Subject/Topic: Science/ Density

- Grades: 8
- Duration: 8 days
- Rationale: Project Based Learning
- Objective: Learn the principles of density, how to manipulate it and graph it through the process of engineering a toy product while marketing it to a target audience.

FLINKER!™

https://www.youtube.com/watch?v=TkuJd-rhXHQ

A DENSITY TOY PROJECT

https://www.youtube.com/watch?v=uZTQAtvGUIY

https://www.youtube.com/watch?v=jlN2dsOZRKo

Background:

You have been hired by the toy company "Kablooey!" to create the next hit water toy. The concept is a toy that can adjust its density to float, sink, and "flink!" (neutrally buoyant). How you adjust this is up to you. Once created, we will have a trade show to showcase & evaluate your product. Then you will be filming a commercial for your product highlighting it's features.

Your prototype will be graded on:

- *FUNCTION* (it can affectively float, sink & possibly "flink")
- *SAFETY* (NO choking hazards, sharp points or edges)
- *EASY OF USAGE* (how easy is it to adjust the density)
- *APPEARANCE* (looks cute/cool/fun/appealing to kids)
- *FUN FACTOR* (it is fun to play with)
- *DURABILITY* (it can be handled without breaking)
- *COST ANALYSIS* (how much will it cost to make)

TIMELINE

DAY	IN-CLASS OBJECTIVE	HOMEWORK
DAY 1 (WED)	Introduce Project; Begin Design	Finalize and choose design
DAY 2 (THUR)	Day 1 of 2 for prototype construction	Buy any additional supplies & keep receipt
DAY 3 (FRI)	Day 2 of 2 for prototype construction	Finish prototype
DAY 4 (MON)	Test Max & Min Density; Graph data & put together cost analysis	Finish Cost analysis & graph for tomorrow
DAY 5 (TUES)	Trade show presentation Day & Peer product Review	Complete Story Board for 30 second commercial
DAY 6 (WED)	Day 1 of 2 for commercial film & edit	If possible, edit commercial
DAY 7 (THUR)	Day 2 of 2 for commercial film & edit	Finish commercial video
DAY 8 (FRI)	Commercial Presentation Day	None

DAY 1: DESIGN (research)

In each section, draw a possible way to build your toy. Label materials and make notes about your design.
Remember: your design should allow your toy to be "adjusted" so that it can sink, float, & "flink."

Design 1

Design 2

Design 3

Design 4

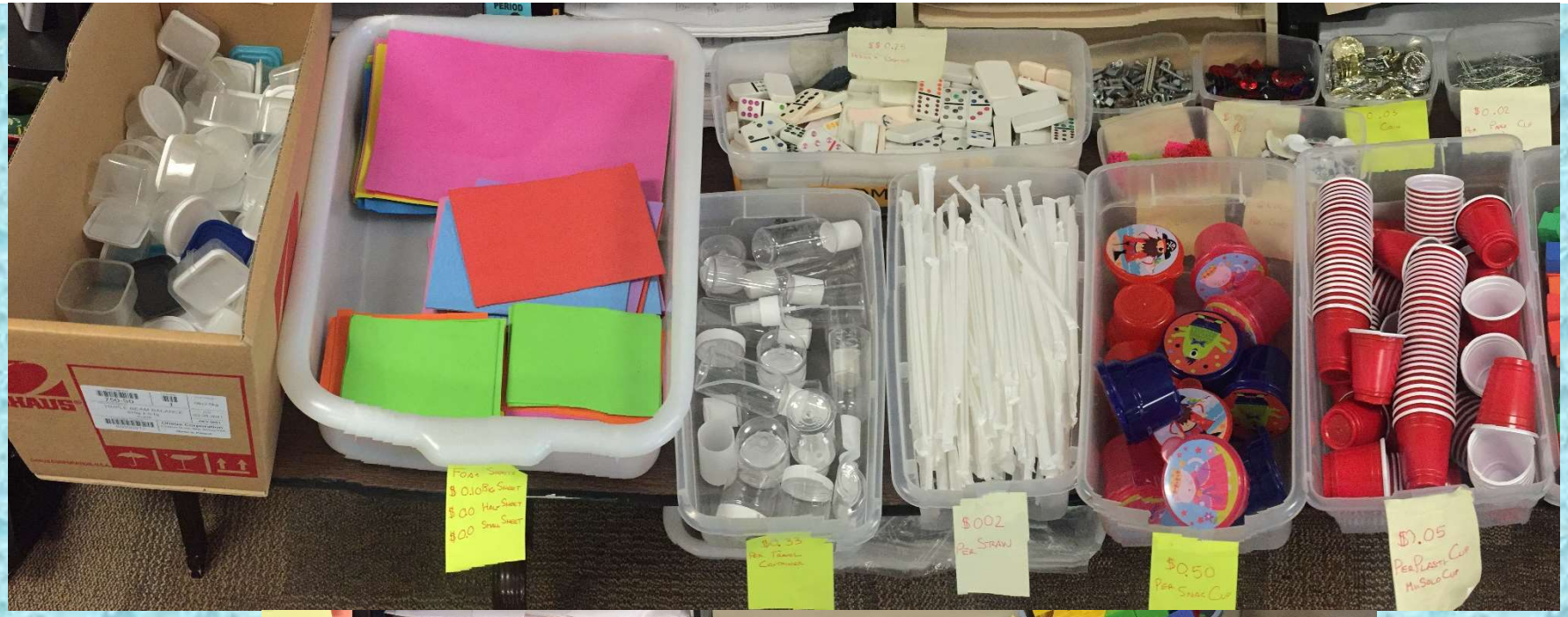
My name is: _____ Partner's name:_____

My email or phone: _____ Partner's: _____

For Day 2 build we choose Design #: _____

PARTNERS: TAKE A PICTURE OF BOTH SIDES OF THIS PAPER AT THE END OF THE PERIOD !


UNDER CONSTRUCTION
CONSTRUCTION ZONE
DAY 2 & 3
PROTOTYPE
CONSTRUCTION
AVAILABLE MATERIALS:

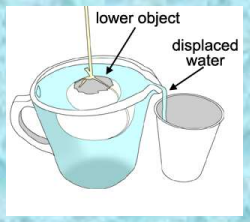

Foam Sheets
$0.10 Big Sheet
$.00 Half Sheet
$0.0 Small Sheet
$0.002 Per Straw
$0.50 Per Snack Cup
$0.05 Per Plastic Cup Mr Solo Cup


$0.01
$0.05
$0.10
$0.13
$0.14

DAY 4: FINDING MAX & MIN DENSITIES OF YOUR TOY

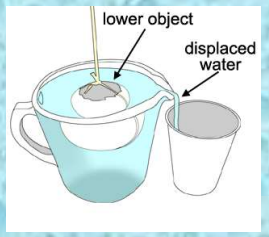
- First adjust your toy for its minimum density (take off weight, squeeze out water, add floatation, etc.)

- Find its mass using the triple beam balance and the volume using the “Archimedes method” shown on the next slide.



- Calculate the minimum density using D=M/V
- Now, adjust your toy for its MAXIMUM density (add weight, suck in water, take off floatation, etc.)

- Find its mass using the triple beam balance and the volume using the “Archimedes method” shown on the next slide.

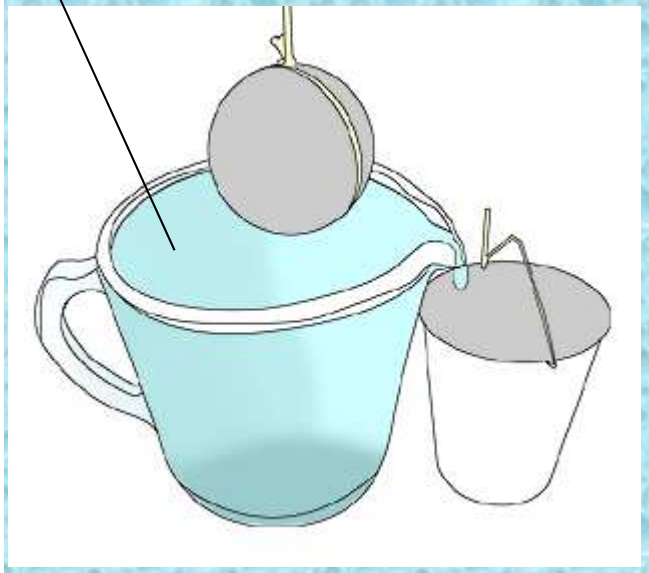


- Calculate the maximum density using D=M/V

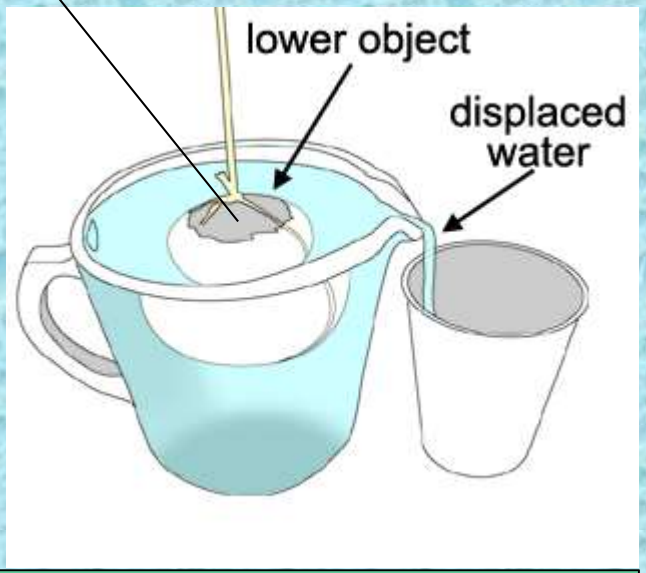
DAY 4: FINDING MAX & MIN VOLUMES OF YOUR TOY

Most of the toys you make are probably too big to fit in a regular graduated cylinder. That means the usual water displacement method won't work. Instead you will probably have to use the "Archimedes Method"

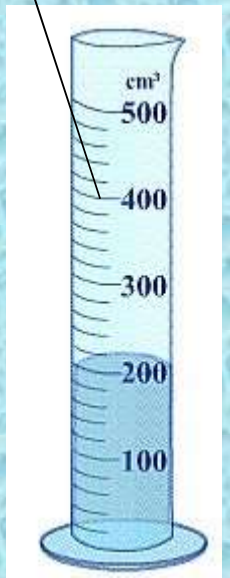
STEP 1: Fill a pitcher to the very top with water. Place a beaker or cup below the spout.



STEP 2: Lower toy into water until it is completely submerged. Catch the overflow (displaced water in the beaker)



STEP 3: Pour overflow water from cup into graduated cylinder and read volume



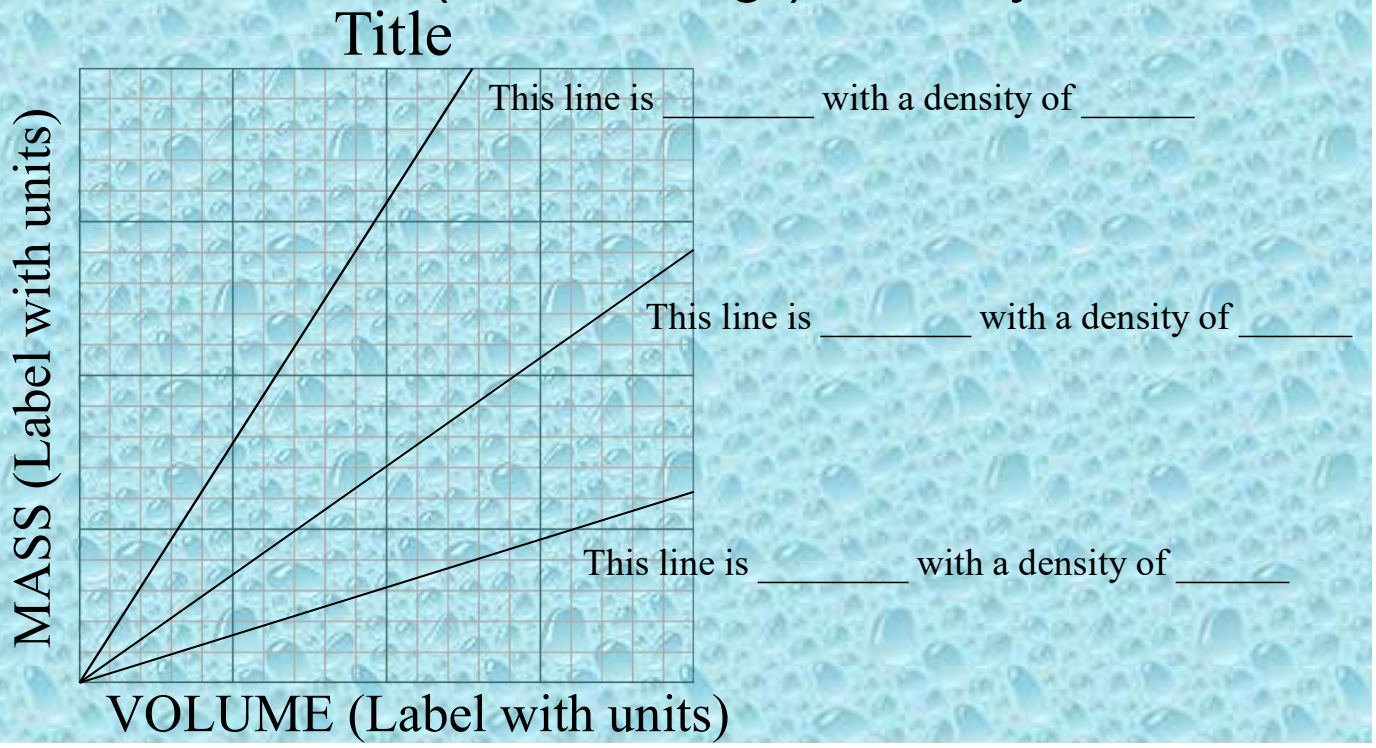
STEP 4: Repeat process for the toy at its maximum density setting.

DAY 4: MAX & MIN DENSITY GRAPH

(your graph will be displayed at the trade show)

(YOU WILL NEED TO MEASURE THIS DATA TO GRAPH IT!)

- Graph should be handmade or a digital print out with Title
- Axis should be labeled with units
- 3 **<u>labeled</u>** lines should be on your graph
  - Line 1: Represents Maximum Density for your Toy
  - Line 2: Represents Minimum Density for your Toy
  - Line 3: Represents Water's (or "Flinking") Density



DAY 4: COST ANALYSIS

(your cost analysis will be displayed at the trade show)

Start by finding your cost to make your toy (see next slide for costs.) To do this, add up the cost of all the supplies you used*. Now take that number and multiply it by 3. This represents the typical mark-up of Toys which is 300%. Now take that mark-up and add it to your supplies cost and you now have your retail price!

Example:

Supplies used		Cost
1 Small Tupperware		$0.25
3 marbles	(3 x $0.01)	$0.03
2 googly eyes	(2 x $0.01)	$0.02
2 pencil grips	(2 x $0.10)	$0.20
SUPPLY COST TOTAL=		$0.50
PROFIT MARK UP=		$1.50
RETAIL COST PER UNIT=		$2.00

$0.50 x 3= $1.50 (3 is the 300% mark up)

$0.50 + $1.50= $2.00

DAY 4: POSSIBLE SUPPLIES w/ cost per unit:

MATERIAL	COST		MATERIAL	COST
Foam cubes	$0.01		Pencil Grip	$0.10
Marble	$0.01		1 Foam Sheet (full/half/quarter)	$0.10/0.05/0.03
Styrofoam peanut	$0.01		Large Easter Egg	$0.10
Penny	$0.01			
Googly Eye	$0.01		Very small plastic containers	$0.13
			Plastic covered magnet	$0.13
Large Paper clip	$0.02		Coloroful Screw-together cups	$0.14
Straw	$0.02		Ping-pong size plastic ball	$0.17
Plastic Gem	$0.02			
Plastic Treasure Coins	$0.03		“Duplo” lego piece	$0.20
			“Fuzzy” pencil grip	$0.20
Easter Egg	$0.05		Domino	$0.25
Nut, bolt, or screw	$0.05		Small Tupperware container	$0.25
Tiny red solo cup	$0.05			
Clear plastic cup	$0.05		Plastic Travel Container/bottle	$0.33
Velcro dot sets	$0.05		Clear film canister with lid	$0.38
Rubber Stoppers (S/M/L)	$0.05/$0.07/$0.10		Snack cup	$0.50

DAY 4: COST ANALYSIS EXTRA INFO

**Cost analysis is actually quite a bit more complicated. For example, normally we would also include the cost of tools and labor in the supply cost however we will assume if you bought your supplies in bulk (large amounts) to mass produce your product then the cost of supplies would go down and would maybe pay for the tools, labor and some manufacturing profit. There is also things like "gross margin" which can make it even more complicated!*

DAY 5
TRADE SHOW PRESENTATIONS!

- You should have a fully functioning prototype
- “Sell” your peers your product
- Demonstrate how to use
- Answer questions
- Have Graph displayed
- Have Cost Analysis displayed
- Peers will fill out a Google Form survey on each product

DAY 6 & 7
FILM & EDIT
A COMMERICAL!

COMMERICIAL SHOULD INCLUDE:

- Intro product with unique name (can't be Flinker!)
- Footage of the toy floating, sinking, & "flinking"
- Show how to use it (adjust the density)
- Show a "child" playing with the toy
- Includes recommended age
- Be charismatic & exciting
- Background music (your own Jingle would be awesome!)
- Include retail cost and how to order/buy
- Highlight 2 of your best factors
  - (Function, safety, ease of usage, appearance, fun factor, durability)
- 30 seconds or less

- Watch real product commercials for ideas! (Pillow pets, Dream Lites, Stuffies, Flipazoo, etc.)

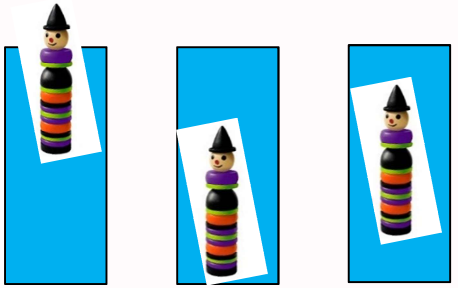
Name of Project: Flinker! 30 sec Commercial Group Members: _____

☐ Intro product name; grab viewers attention; background music/jingle

"The Flinker is an amazing new toy that is sure to bring hours of fun for boys & girls of all ages!"

☐ Describe what your product is and the recommend age

"It Floats. . . It Sinks. . . It Flinks!"



☐ Demonstrate what it can do (sink, float, flink)

"Simply rotate the rings to adjust and watch the density change before your eyes!"

☐ Demonstrate how to use/adjust it

"The Flinker is made of NASA grade plastic so it will last for years and its colorful design and happy face make it adorable!"

☐ Highlight 2 of its best qualities (Function, safety, ease of usage, appearance, fun factor, durability)

"The Flinker can be purchased at any Toys-R-Us for the low cost of $19.99!!"

☐ Include where the toy can be purchased (store, online, etc.) and the cost

DAY 8
COMMERCIAL PREMIERE DAY!

- We will watch all groups 30 second commercials and review

ADDITIONAL INFO FOR COST ANALYSIS

Many of the inventors I meet got started because they wanted an outlet for their creativity or sought more freedom in their careers. Rarely do I meet someone who has approached inventing from a number-crunching background. It seems that many inventors just aren't that comfortable with "the numbers." However, if you create a viable product, you've got to sell it. And pricing and profit margins are a critical part of that process.

Whether you sell directly to end-users or to a retailer or distributor who sells to customers, you need to know how to price your product to ensure everyone in the process will make their required profits. As you probably suspect, this involves a bit of art--and a lot of science.

Common sense dictates that the price you choose should be neither too high nor too low to attract the most customers and generate the greatest amount of profit. Your price also needs to cover the cost of doing business. This is where understanding the basics of "markups" and "gross margins" can help.

Before we get into these concepts, I'd like to define a few terms that people often confuse:

•**Retail sales:** This is sales of a product to an end user. Example: the price you'll pay for cookies at a grocery store

•**Wholesale sales:** This means the sales by a manufacturer or distributor to a retailer. Example: the price Nabisco charges grocery stores for its cookies

•**Markup:** This is the difference (reflected in both dollars and percentage) between what a retailer will pay for a product and its retail price (what the end user will pay). Example: XYZ Cookie Company sells a bag of cookies to the grocery store for $2, and the grocery store charges $5. The markup is $3 per bag.

•**Gross margin:** This is the percentage of profit derived from a transaction. (Both the manufacturer and the retailer will expect their own gross margin.)

How Markups Work

The best way to illustrate the concept of markups is with a simple example. Assume you, the manufacturer, make a product we'll call Gizmo for $1. You then sell it wholesale to a retail store for $3. Thus, your markup is $2 ($3 - $1 = $2), or 200 percent (2 / 1 = 2.00: Remember, percentages are determined by moving the decimal point two spaces to the right and adding the percentage sign, hence 2.00 = 200%). If the retail store, then sells Gizmo for $8, its markup is $5 ($8 - $3 = $5), or 166 percent (5 / 3 = 1.66).

Figuring Out Your Gross Margin

Now that you know your markup, you can figure out your gross margin. (These two terms are often mistakenly used as though they're synonyms. They are related, but they're not the same.) This number is calculated by dividing the markup by the price to acquire it.

Using the above example, we'll first figure out your gross margin as the manufacturer. Divide your markup ($2) by the price the retailer paid for it ($3). Thus, your gross margin as the manufacturer is 67 percent (2 / 3 = .67). So in this case, a 200 percent markup resulted in a gross margin of 67 percent.