Objective

Since you already cannot smell in the wintertime, using extra fragrances would just be a waste!

Arctic Fury is a very functional soap that will leave your skin feeling clean and moisturized after each use

This all-natural, no extra fragrance soap is perfect for those who are hypoallergenic, dislike the generic strong scents of soaps, or simply cannot smell

SOAP DESIGN

Our soap was designed having the following properties in mind:

1. Portability – compact and ergonomic shape allows for a high degree of transportability and versatility
2. Minimal fragrance – allows for soap to be used on a variety of skin types, non-irritating, good for hypoallergenic users
3. High functionality – combats a variety of skin problems and exhibits many visible cleansing and moisturizing benefits
4. Modern design – combination of geometrically tapered corners and precise edges, allow for a unique and versatile cleansing experience
5. Environmentally Friendly – all-natural ingredients

PACKAGING

Paper bags

1. Reusable and recyclable packaging allows for sustainable product distribution
2. Allows for the packaging of multiple bars of soap
3. Economical choice with a low environmental impact

INGREDIENTS – Coconut Oil

28 weight %

140 g

- natural scent
- excellent moisturizer
- highly cleansing
- produces a high degree of bubbly, creamy lather

Known to: remove dead skin cells and dirt, reduce and prevent acne

INGREDIENTS – Ghee

10 weight %

50 g

- creamy & moisturizing
- minimal scent

INGREDIENTS – Crisco

42 weight %

211 g

- high levels of hardness & conditioning

- economical (low cost)

INGREDIENTS – Olive Oil

20 weight %

100 g

- clean, buttery feeling

- long-lasting moisturizing effect, making it ideal for very dry and sensitive skin

- natural scent

Known for: antioxidant properties – repair damage, stimulates cell generation, improves elasticity of collagen in the skin

Lye - NaOH

72.2 grams added

- Creates a firm bar soap

- Excellent and cheap ingredient

- Used in the saponification process to break down fats and oils into fatty acid chains

- Lye combines with oil molecules to form soap molecules and glycerin

SOAP CALCULATOR

Oils	Percentages	Quantity (g)
Coconut Oil, 76 deg	28%	140
Ghee, any bovine	10%	50
Crisco, old	42%	211.111529
Avocado Oil	0%	0
Olive Oil	20%	100
Sesame Oil	0%	0
Corn Oil	0%	0
Grapeseed Oil	0%	0
Sunflower Oil	0%	0
Canola Oil	0%	0
Total	100%	500

- Given 500 g of the oils, we needed to choose the percentage of each oil that would reflect the properties we wanted to see in the soap
- As we adjusted percentages, we were able to reach our target values for each property (hardness, cleansing, bubbly lather, creamy lather, conditioning)
- We were also able to see the cost of each ingredient and the cost of our final product
- Cleansing was the main priority of the optimization

			Mass of Oils (g)	500					
			Percentage of Water as a Percentage of Oils	38%					
			Mass of Water (g)	190					
				Mass of NaO	**Mass of KOH**	**Hardness**	**Cleansing**	**Bubbly Lathe**	**Creamy Lathe**	**Conditioning**	**Cost**
		Totals		72.3351655	101.520243	41.9977995	20.26	20.26	21.7377995	50.9556141	$ 5.05
				Recommended Ranges		29-54	12-22	14-46	16-48	44-69	
				Targets		41	20	23	23	52	
				Objective Function		16.3086897					

COLD SOAP MAKING PROCESS

- Oils are first measured out, combined, then heated (70 degrees C)
- NaOH pellets are dissolved in water (pour pellets into already poured water to prevent abundant splashing)
- The lye solution is then added to the heated oils and blended until a honey-like consistency is reached
- The soap solution was then poured into various molds

Context & Background

Conducted Work

- A team of four students worked in the E7 Ideas Clinic to develop a soap recipe and select a design that would be functional and marketable to the public
  - **Marketing points:** affordable cost, all natural, cleansing & moisturizing, hypoallergenic (no additional fragrances)
- **Design considerations:** size of each soap bar, shape of mold, and packaging
- It was necessary to consider "green chemistry" – environmentally harmful materials (ie. plastic packaging) should be avoided

- **Learning Objectives:**
  - Team-building skills – working alongside group members and running through various opinions and ideas to select one that would prove the most success
  - Problem-solving skills – development of soap was open-ended but constraints had to be maintained

Saponification Process

- **Saponification:** chemical process in which fats and oils (triglycerides) are broken down into fatty acid chains
- Lye combines with oil molecules to form soap molecules (fatty acid salt) and glycerol
- **In our mixture:**
  - 72.2 grams of lye (NaOH pellets) were dissolved in water
  - After the oils were heated, the lye solution was added to the oil mixture and blended thoroughly
  - NaOH results in a hard bar of soap

Options and Iterations

Lather Focused Soap

Rationale

- This soap would give the user a more appealing overall sensory experience
- Would give a strong visual and physical representation that the soap is cleaning well as more bubbly and creamy lather is produced

Drawback

- By investing in oils that would make our soap have more lather, we would sacrifice other properties such as cleansing and hardness

Solution

- Since we determined that our soap should primarily be a functional cleaning soap, we sacrificed some extra lather to balance out the rest of our soap's properties

Coconut Oil Focused Soap

Rationale

- Since we determined that we would not use any additional fragrances, we considered investing more into coconut oil due to its pleasant natural fragrance

Drawback

- Using a lot of coconut oil means sacrificing conditioning properties for more hardness, cleansing, and lather

Solution

- Instead of coconut oil, we decide to add more olive oil, as it still provides a great fragrance, while including more balanced properties to our soap

KOH to Induce Saponification

Rationale

- KOH tends to make soaps more soluble in water than NaOH. This means that it is easier to lather and will produce a more physically appealing soap.

Drawbacks

- KOH is more expensive than NaOH and is primarily used in the making of liquid soaps.

Solution

- Although KOH would be able to make our soap lather better, it would not be worth it to risk compromising the determined hardness for our soap. Also the cost of NaOH makes the production of our soap significantly more costly. (maybe add a link to a screenshot of proof)

Design Criteria & Constraints

- We prioritized cleaning in the process of making our soap as that is the main purpose of soap
- Our soap was specifically designed to achieve an ideal balance between quality and price. Perfectly balanced, just as all things should be
- We chose to leave our soap unscented as we felt adding a scent would not make it natural which is what we were aiming for
- Our soap was made using the cold process because it is considered to be a more natural bar of soap and cold process made soap is often has a creamier feel

Design Criteria & Constraints

- When designing our soap we were only able to make 500g of soap requiring us to balance the 4 oils we used and the lye accordingly
- Environmental impact was another factor taken into consideration while designing our soap which is why waste products from our soap making process were donated and not wasted
- The tools that were made available to us were limited therefore we had to take into consideration what we had access to, and we did not have access to
- Our time was also limited as we had to take that factor into consideration

MOLD SELECTION

- We select ice tray as the mold in order to create ice-cube shaped soaps
- The size and shape of these cubed soap can help us to easily decide the amount of soap contained in a package
- Ice cube shape is also appealing, handy and mobile
- Cubed soaps give us the winter vibe which helps contribute to our arctic theme

Economics

- Total Cost of Oils = $5.05/500 g (there is approximately 29.4 g oil in each bar)
- Total Cost of NaOH = %14.93/500 g (72.3 g used overall)
- 16 Bars of Soap Produced
- Cost of Oils per bar = $0.32
- Cost of NaOH per bar = $0.13
- Total Cost per Bar = $0.45
- Cost of Packaging per bag = $0.33
- Total Cost per Bag = (3 bars per bag) x (Total Cost per Bar) + Cost of Packaging per Bag + $2 (includes labour fee) = $3.68