# NORTHERN LIGHTS SOAP COMPANY

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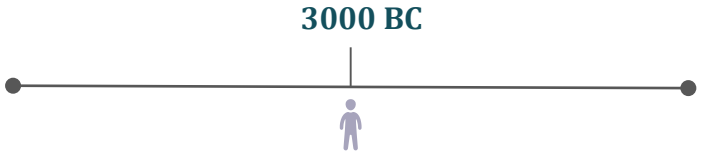


## A brief history of soap-making

With its roots dating back to 3000 BC, the first soap discovered was originally comprised of a mixture of animal fats and wood ashes. This ancient form of soap has since become crucial to personal hygiene in our society due to its use as a cleansing agent and its mild antiseptic properties. Recently, activist movements have driven soap manufacturers to strive to be environmentally friendly, contain natural free-trade ingredients, be animal cruelty-free in their testing processes, and be safe, cheap and gentle for the consumer to use.

## Saponification

Saponification is an exothermic chemical reaction in which fats and oils (triglycerides) react with a sodium hydroxide to form a fatty acid salt, also known as crude soap. Each oil and fat has a ‘saponification value’ which is the amount of lye needed to completely neutralize them into soap without any lye left over. The triglyceride units of fat reacts with sodium hydroxide to convert into soap and glycerol.

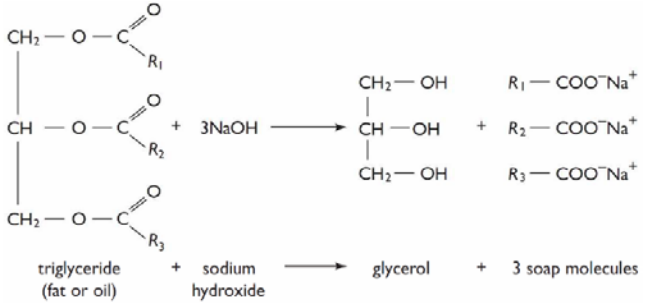


*Figure 1: The General Saponification Equation*

| Oils | SAP - (NaOH) | SAP - (KOH) |
|---|---|---|
| Coconut Oil, 76 deg | 15.46242029 | 21.71498369 |
| Ghee, any bovine | 4.159187965 | 5.827997951 |
| Crisco, old | 53.40697189 | 74.84772702 |

*Table 1: SAP values for Coconut oil, Ghee, and Crisco*

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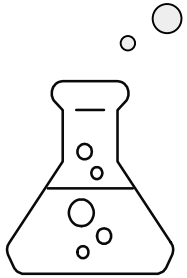
## The Chemistry Behind Soap

*A step into how soap works:*

In crude soap produced as a result of saponification, there is both a hydrophilic head as well as a hydrophobic tail. The hydrophilic head of the soap molecule is hydrophilic due to its polarity and is attracted to water molecules, while the hydrophobic tail of the soap molecule is attracted to oil molecules. During the process of using soap, oils are lifted from the skin when the soap is washed away with water.



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## OUR PRODUCT

A traditional soap with a peppermint kick — this creamy lathering bar of soap is bound to leave your skin feeling fresh, conditioned, and moisturized.

*We wash you a merry christmas!*

Candy Cane Clean

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# BENEFITS

Great cleanser for skin by removing dirt and dead skin cells

Natural anti-aging benefits reducing acne and wrinkles

Eco-friendly, consumer-friendly, and cost-efficient design using recyclable packaging

Creamy, conditioning, and moisturizing properties on skin

A lovely *Christmas* gift!

# Ingredients

## Crisco

With bactericidal properties that are known to soothe eczema prone skin, crisco is an excellent moisturizer for dry skin and creates a creamy lather to condition skin cells. It also has a low cost, making it very affordable.

## Ghee

With natural anti-aging properties due to its essential fatty acids, Ghee is effective on all skin types and moisturizes dry skin by inducing hydration in skin cells.

## Coconut Oil

As an excellent skin moisturizer due to its cleansing and skin softening properties, Coconut Oil prevents and reduces acne  by removes dead skin cells and dirt, leaving your skin feeling cleansed and refreshed.

## Peppermint Oil

A revitalizing oil that reduces stress and nausea, peppermint oil creates our signature Candy Cane Clean scent relieving muscle pain, itching, and headaches.

## Sodium Hydroxide

As an essential part of our formulation, sodium hydroxide ensures that our soap obtains the maximum hardness that a bar of soap can provide by reacting with oils during saponification.


# Crisco

- Bactericidal properties soothe eczema prone skin
- Moisturizes dry skin
- Creates a creamy lather
- Conditions skin cells
- Low cost


# Coconut Oil

- Excellent skin moisturizer
- Prevents and reduces acne
- Removes dead skin cells and dirt
- Cleansing and skin softening properties


# Sodium Hydroxide

- Reacts with oils during saponification and produces a solid bar of soap
- Maximizes hardness


# Ghee

- Essential fatty acids induce hydration in skin cells
- Moisturizes dry skin
- Effective on all skin types
- Natural anti-aging solution


# Peppermint Oil

- Creates our signature Candy Cane Clean scent
- Reduces stress and nausea
- Relieves muscle pain, itching, and headaches


# Free of Artificial Dyes and Colours!

- Keeps soap as natural as possible
- Will not stain hands or clothes
- More environmentally friendly
- Reduces the possibility of skin irritation

NO ARTIFICIAL COLOURS OR FLAVOURS

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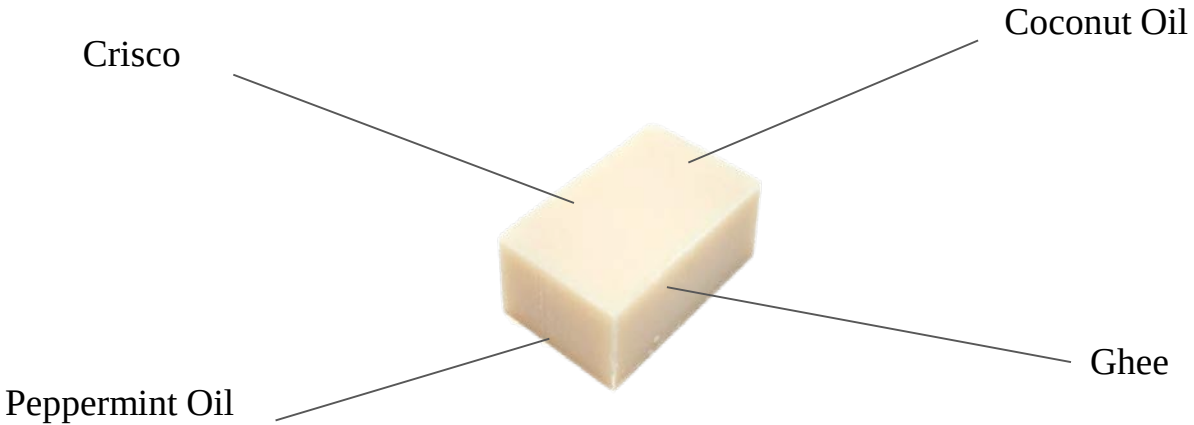
# Key Components of Our Soap



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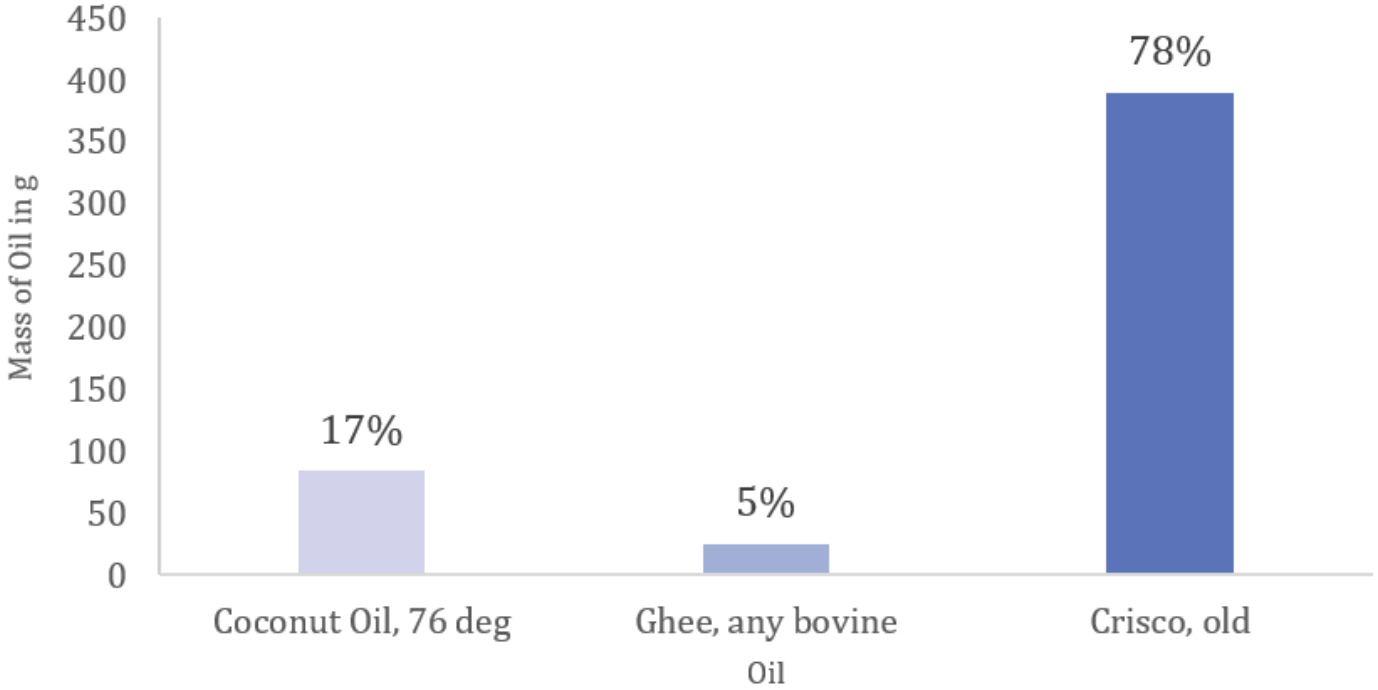
# Composition of Oil in Our Soap (g)



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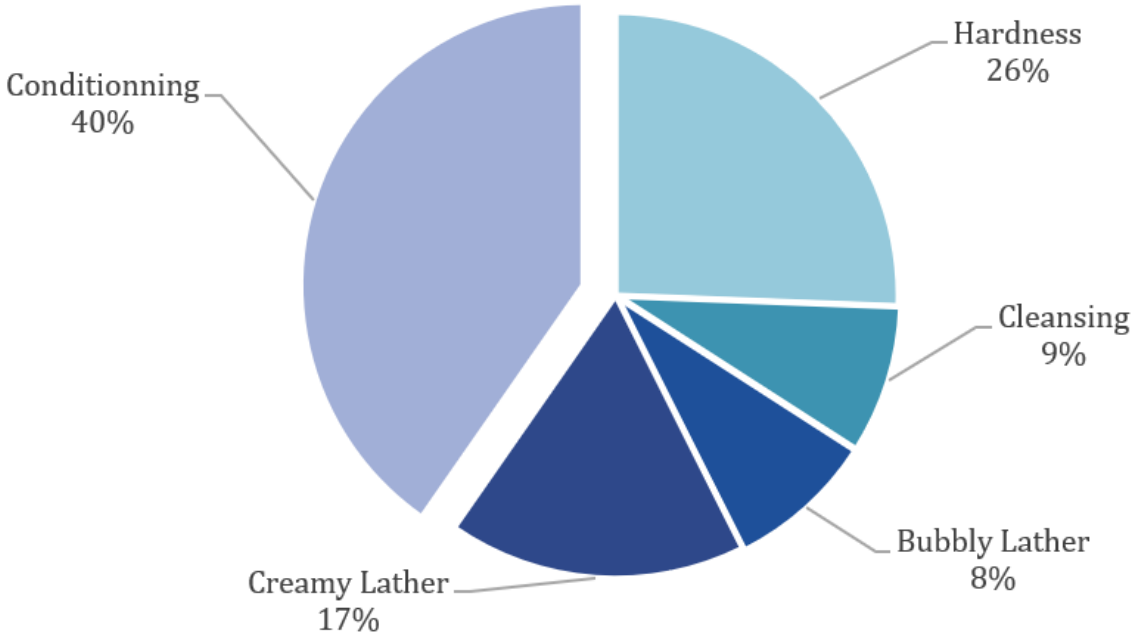
# Properties of Our Soap



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# Packaging

- Protects soap and retains the soap’s signature Candy Cane Clean scent
- Minimal packaging reduces waste and environmental impact
- Loose tag attached using compostable twine made of natural fibers
- Clear labels allow pattern to be seen while including required information
- Recyclable and biodegradable glassine paper
- Festive design

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# Cost

| | | | |
|---|---|---|---|
| **Cost of Lye per 500g** | $14.93 | **Cost of Lye used (69.77 g)** | $2.08 |
| **Amount of Ghee used (g)** | 25.67 | **Cost of Ghee used** | $0.42 |
| **Amount of Coconut Oil used (g)** | 84.46 | **Cost of Coconut Oil used** | $1.50 |
| **Amount of Crisco used (g)** | 389.83 | **Cost of Crisco used** | $2.02 |
| | | | |
| **Total Cost of Ingredients (569.77 g)** | $6.02 | | |
| **Total Cost of Ingredients per bar (80 g)** | $0.85 | | |
| | | | |
| **Cost of glassine bags (8 bags)** | $2.00 | **Cost of bags used (6 bags)** | $1.50 |
| **Cost of Twine per 20 ft** | $2.98 | **Cost of twine used (13.8 ft)** | $2.06 |
| | | | |
| **Total Cost of Packaging (6 bars)** | $3.56 | | |
| **Total Cost of Packaging per bar** | $0.59 | | |
| | | | |
| **Total Cost of each bar of soap** | $1.44 | | |
| **Selling Price of each bar of soap** | $3.50 | | |
| | | | |
| **Profit Margin per bar** | $2.06 | | |
| **Percent Profit** | 59% | | |

# Design Criteria

- The selection of oils was limited to only 10 oils. The products used were relatively inexpensive to reduce the cost of creating the soap.
- The choices of Lye were also restricted to Potassium Hydroxide and Sodium Hydroxide.
- The materials were selected by using our soap calculator to set specific property values. The oils were given certain values for their properties in a reference spreadsheet based on the amounts of fatty acids contained in them.
- The amount of time it took to make the soap was also a factor. Hot process would yield a faster curing time; however, to be safer in our design cold process was the option that was chosen.


# Soap Calculator

- The soap calculator calculates values from real properties by trying to get as close as possible to the desired properties input by the user.
- It then relates this to the amount of each oil that should be used to optimize these.
- Then it calculates the amount of each type of lye (NaOH or KOH) required to saponify the oils chosen and the amount of water needed to dissolve it.
- It also considers cost by converting the mass of oils to mL

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# Soap Calculator: as designed vs made

- The soap calculator originally provided us with masses of oils which were altered during production due to the oils all being solid, making them hard to remove from containers..
- If we had obtained all the soap from the soap calculator we would have achieved 569.299 grams of soap. In reality, the amount ready for sale was about 480 grams resulting from amount of packaging material and some mass of ingredients lost during the soap clinic because it did not all fit into the square molds.
- The calculator that was utilised also accounted for less water than was used which meant our soap took longer to dry than expected.
- The properties we accounted for in the original design changed slightly in the final product. However, it was not great enough to affect the overall properties of our soap.

# Mold Selection

During the design process of creating our soap, we decided that rectangular shaped bars of soap would be best for a simple and traditional design. The easiest way to create these bars of soap was to use a square shaped baking tray to easily facilitate the removal and molding process of our soap. The chosen square shaped baking tray, being coated with polytetrafluoroethylene (Teflon; a common non-reactive chemical used to provide a non-stick surface), eliminated the risk of the mold interfering with the saponification process and ensured that the soap bars would not stick to the mold.

# Options and Iterations

Options for the lye:

- NaOH was used instead of KOH to create a solid opaque bar of soap since KOH is typically used to produce liquid soaps.

Options for base oils:

- In our soap calculator, we manipulated the values for the soap properties multiple times to see different combinations of base oils. Before the final formulation was decided, a few trials were made to see which option was the most affordable while having adequate numbers for each soap property.
- During these trials, we also aimed for coconut oil as one of our ingredients because it is a popular moisturizer for the skin that customers prefer. It also has multiple benefits to the skin along with the desired properties we wanted to achieve.

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Options for desired properties:

- Our goal was to produce a soap that is best for softening the skin. To accomplish this, we had higher inputs for creamy lather and conditioning in our soap calculator to maximize these properties in our final soap formulation .
- We also put smaller values for hardness and bubbly lather properties to focus more on the creamy aspect of the soap and to avoid having a soap that is too dense or too hard.

# Soap Making Process