Making Math Stick:

Teaching Through Project Based Learning

Sarah Clements, 5th grade, Peter Howell Elementary School, Tucson Unified School District

Stephanie Greene-Hunley, 4th grade, Peter Howell Elementary School, Tucson Unified School District

Michelle Hine, Program in Applied Mathematics, University of Arizona

Project Based Learning

- Student-driven inquiry-based learning
- Integrating the curriculum
  - Science, math, reading, writing, social sciences
  - Visual and performing arts
  - STEAM (STEM plus Arts)
- Addresses real-world problems or situations
  - Original Soda Flavors
  - Fourth Grade Design Project
  - Stock Market Project

Strengths of Project Based Learning

- Teacher/Fellow:
  - Provides an effective framework for collaboration
  - Allows educators and scientists to use their particular expertise in creative ways
- Students:
  - Higher level of engagement
  - High order thinking skills
  - Provides authentic learning experiences

Original Soda Flavors

- Math, science, persuasive writing, visual and performing arts
  - Fractions and proportional reasoning
  - Mixtures and solutions
  - Creating scripts and jingles for 30 second commercials to sell a product
  - Package design

Phase I: Brainstorming

- Students assigned to teams of 3
- Students came up with list of flavors they want to use
- Strawberry-kiwi, watermelon, lemon, chocolate, chipotle, lime, caramel-apple, cherry, coconut, pickle juice, and bacon.

Phase II: Practice Makes Perfect

- Practice measurement using tools and materials
  - Dry and liquid ingredients
  - Math: Proportions of flavor to the whole
  - Good scientific note taking skills: recording tries, writing down amounts used (mL)

Phase III: Test Kitchen

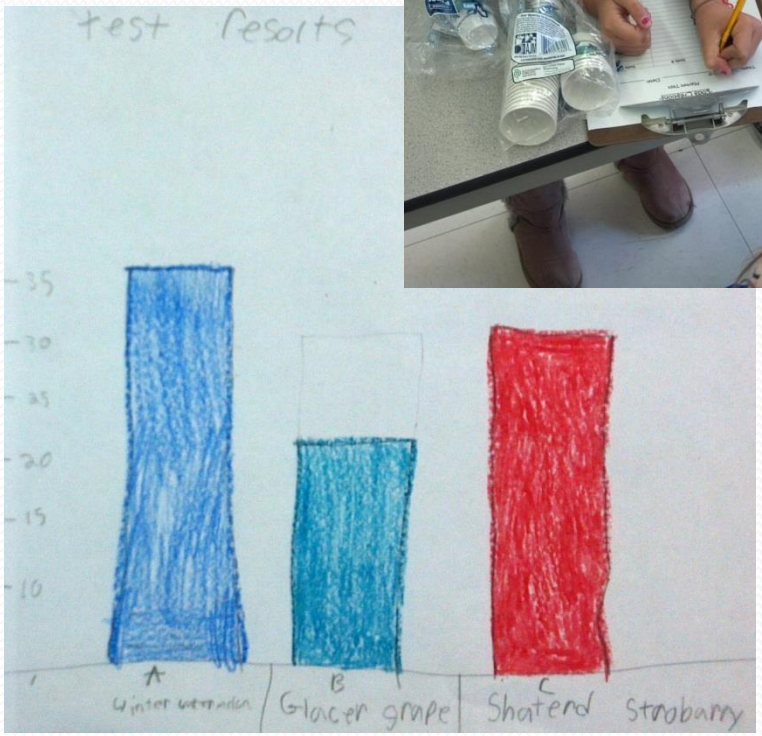
- Teams brainstorm a recipe using up to 4 flavorings and 250 mL of liquid
- Student recipes
  - Pickle juice-vanilla
  - Vanilla-chocolate
  - Bacon-caramel apple (tastes strangely like coffee)
- Teams informally test sodas on other students
- **Lesson:** Proprietary information
  - One team accuses another team of stealing their recipe; we explain that the proportions of ingredients make up the formula just as much as the list of ingredients

Phase IV: Market Testing

- Students double recipes to make 500 mL of soda for testing
- **Lesson:** Sugar was measured not measured in mL, but in cups or tablespoons, and they are not the same!

Phase IV: Market Testing

- Students make up all three recipes, then test their soda flavors on third, fourth, and fifth graders during lunch.
- Based on the data, students select the winning recipe.
- **Lesson:** Dealing with real-world data to make decisions



Phase V: Mass Marketing

- Packaging, commercials, jingles

Fourth Grade Design Project

- Give students freedom in how they approach a real-world situation
- Integrate math, art, statistics, and social sciences
- Interview an expert
- Survey other students
- Interpret and make decisions from data
- Present results

Project Options

- Design a new playground
- Design a new school meal
- Choose a new animal for Reid Park Zoo and design an enclosure

REID PARK ZOO

Online Research & Standards

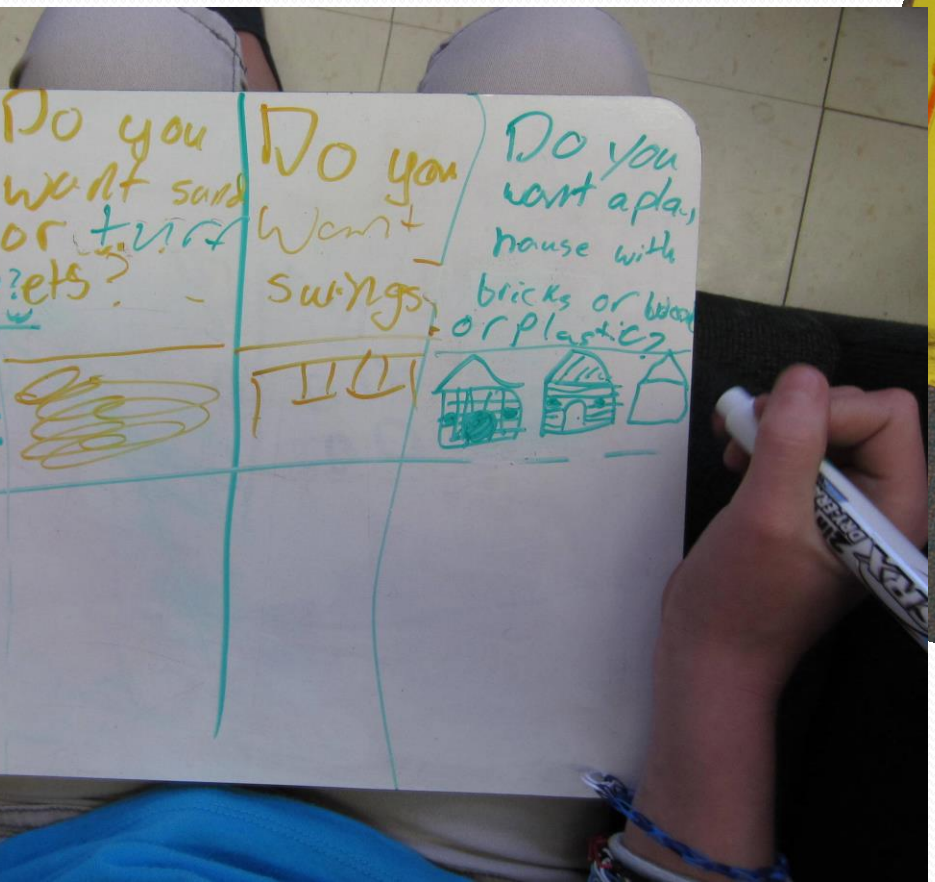
- Defining a research question
- Keywords, search engines
  - Price of food
  - Price of playground equipment
  - Animals currently at the zoo
- Playground safety standards
- USDA school meal standards
- Animal food/enclosure requirements

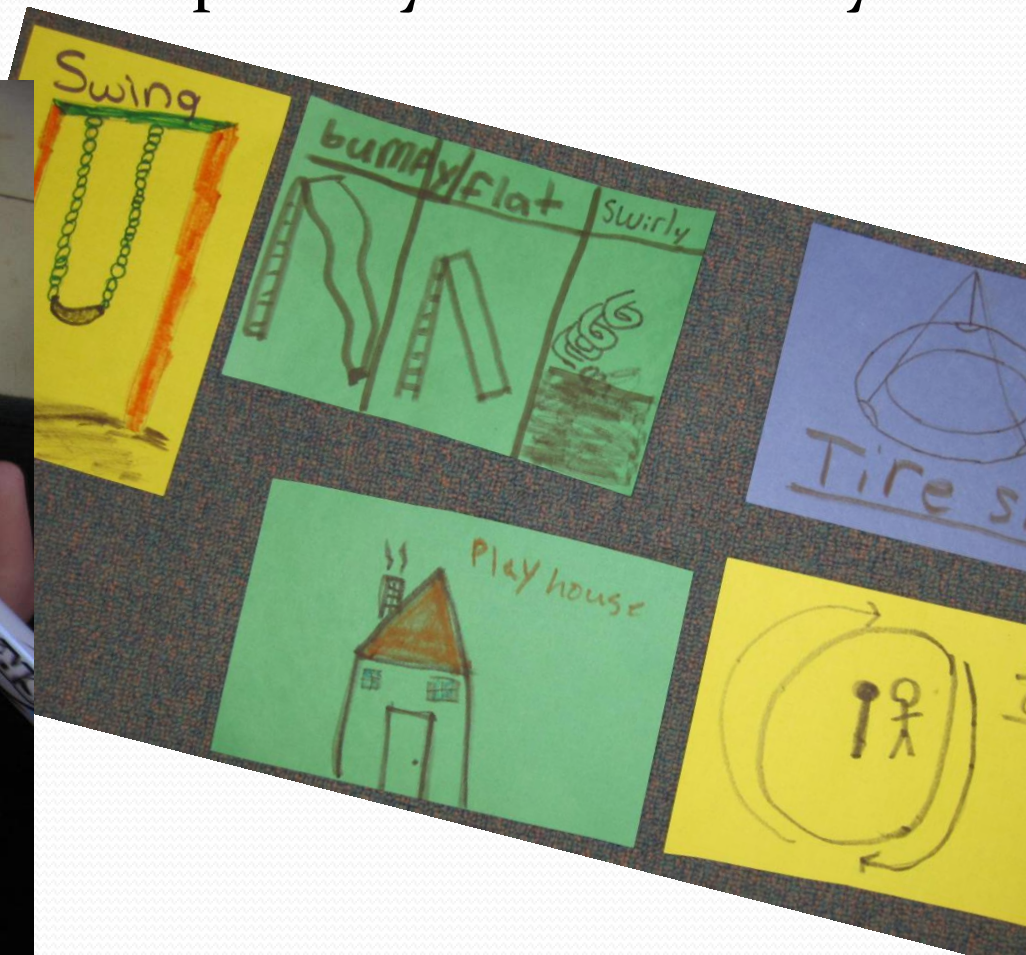
Interview an Expert

- Students develop questions
- Open vs. closed questions
- Professional interview behavior

Survey Other Students

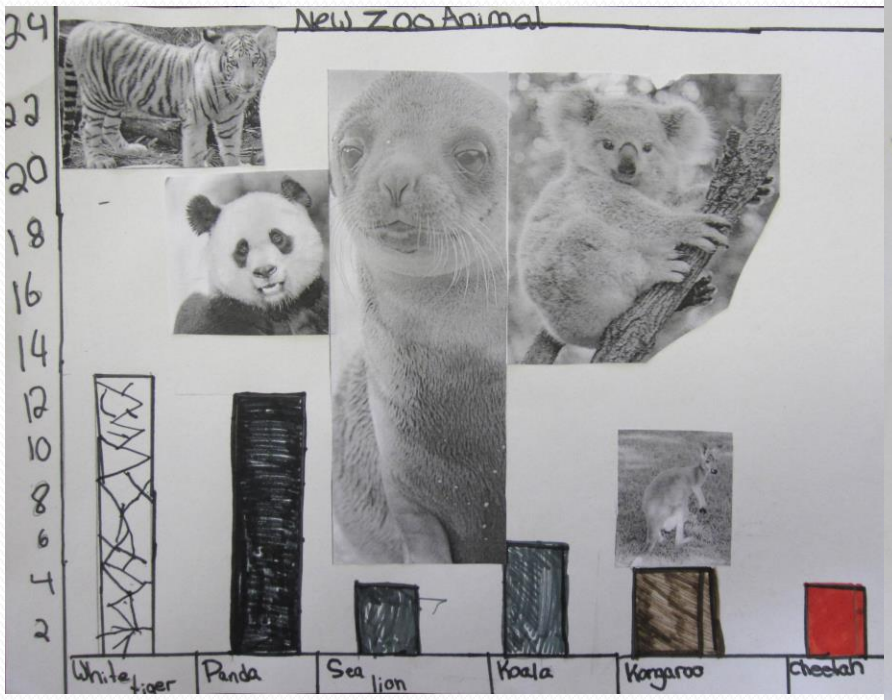
- Plan appropriate questions for primary and secondary

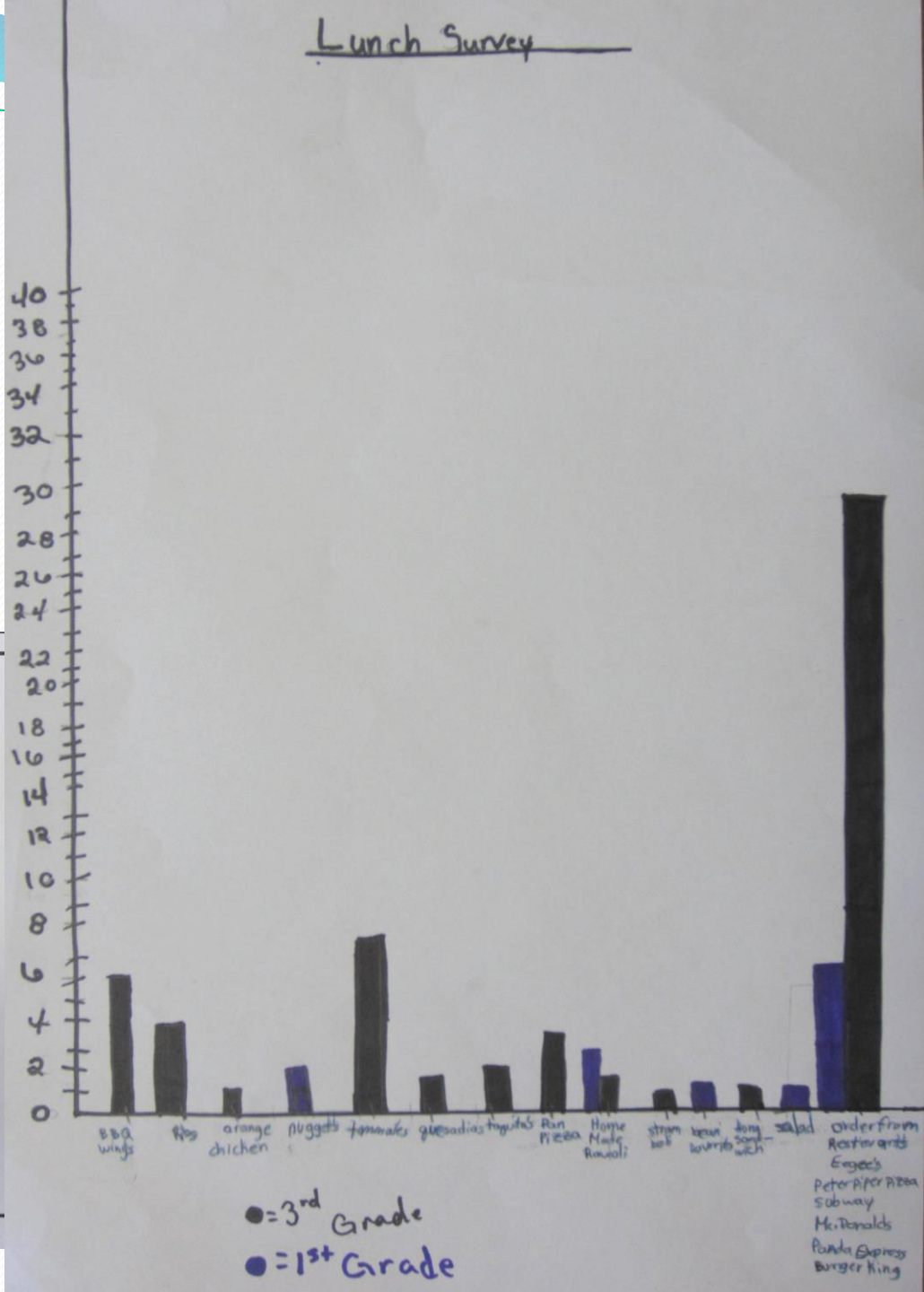




Interpreting Data

- Survey multiple classes
  - 1 primary
  - 1 intermediate

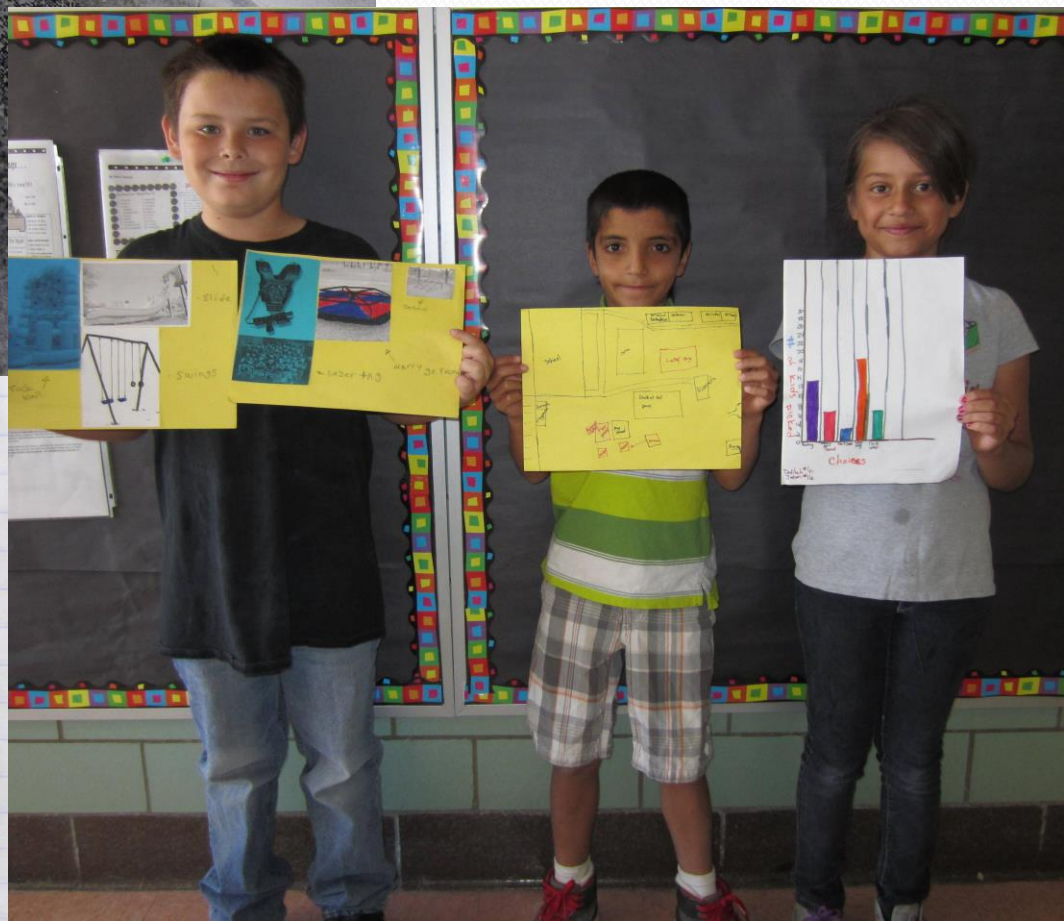




First, we printed pictures of a wolf, panda, gorilla, Piranha, kangaroo, and a koala. Second, we surveyed Mrs. Fox's class, and mrs. Selby's class. Third, we made visual represention of our results. Fourth, we picked the wolf. Enclosure is 5,000 feet of space. And that will cost to be buy 5,000 is 25,000 Dollars. And the food is 10,000 Dollars a year, So thats 30,00 Dollars a Day.

Final Projects

Today we were interviewing the lunch ladies and we asked them what did they think about eating outside, and they said "they think it would be nice eating out side on a sunny day". Then we asked what did they think about eating out and they said, having it once a week. Next, we asked what did they think having our own oppinions about our food. Finally, we asked what



Students Say…

- "I liked how we had team work and we had to survie the 2nd graders and kinders. I learned that you had to have safty for the kids won't get hurt well if you were working on playground Having team work was fun. We had to come up with hard questions for Mr. O. We had help from Ms. Hine and Mrs. Hunley. [sic]"

- "I liked that we got to interveiw people and think and draw and color our graph's some things I learned was that it's really not that cheep to pay for food for each kid in this school it's alot of money and having to go on the internet and google things. The thing that was fun is that we got to learn about thing's that we never knew of. [sic]"

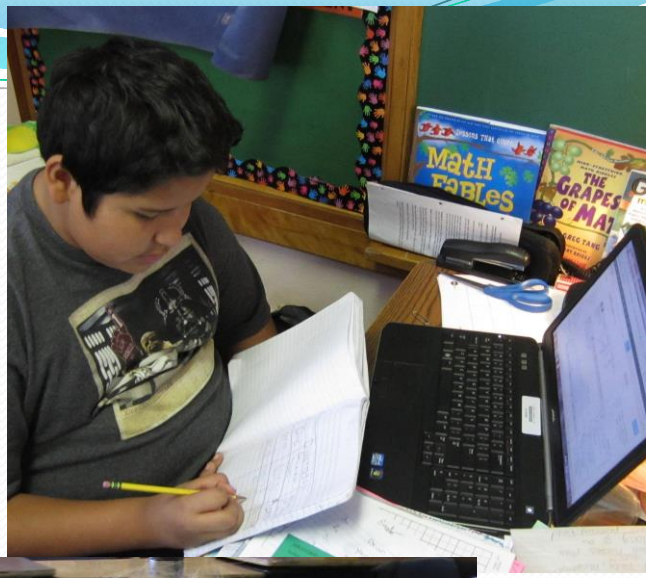
Students Say…

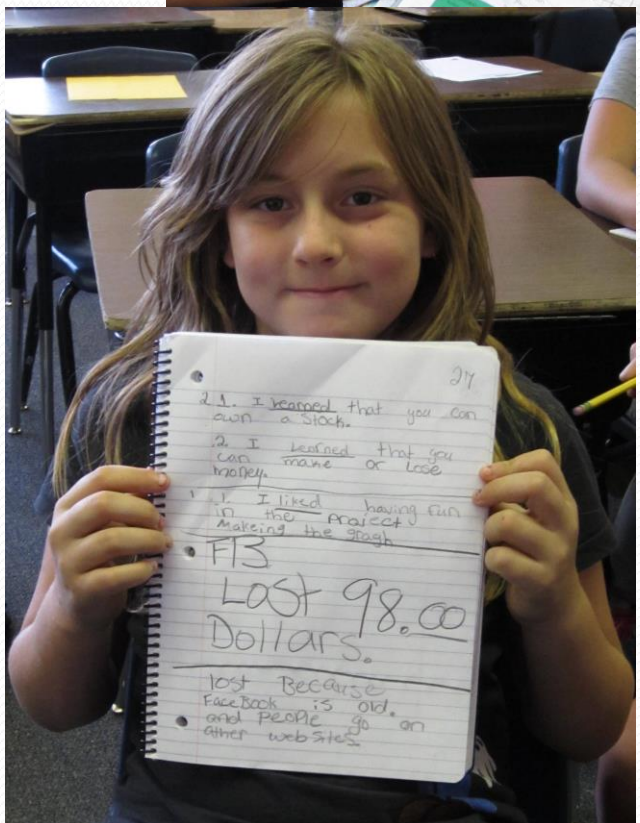
- “I Liked the way we didn’t just de sighn a playground but we found out the cost and the safety of it all. I Learned that a playground is hard work to make!! yes It was fun! It was challenging to find out How much railing cost but we finaly found a web site. [sic]”

- “What was fun is that you got to have a lot of fun waill your interviewing the classes you get to learn what the other kids like. My challanges were doing all of the math so you find out how much every thing cost. I got over my challanges with math I asked for help and if you need help with something just go to someone that can help you. ☺ [sic]”

Stock Market Project

- Build financial literacy
- Showcase real-world mathematics
- Engage students in learning (money speaks!)
- Teach data analysis in context
- Link math and economics





Day 1: Introduction

- Learn about the stock market
- Class discussion
- Major concepts:
  - What are the 2 types of companies?
  - How does the stock market work?
  - Why do companies sell stock?
  - Why do people buy stock?
  - Do people always make money?

Phase I: Introduction

- The class acts out the stock market with Facebook

Phase I: Introduction

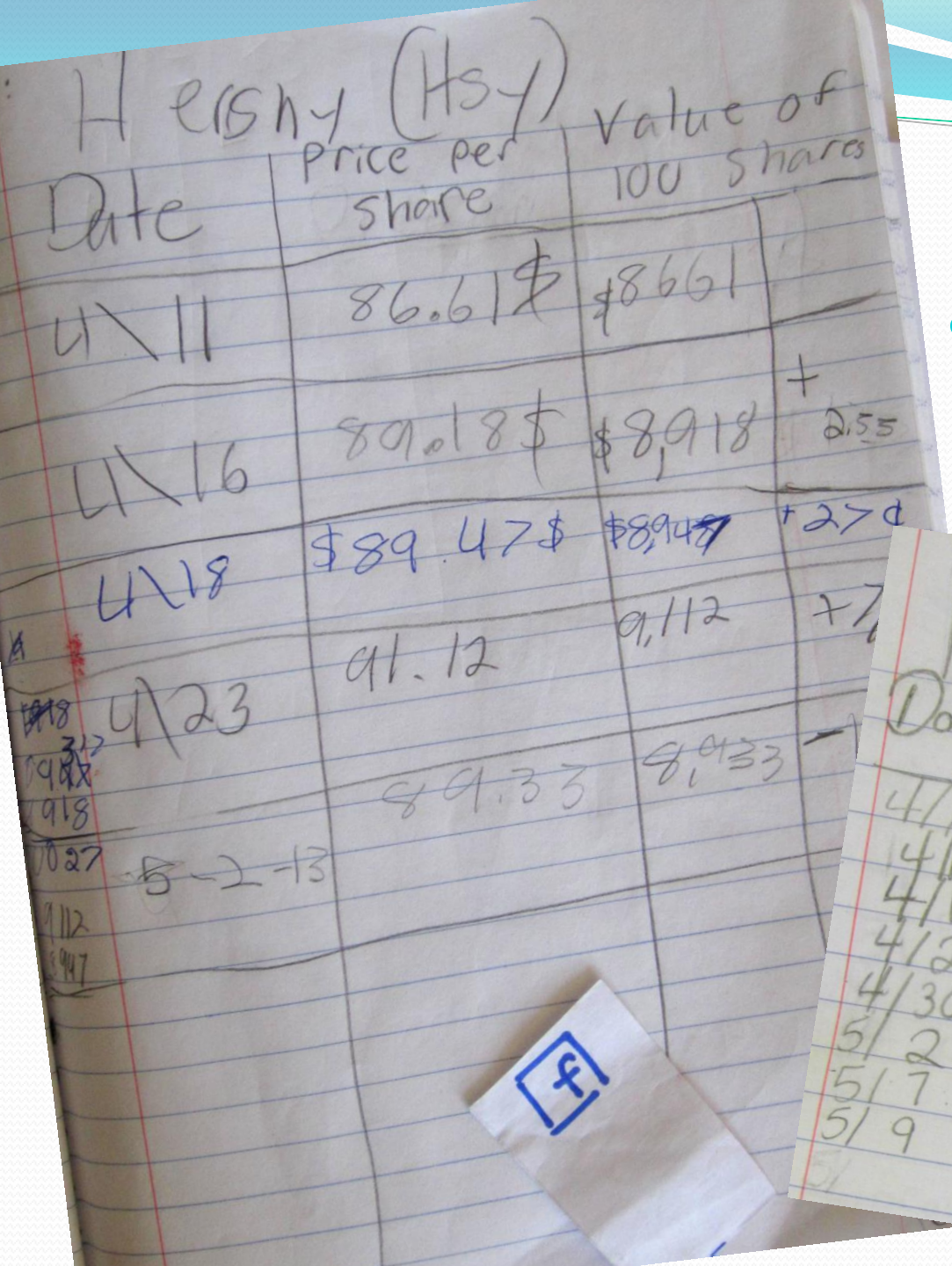
- Student groups "buy" 100 shares of stock

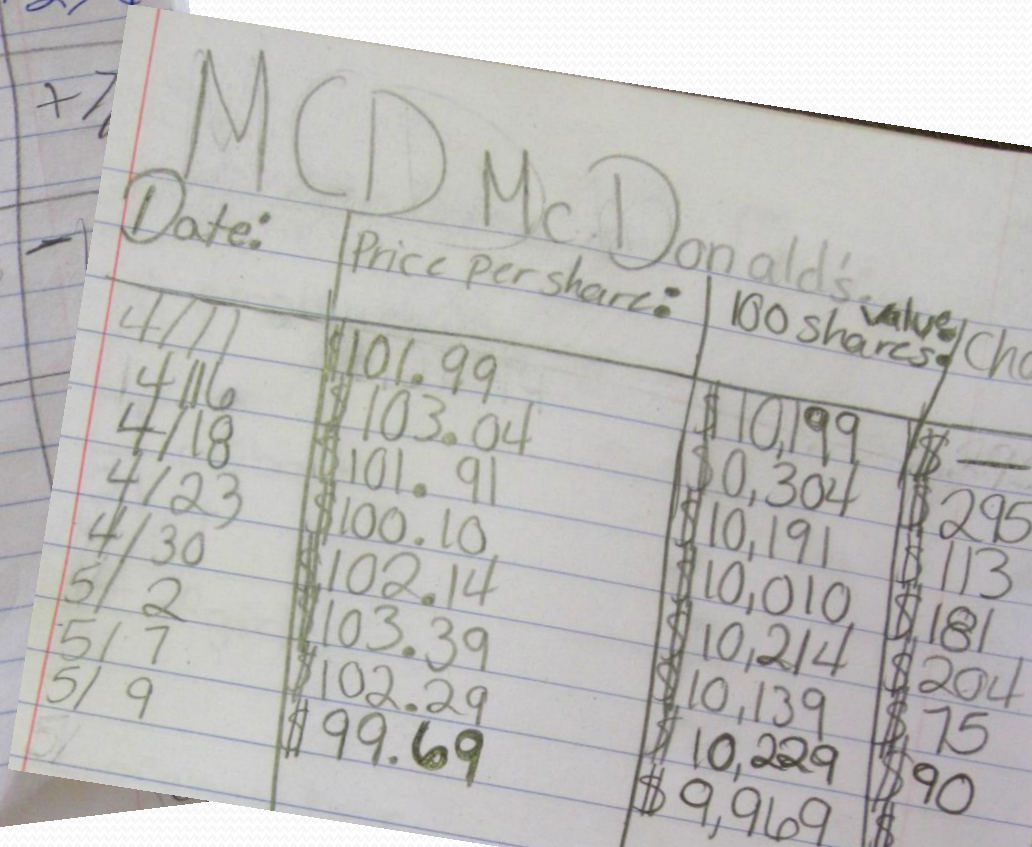
- **Lesson:** Students are picky about their stocks; they don't like McDonald's

Phase II: Tracking the Stocks

- Groups track stocks every Tuesday and Thursday via www.google.com/finance
- High student engagement
  - Values change in real time
  - Groups check multiple stocks
- **Lesson:** Students like watching the stocks change

- Students keep track of change in value of 100 shares





Phase III: Graphing Data

- Review stock market concepts
- Introduce students to graphs using their own data
- Replaced a day of math curriculum
- Concepts:
  - Label Axes
  - Numbers on Axes
  - Title

google find macks

Stock Apple (AAPL)

Date	Prize per share	100 value shares	Change
4/11	$434.33	$43433	
4/16	$426.24	$42624	- 809
4/18	$392.05	$39205	- 3419
4/23	$402.90	$40290	+ 1085
4/30	442.78	44278	+ 4398
5/2	446.88	44688	+ 410
5/7	$458.68	$45,868	
5/9	456.77	456 77	

40290 − 39205 = 1085

44688 − 44278 = 410

43433 − 42624 = 0809

40290 − 44278 = 012

42624 − 39205 = 03419

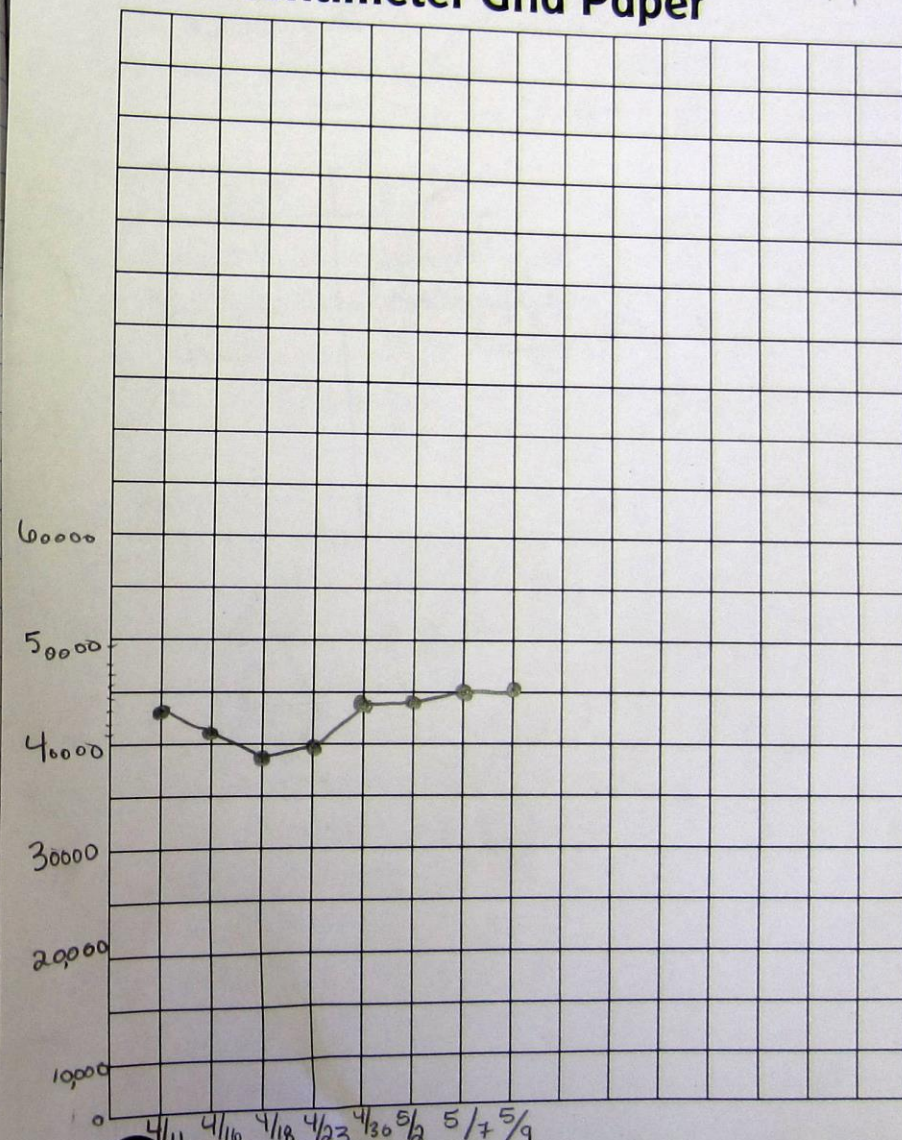
44688 − 40290 = 4398

Name Date

Factors, Multiples, and Arrays

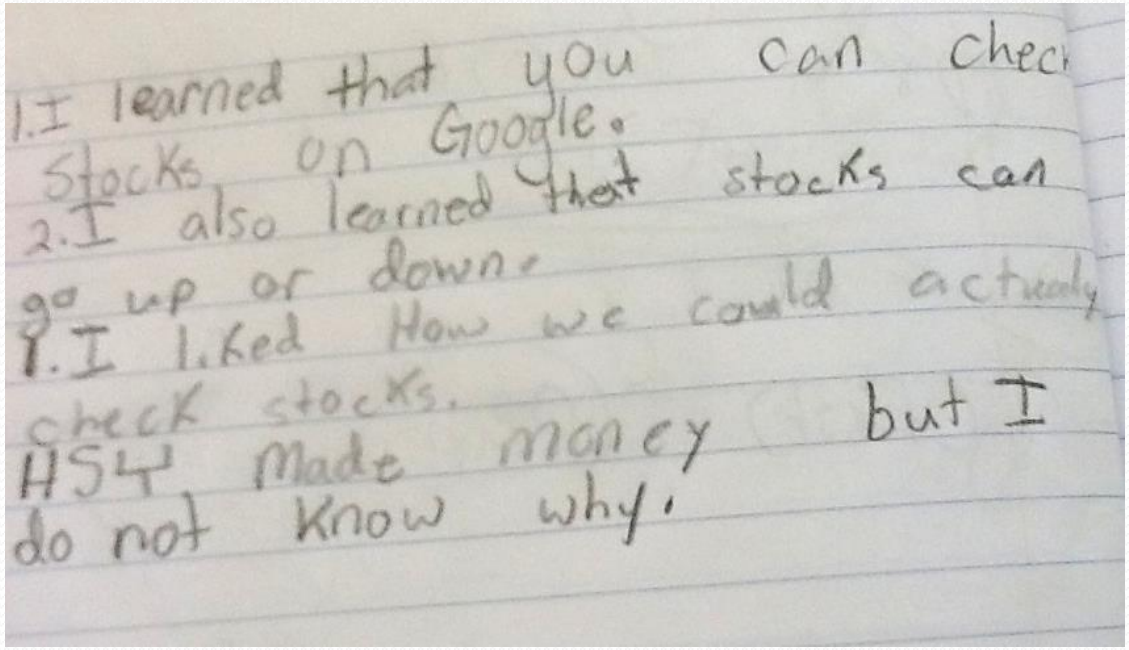
Stock market graphs Awsome Apple

One-Centimeter Grid Paper



Phase IV: Results

- Calculate final profit/loss
  - Apple $2,244
  - Disney $612
  - Hershey $114
  - Coca Cola $103
  - Facebook -$98
  - McDonald's -$230



- Who won?
  Why did some stocks gain value while others lost value?

1. I learned that you can own a stock
2. I learned that you can make money or lose money

I did not like anything.

FB 98.00

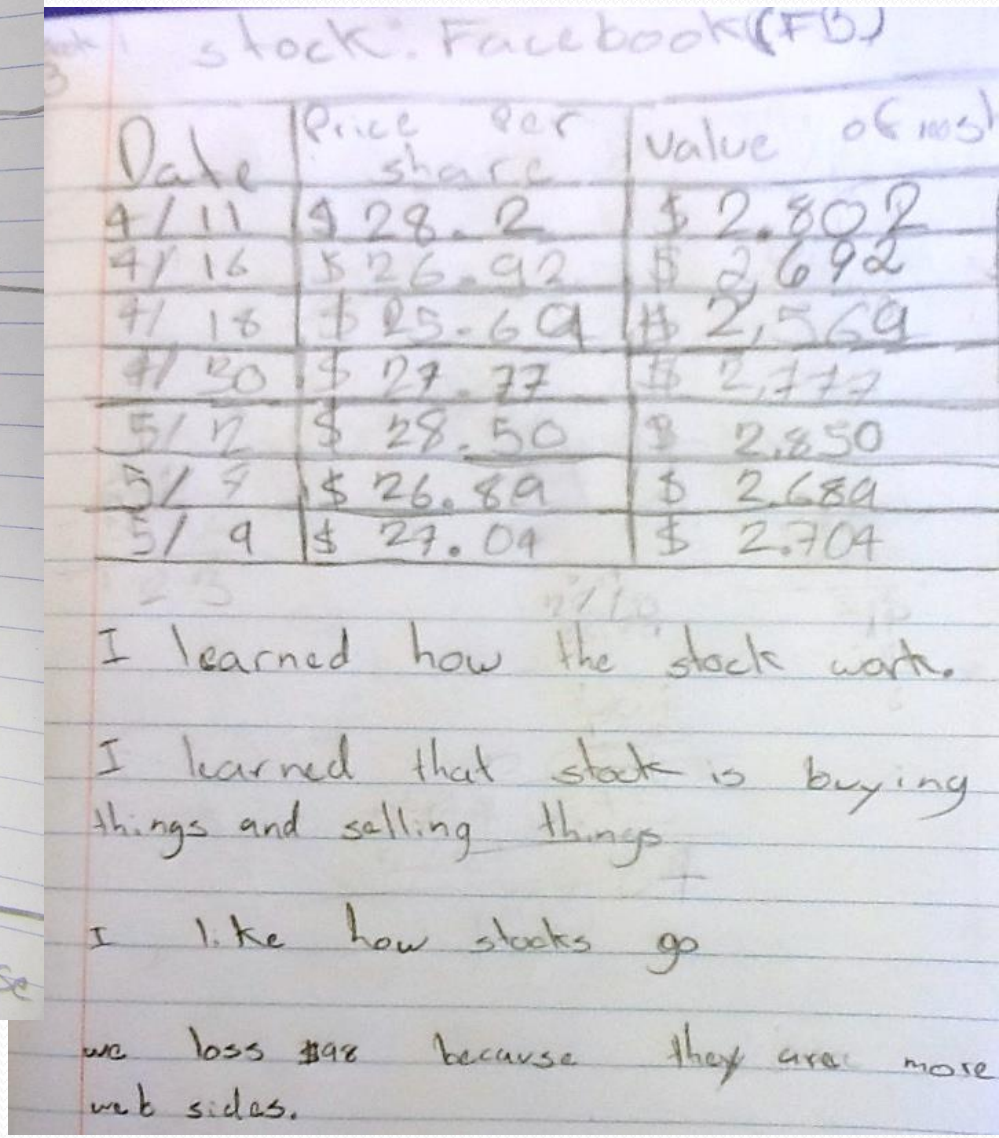
LOST

Dollars.

we lost money because it was old

Low writer

ELL student



Outcomes

- 100% engagement
- Students working productively in teams
- Develop research skills
- Students see authentic application and connection between the arts, literacy, math, science, and economics
- Create visual representations of data
- Interpret and make decisions based on real-world data
- Integrated teaching, rather than distinct strands
- Organic learning experience

Resources

Michelle: mhine@email.arizona.edu

Stephanie: stephanie.greene-hunley@tusd1.org

Resources available online

http://math.arizona.edu/~mhine/gteams.html