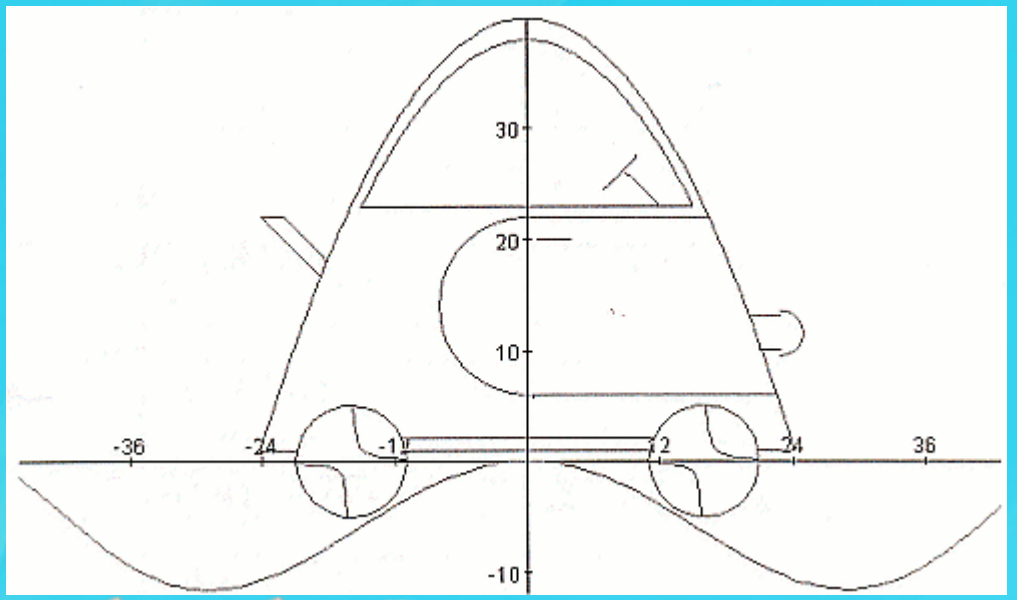
- Free software
  - Higher resolution
  - Faster
  - Up to 100 functions
- Let's see some student work...

Year 1: No Exemplars Given

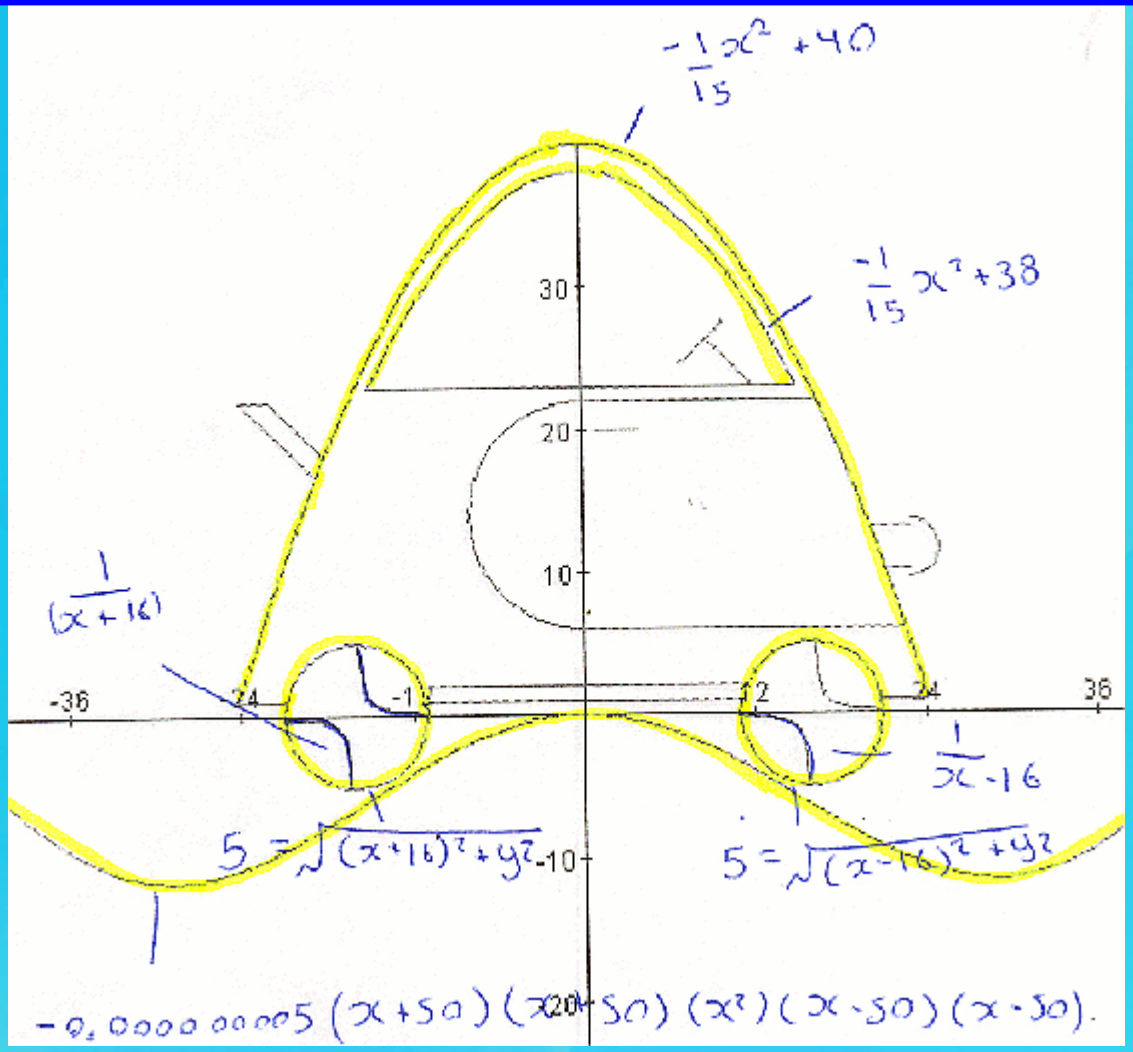
- 65 Functions



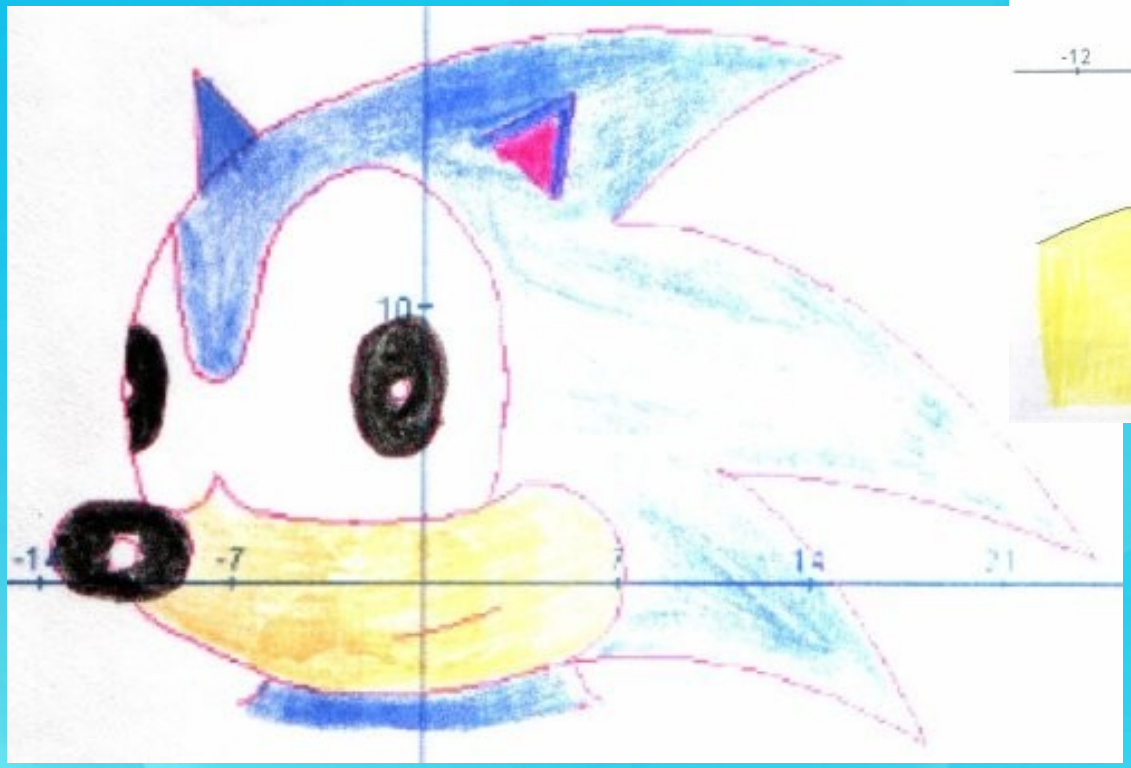
- 30 Functions

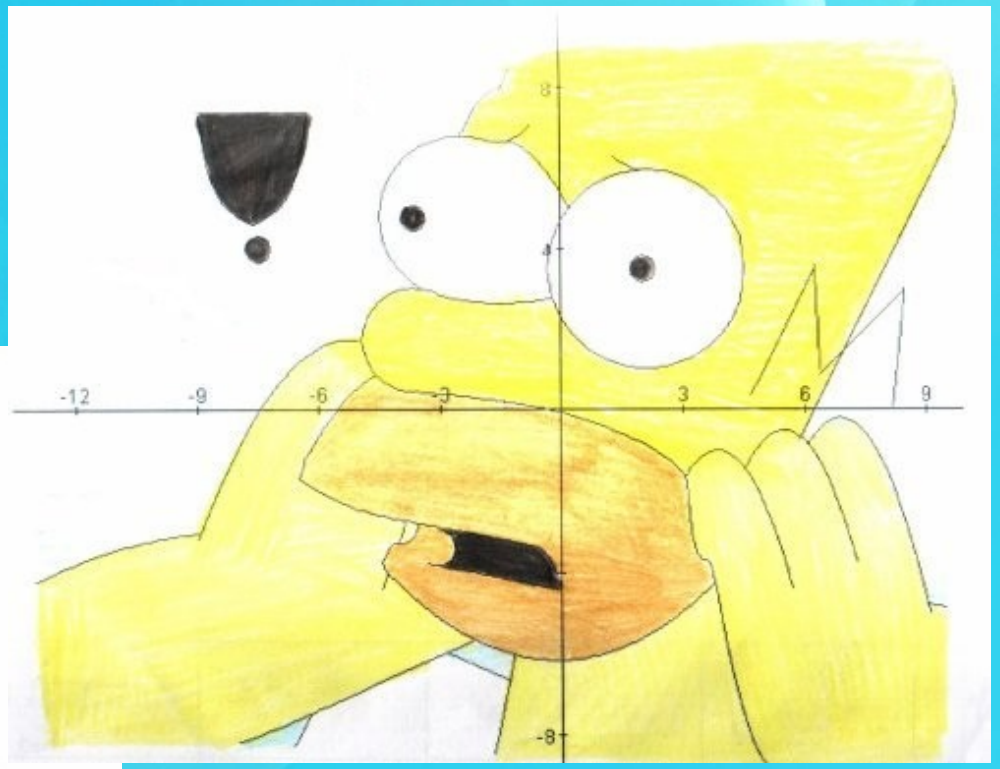


Year 1: Annotation Required



Year 2: Exemplars Given





Today's Plan

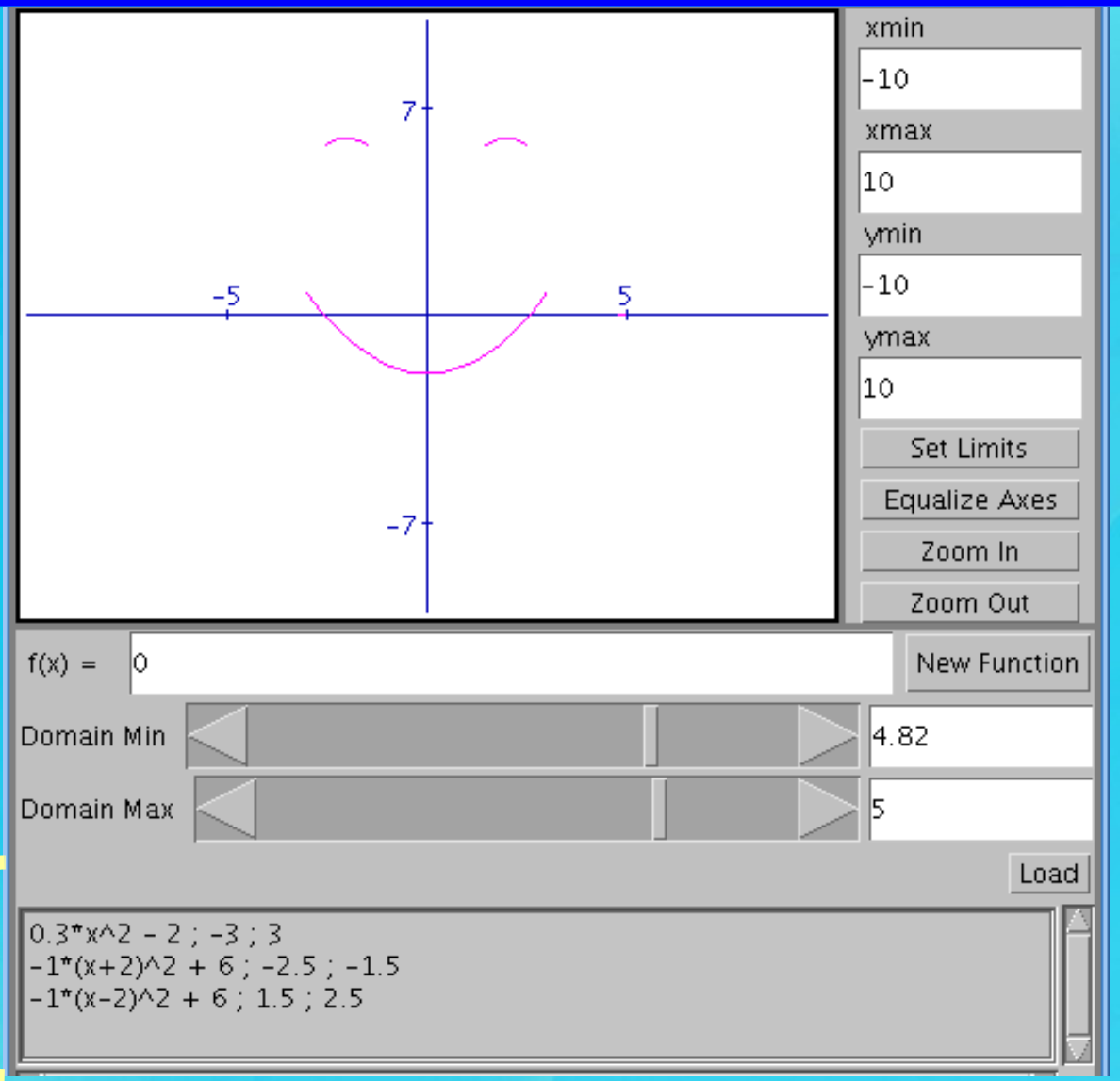
- Project History
- Using the Program (Demo)
- Typical Student Progression
- **Play Time – Part 1 (Tutorial)**
- Creating a Meaningful Project
- Sample Projects
- Credits
- **Play Time – Part 2**

Project History

- Wanted to use pictures / art as a way to review Pure 20
- Unsuccessful search for free software where user can specify domain to plot (2003)
- Modified an existing suite of software to allow domain limiting:

Java Components for Mathematics
David Eck
Hobart and William Smith Colleges
http://math.hws.edu/javamath/

The Result

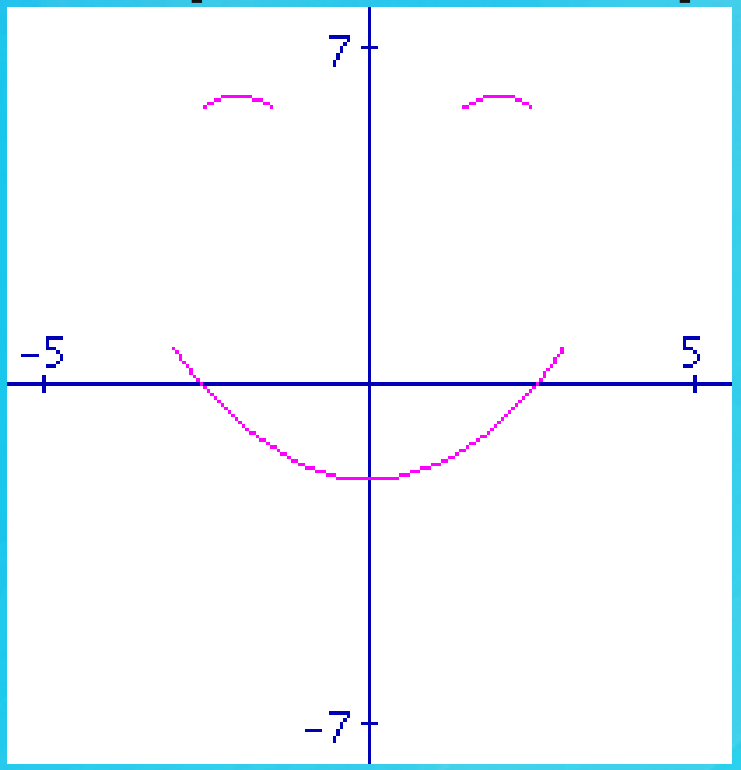


Window Settings

Individual Function

List of functions, with limited domains

A Simple Example




```
0.3*x^2 - 2 ; -3 ; 3

-1*(x+2)^2 + 6 ; -2.5 ; -1.5

-1*(x-2)^2 + 6 ; 1.5 ; 2.5
```

A Brief Diversion

Calculator (TI)

- All students have one
- No internet required
- Increases familiarity with calculator

Function Art

- Up to 100 Functions
- Can be saved
- Higher resolution
- Instantaneous
- Verifiable (Were they functions or pictures?)

Typical Progression

Phase 1: Cool!

- Desire to create an amazing picture

- Parameter fiddling to see graphical results, but not guided by mathematical knowledge

Typical Progression

Phase 2: More Realistic

- Goal becomes less ambitious
  - A face instead of complete person
  - A house instead of a picturesque street
- How can I create a curve like this?
  - Relating degree to graph
- Why doesn't this curve stop where I want?
  - Domain

Typical Progression

Phase 3: Mathematical Thinking

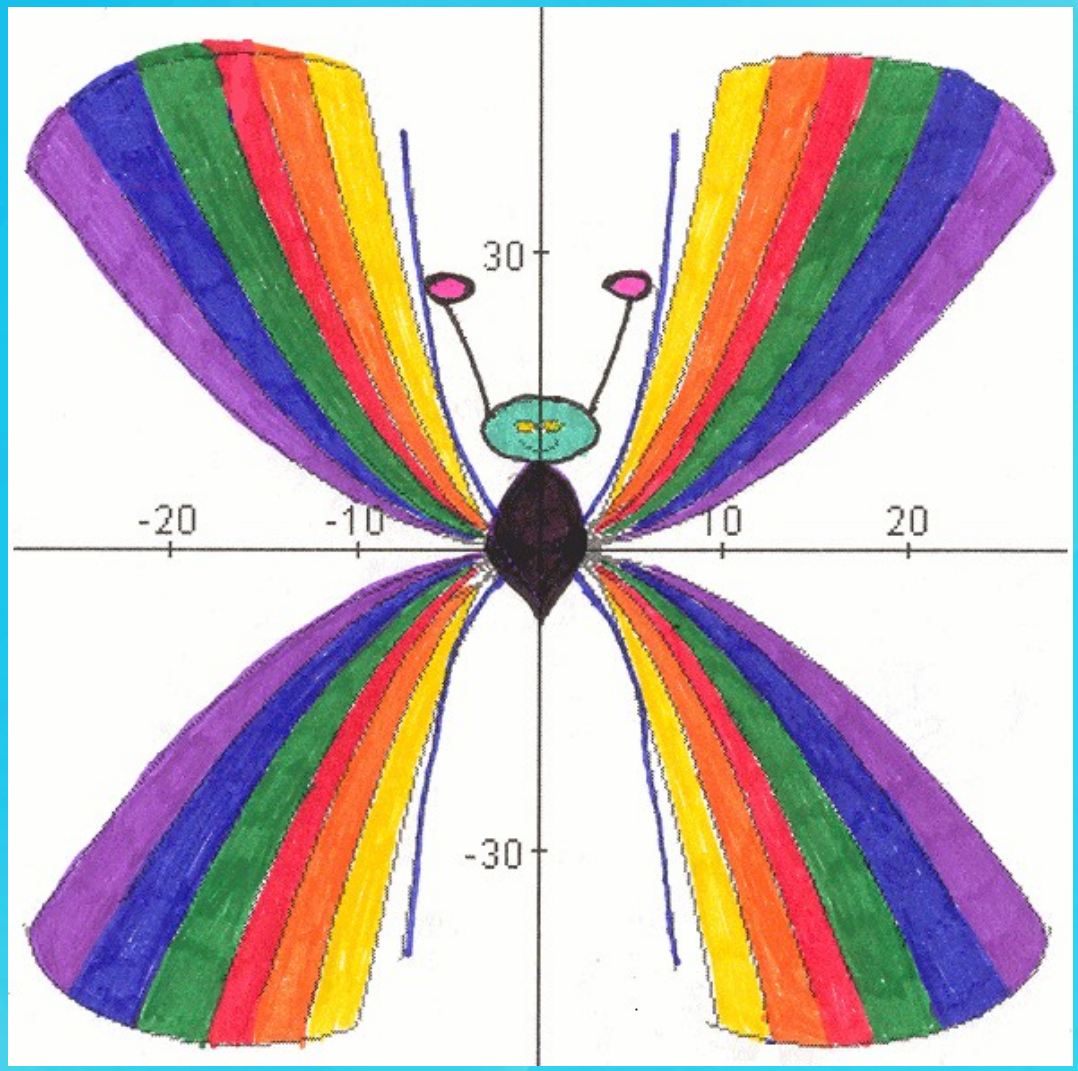
- How do I move / transform this line, parabola, cubic, asymptote...?
  - Completing the square
  - Relationships between algebraic and graphical features:
    - $y = mx + b$
    - $y = a(x – p)^2 + q$
    - $(x – h)^2 + (y – k)^2 = r^2$
    - Zeros and x-intercepts
    - Non-Permissible Values
- How do I enter the equation for a circle?
  - Functions vs. Relations

Play Time1

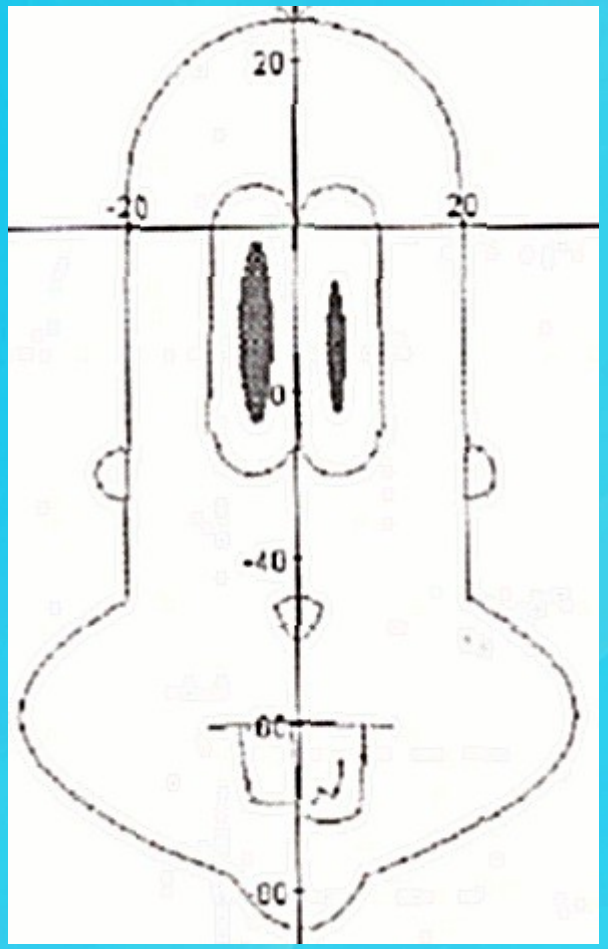
Part 1: Tutorial

- Open the file index.html in the function-art folder
- Click “this tutorial” link

Perseverance



Engagement



Interest

- “This is the best math assignment ever!”

Creating a Meaningful Project

- Specify families of curves that must be used
  - linear, quadratic, cubic, sinusoidal, ...
- Require an algebraic analysis of required components
  - zeros, asymptotes, axis of symmetry, period...
- Create equivalent forms
  - standard and slope-intercept forms
  - completing the square
  - conic standard and general forms

Creating a Meaningful Project: Part 2

- Walk through a simple example
- Provide templates to organize required calculations
- Require teacher approval of design
- Have students e-mail their lists of functions
  - Verification
  - Exemplars for next year
- Have students hand in 2 copies of their pictures
  - Annotated
  - Coloured

Pure 10 Sample Project

- Create a design composed of at least 12 line segments that uses all 4 quadrants
- Your design must include at least:
  - 2 horizontal line segments
  - 2 oblique line segments
  - 2 line segments with positive slope
  - 2 line segments with negative slope
- Convert the equations for 4 of your lines from Slope-Intercept form to Standard Form

Pure 10: Curriculum Outcomes

Relations and Functions

4.2 Use a graphing tool to draw a graph

4.5 Determine domain and range from graph

4.6 Determine intercepts, slope, domain, range from eq^{n}

Line Segments and Graphs

3.2 Solve problems involving distances between points

3.3 Solve problems involving midpoints of line segments

3.4 Solve problems involving rise, run, slope

3.5 Determine the equation of a line

3.6 Slopes of parallel, perpendicular lines

Pure 20 Sample Project

- Create a design composed of at least 12 curves or line segments that uses all 4 quadrants
- Your design must include at least:
    - 2 straight line segments
    - 2 parabolas
    - 2 cubic curves (or higher degree)
    - 1 rational function curve that has an asymptote
- Show quadratic functions in expanded and standard form
- Determine integer x-intercepts of cubic curve
- Determine asymptote(s)

Pure 20: Curriculum Outcomes

Quadratic Functions and Equations

- 2.1 Vertex, domain, range, symmetry, intercepts from graph
- 2.2 Transformations using completing the square
- 2.4 Solve quadratic equations

Polynomial / Nonlinear Functions and Equations

- 3.1 Solve nonlinear equations
- 3.4 Determine the inverse of a function
- 3.5 Analyze polynomial and rational f^{n}s

Circle and Coordinate Geometry

- 5.4 Distances between points and lines

Pure 30 Sample Project

- Create a design composed of at least 12 curves or line segments that uses all 4 quadrants
- Your design must include at least the following types of functions. For each type there must be 2 functions, where one is a transformation of the other
    - Conic, log, exponential, trigonometric
- For each transformed function, state the transformation
- For each Conic, state its equation in standard and general form

Pure 30: Curriculum Outcomes

Transformations of Functions

1.1 Translations

1.2 Stretches

1.3 Reflections

1.5 Combinations of transformations

Trigonometry

3.8 and 3.9: Amplitude, period, domain, range, asymptotes, transformations

Conic Sections

4.3 Convert between general,standard form

Credits

- All of my students
  - Highwood High School (2003 / 2004)
  - Lester B. Pearson High School (2004 / 2005)
  - Ross Sheppard High School (2006 / 2007)
- Lester B. Pearson Math Department
- David Eck at Hobart and William Smith Colleges (original Java software)

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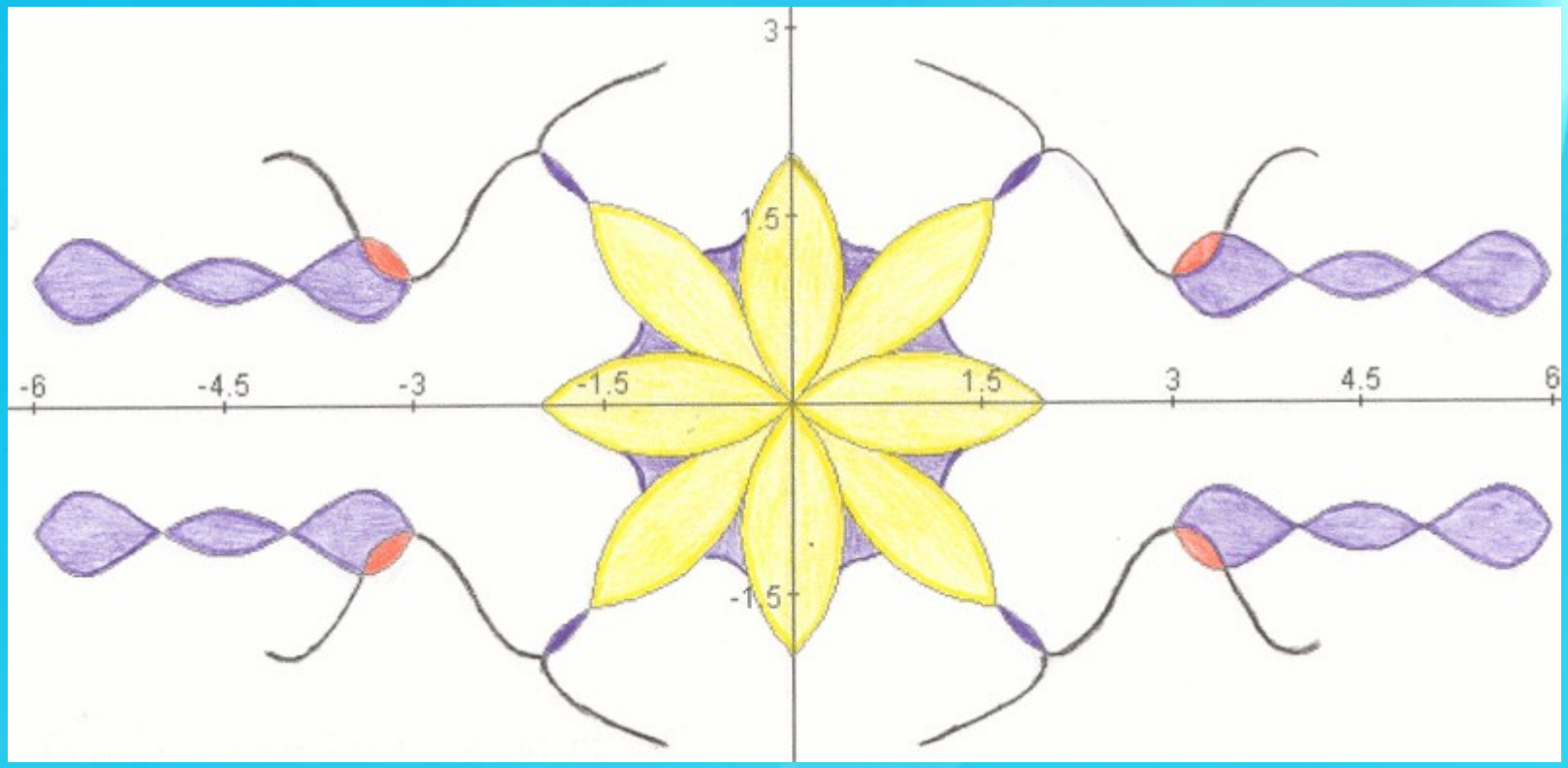

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