

AKnife

Ergonomic Knife

Designed for People with
Limited Dexterity

Angela Peng

***"Experience
effortless
precision and
reduced hand
fatigue with our
ergonomic knife
design."***

Introduction & Problem identification

Project Brief

This product is aimed to create ease of using and cutting food to reduce food preparation for users with limited dexterity. It is also good for any user who wants to have an easier time in food prep. The product would have to conform to voluntary “location-restricted knife” standards in some states in the US which is that a knife blade must stay within a length of five and one-half inches. The functionality of this knife is meant to be easy to use and cut food with smaller strength compared to usual household knives. It is meant to be used in the kitchen and food preparation. Currently, on the market, some knives have good ergonomics but hard-to-cut blades, easy-to-hold knives but small blades that require a lot of time to cut through larger pieces of food, handles that are hard to grip yet the blade is good at cutting, etc. This product is aimed to provide a stable grip with an ergonomically designed handle, a blade that is easy and safe to use, and allows an easy cleaning process. This is a stand-alone item made with eco-friendly stainless steel.

User Persona

Goal

Challenges

Description



DANIEL

52

ANN ARBOR, MI

PRODUCT
MANAGER

- Easy to use kitchen utilities that doesn't require a lot of strength for food cutting
- Kitchen utilities that are easy to clean and has a good grip
- Don't want to spend too much time cooking due to limited dexterity
- Daniel has limited time for food preparation during weekdays. He's not a social person and doesn't like to go to restaurants. He attends biweekly physical therapy sessions due to limited dexterity in his right arm.



NIKI

31

ATLANTA, GA

ILLUSTRATOR

- Wants a knife that has comfortable grip
- Knife that allows easier food cutting with single hand
- Can only cut with single hand due to unpresented of left arm
- Niki lost her left arm in a car crush when she was in her 20s. She enjoys cooking and have been used to preparing food with only her right hand. As an illustrator, Niki likes to purchase kitchen utilities that has interesting designs.

Use Case/ Context of Use/ Use Scenario



Meat cutting



Vegetable cutting



Fruit cutting



Bread cutting



Cheese slicing



Herb, garlic, onion chopping/ mincing

Product Design Specification

1. Performance

- 1.1 Must be easy to cut – it is expected that the targeted user could easily cut anything with one hand
- 1.2 The product should withstand rough handling
- 1.3 The blade must be sharp and doesn't require too much strength to cut
- 1.4 Tip of blade must be sharp

2. Material

- 2.1 The blade metal must be made of sustainable materials (Stainless steel etc.)
- 2.2 The knife tang should be partial tang (guess)
- 2.3 All the materials should be non-toxic
- 2.4 Materials must withstand environmental conditions
- 2.5 Materials should not oxidize in any way
- 2.6 All materials should be easy to clean

3. Life in Service

- 3.1 A minimum of 8 years is required for this product (guess)

4. Target Product Cost

- 4.1 The product is aimed at the mid-price range, \$60

5. Competition

- 5.1 Wüsthof.
- 5.2 Zwilling J.A. Henckels
- 5.3 Shun

6. Packing

- 6.1 Size must be kept to a minimum
- 6.2 Cost must be kept to a minimum
- 6.3 Must be safe
- 6.4 Must be easily unpacked by the customer single handed
- 6.5 Must be easily removed from knife sleeve

7. Shipping/ Transport

- 7.1 Packages will be stored 5 to one box (guess)
- 7.2 Transport will be by air/ sea/ road/ rail (guess)

8. Quantity

- 8.1 5,000 units to be produced annually (guess)

9. Size

- 9.1 Size must adhere to legal requirements for all 50 states

10. Weight

- 10.1 The knife must be light weight, within 8 ounces (guess)
- 10.2 The knife must be easily held with one hand

11. Aesthetics

- 11.1 Brand name should be visible (guess)
- 11.2 Company logo should be clearly seen on packaging
- 11.3 Robust images must be displayed on the packaging

12. Ergonomics

- 12.1 The knife handle must withhold principles of ergonomics
- 12.2 The knife handle must have comfortable grip that has enough friction (non-slip)
- 12.3 The knife handle must HAs comfortable for all hand sizes (male and female)

13. Standards

- 13.1 ISO 8442-5:2004 sharpness and retention of knives

14. Customer

- 14.1 It is expected that the customer will be adults age 15+

15. Quality

- 15.1 The company will offer a 2-year full warranty

17. Testing

- 17.1 Batch inspection to be used for the final product
- 17.2 Batch test of 1 in every 500 will be adopted

18. Safety

- 18.1 No sharp edges to be exposed when not in use
- 18.2 One side of blade bust be safety blade to reduce risk of injuries

19. Market Constraints

- 19.1 The product will be marketed on a worldwide basis

20. Political/Social Implications

- 20.1 The name of the product should be thoroughly checked when considering exportation to non-English speaking countries.
- 20.2 Logos and colors used in the product should be checked against individual countries' tastes.
- 20.3 Product should be manufactured to company's social and ethical guidelines.

21. Documentation

- 21.1 Product accompanied by appropriate comprehensive documentation for use and maintenance.

Research

User Observation

During my research, I found three pain points that my targeted users might face during food cutting.

Key point 1: Uncomfortable Handle Design

- Observation: Many people who cut food with a single hand hold their index finger on top of the blade, causing increased pressure on the top of the blade. The current handle design only allows for applying force from the end of the knife blade. See images on the right
- Cause: Poor ergonomic design of the handle.
- Effect: Users may experience discomfort and muscle fatigue, especially when cutting a large amount of food.
- Possible solutions: Improve the ergonomic design of the handle to reduce pressure on the top of the blade and provide a comfortable grip. Consider designing a rocker knife that can be used with a rocking motion, rather than requiring downward pressure.



Key point 2: Stabbing for Control

- Observation: Some users tend to use the tip of the knife to stab into the food to control it during cutting
- Cause: Lack of confidence or skill in handling the knife, or using an inappropriate type of knife for the task
- Effect: Risk of injury, uneven and messy cuts, difficulty in achieving precision
- Possible solutions: Improve knife balance and weight distribution, sharper knife blade



Key point 3: Knife not sharp enough

- Observation: Many users struggle to cut through certain foods, such as meats and hard vegetables, even with considerable effort
- Cause: Dull or damaged knife blades, improper sharpening techniques, using low-quality knives
- Effect: Difficulty in cutting, uneven cuts, safety hazards as more force is required to cut through food
- Possible solutions: Use high-quality knives with strong and durable blades, sharpen knives properly and regularly, provide guidance on sharpening techniques, recommend the use of sharpening tools, offer knife sharpening services.

User Disclosure

Q: How does the design of the ergonomic knife affect the user's ability to cut food with limited dexterity?

A: Ergonomic knife would feature a wider handle, comfortable grip, and sharp and weighted blade which would allow easier cutting process while experiencing more precision and control.

Q: How does the shape and size of the blade affect the user's ability to cut food with the ergonomic knife?

A: The blade's shape and size play a crucial role in the user's ability to cut food with the ergonomic knife. The blade's length and curvature affect the knife's cutting motion, and the sharpness and thickness of the blade affect the ease of cutting.

Q: How does the ergonomic knife compare to traditional knives in terms of usability and safety for users with limited dexterity?

A: The ergonomic knife, in comparison with the traditional knives, would be more user-friendly and safer for users with limited dexterity. It would also provide a more comfortable grip and better control during cutting.

Q: How do users with limited dexterity rate their satisfaction with the ergonomic knife compared to other knives they have used?

A: Users with limited dexterity or loss of one arm rate their satisfaction with the ergonomic knife highly compared to other knives they have used. They report that the knife's ergonomic design makes it easier and more comfortable to use, and the weighted blade improves their cutting performance.

Empathic Reflection



Figure 1



Figure 2

To be better acquainted with what food making with limited dexterity feels like, I cooked a Chinese dish tomato egg stir fry with one arm, which helped me in the design of my knife.

Pain Point 1: Hard to remove knife sleeve.

When I was cutting the tomato, I found a knife sleeve would be hard to remove (Figure 1) with one hand and the removal process might be more harmful than without a knife sleeve.

Pain Point 2: Needs a lot of strength for cutting with handle at one end of the blade

The second obstacle I faced was the amount of force I needed to apply through my index finger when cutting the tomato (Figure 2). Thus, in my design, I designed a handle that stretches through about a little more than half the length of the blade so that a top down force could be applied to reduce the amount of force needed to cut food.

Environment Inquiry

The environmental inquiry of the knife would examine how the knife's design and production impact the environment. This would include materials used to make the handle, blade, and packaging. The consideration on energy used in the manufacturing process and how to reduce knife's carbon footprint is also important.

Another environmental inquiry to be aware of is to perform sustainable practices in the kitchen. This would include designing the knife to reduce food waste and energy consumption by allowing users to cut food with more precision. Moreover, the longevity and durability of the knife would also allow the need for frequent replacement.

Knowledge Review

	Description	weights (scale 1 - 3)									
Handle Comfort	Ergonomics in designing the handle (whether it's flat, sharp or fits nicely)	3	2	2.5	0.5	3	3	2	2	1.2	
Blade Sharpness		2.6	2	2.5	1	3	2.9	2.2	2.2	3	
Safety when Using	If slipping may cause minor cuts more easily	3	2.5	2.7	3	3	3	1	1	2	
Safety when not in use	If there are any knife sleeves, would it be safe if there are kids in the household?	1.9	3	2.7	2.5	1	1.5	1	1	3	
Uniqueness aesthetically	Does it look unique? Is there an interesting design?	1.2	3	1	1	2	2	2	2	2	
Overall Weights	Does it require a more strength to hold to knife than usual?	2.5	2	3	2.5	2	2	2.5	2.5	1	
Easy to use/ Cut	Is it able to cut food easily?	3	2	2	1	3	2.7	1	1	2.7	
Easy to Clean	Are there any areas that are hard to clean such as grip?	1.5	3	1	3	2	2	2	2	2	
Grip Stability	Is there enough friction to allow user to hold the knife more easily?	3	3	3	0.5	3	3	2	2	1.5	
Total			52.5	52.43	34.3	56.1	55.89	39.95	44.8		

Market Precedence



ULU KNIFE SET

IN STOCK

SHIPS BY NEXT DAY

MANUFACTURER: MARCELLIN

PRICE: \$ 65



ROCKER KNIFE FOR DISABLED

IN STOCK

SHIPS IN TWO DAYS

MANUFACTURER: FSTCRT

PRICE: \$ 15.99

Product Feature:

A versatile knife based on traditional Alaskan design. Its blade is made of tempered, high-carbon stainless steel that allows user to slice smoothly and quickly on the paired cupped center cutting board. The cupped center and curved blade also allow rocking motion to cut through foods. It's great for cutting herbs, bread, sausage, pizza, mincing etc.. A wooden storage stand also exists as part of the cutting board, allowing the ulu knife to stand upright.

Primary User

Anyone could use it. Its unique design and versatility is particularly good for those with limited strength/dexterity issues because of the little pressure needed on the handle.

Product Feature:

The Rocker Knife with a vertical grip is a versatile and efficient kitchen tool designed for individuals with limited dexterity or loss of one arm. Its swinging motion effortlessly cuts through most foods, and its unique design features a vertical grip that increases downward cutting force and limits hand slippage. The knife's vertical cutting method allows it to reach into small spaces for cutting, making it an ideal choice for cutting canned foods. The Rocker Knife promotes safety, precision, and sustainability in the kitchen, making it a valuable addition to any home.

Primary User

People with hand injuries, Parkinson's disease patients and other hand movement restrictions.

Market Precedence



STEAK KNIFE

IN STOCK

SHIPS BY NEXT DAY

MANUFACTURER: MARCELLIN

PRICE: \$25.77

CURRENTLY ON SALE: \$16.07

Product Feature:

The Steak Knife is a versatile and efficient kitchen tool. Its unique design features a vertical grip that increases downward cutting force and limits hand slippage, promoting safety and precision in the kitchen. With its curved stainless steel blade and included snap-on cover for safety, this knife is ideal for cutting through most foods with minimal motion and smooth downward force. Measuring 6.5 x 2.25 x 0.5 inches and dishwasher safe for easy cleaning, the Rocker Knife is a valuable and practical addition to any home cook's collection.

Primary User

Individuals with limited dexterity or loss of one arm



MEZZALUNA VEGGIE KNIFE

IN STOCK

SHIPS BY NEXT DAY

MANUFACTURER: FSTCRT

PRICE: \$32.74

Product Feature:

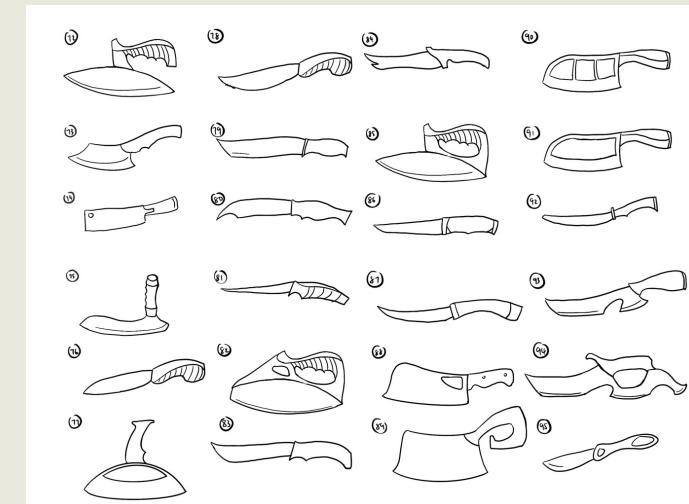
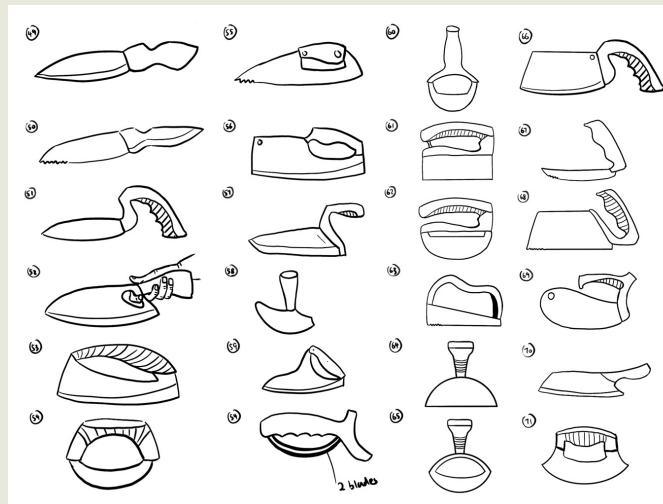
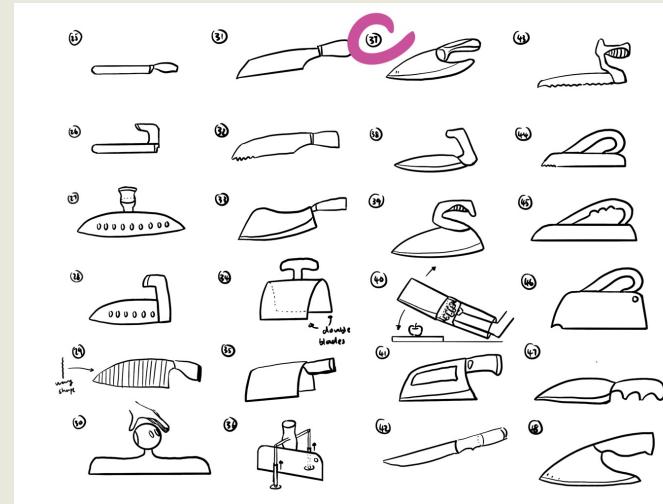
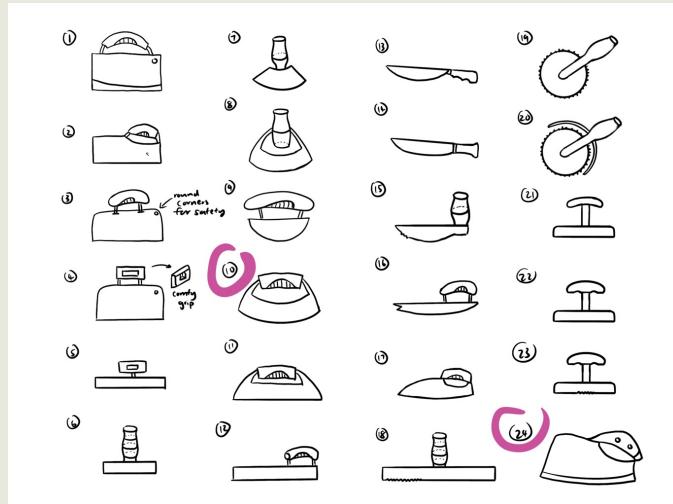
The Mezzaluna Veggie Cutter is an effortless way to chop and mince herbs and vegetables with a rocking motion. This versatile knife can be used to cut onions, cucumber, lettuce, chocolate, nuts, and more. The round cutting board features a concave bowl/well to keep your veggies contained while chopping for a tidy, efficient process. The stainless steel blade is protected by a specially designed sheath included with the set for safety. The knife and cutting board are easy to clean, with the rocker knife being dishwasher safe and the cutting board easily rinsed or wiped clean.

Primary User

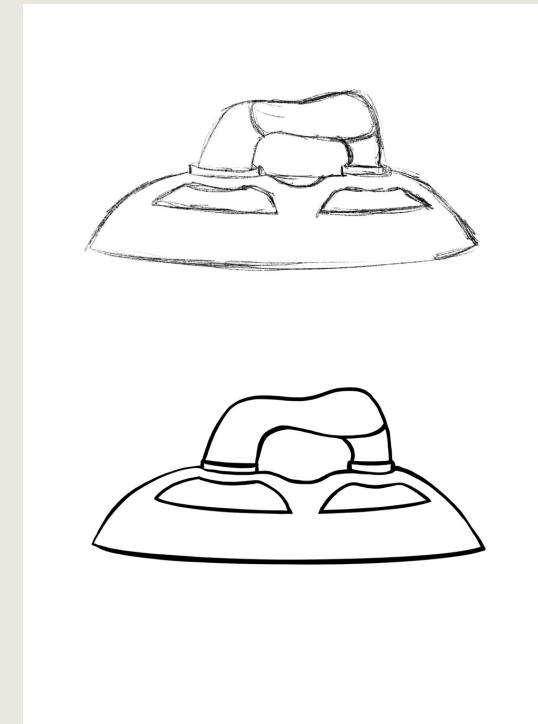
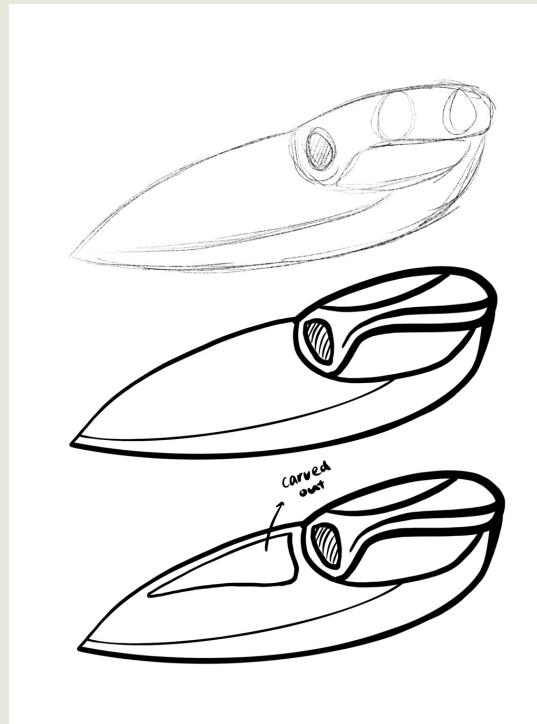
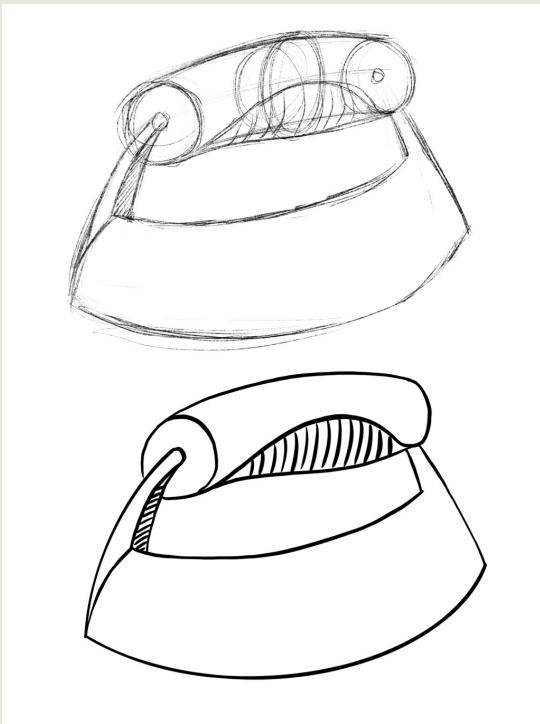
Everyone

Design Development

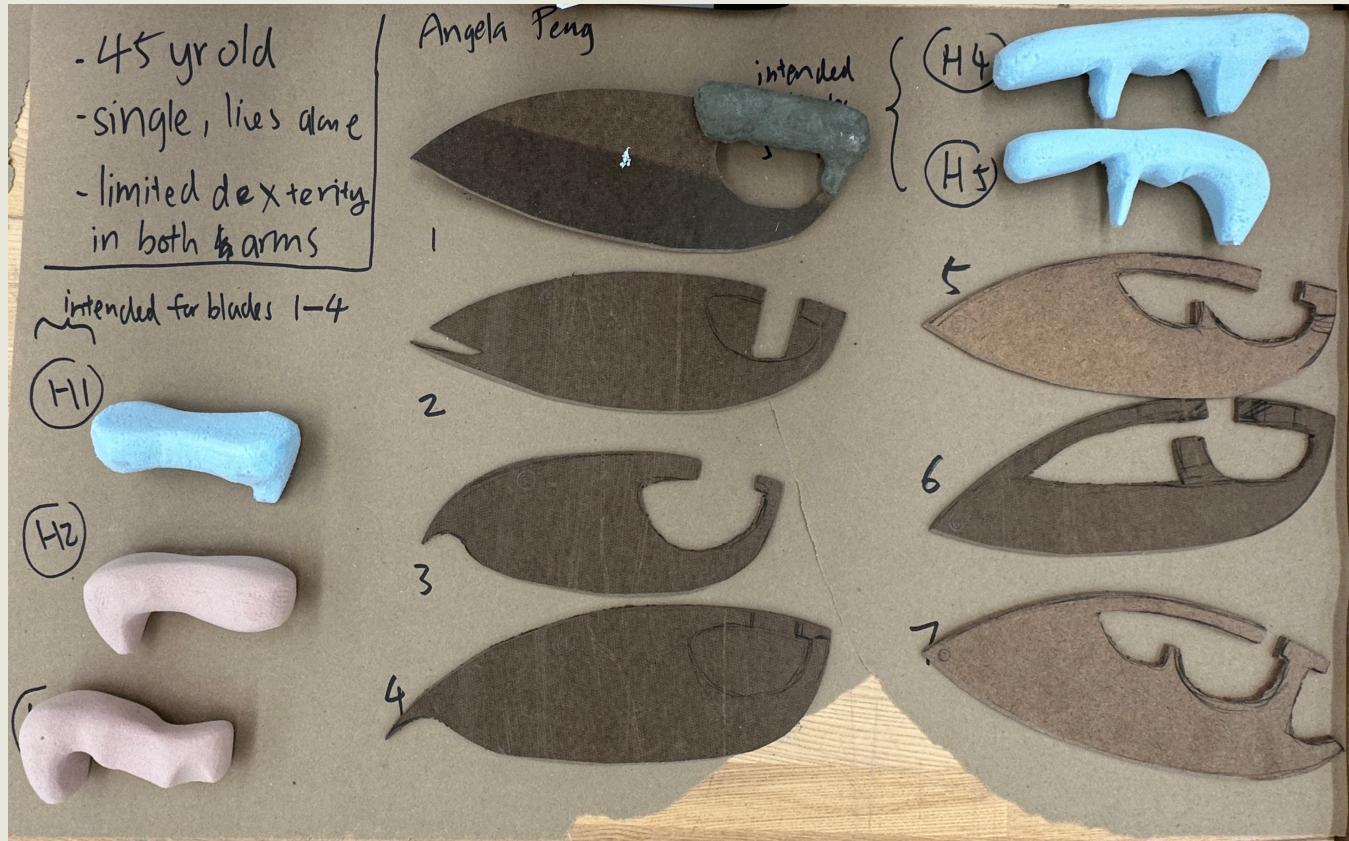
Ideation



Top Concept Images

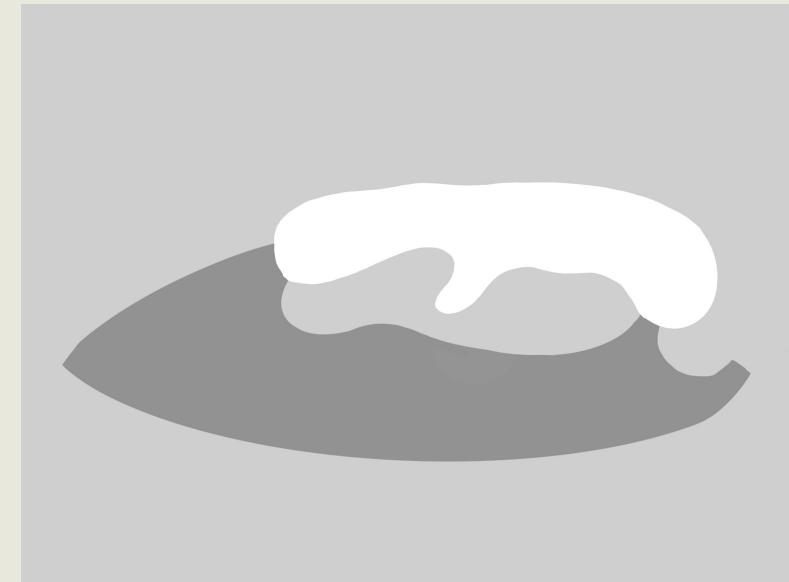
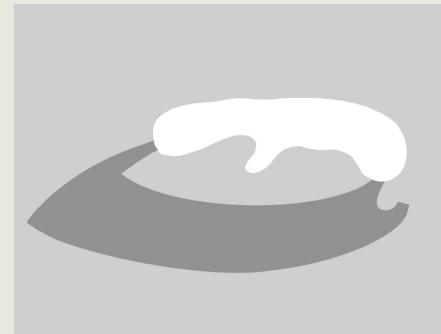
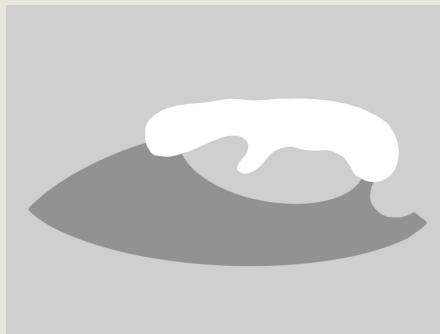
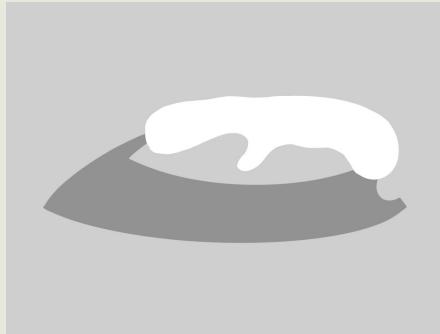
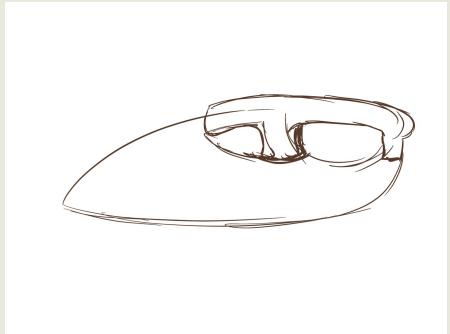


Top Concept Images and Evaluation



14 feedback were received from my peers. Out of all the user feedback on the prototype of all the initial round of handles and knives, I decided to go with a more refined version of Handle 5 and Blade 7.

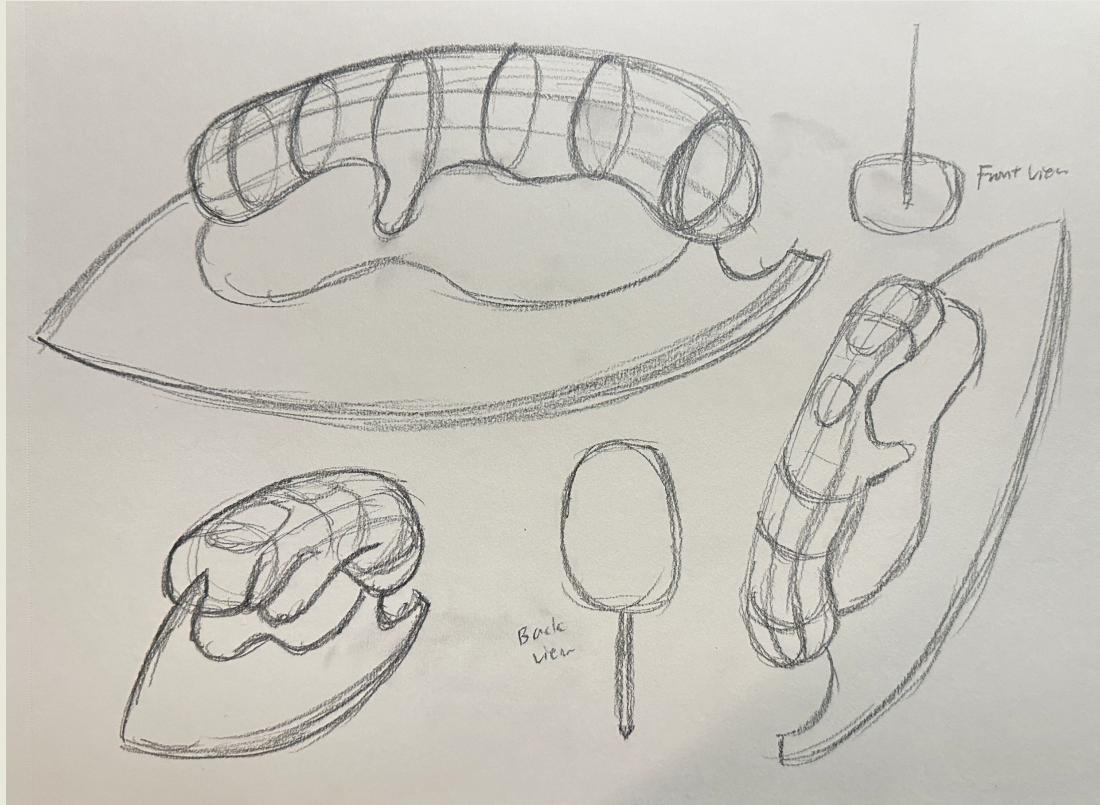
2D Sketching



Final Sketch

Initial Sketches

3D Sketching and Modeling



Clay Modeling



Foam Modeling

Final Design

Photographic Images of Final Product



Photographic Images of Final Product

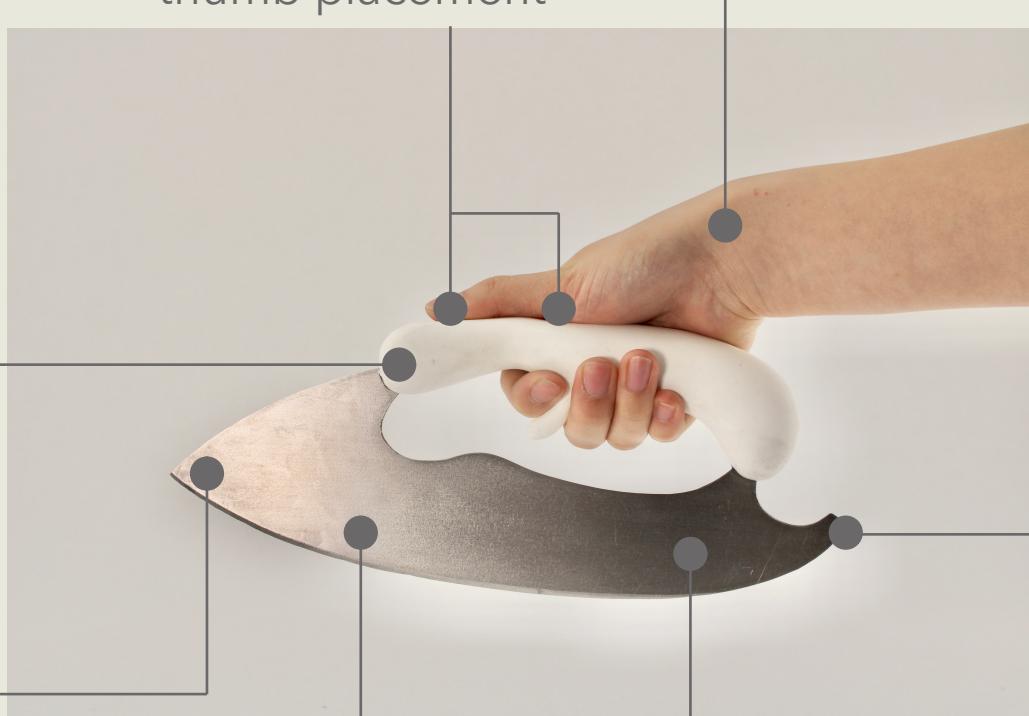


Two Ways of Holding the Knife,
Suitable for both large hands & small hands

Design Features

Ergonomic & Comfortable Grip:
handle design providing control, stability and precision cutting

Pointed tip for food poking



Sharp blade for easier cutting

Well-Balanced: Consists features of both regular knife and rocker knife, allowing easier cutting and more distributed application of force onto entire blade

Non-slip: Two grooves for thumb placement

Universal Design Features

Versatile: Handle a variety of cutting tasks + two ways of holding the knife (see previous slide), suitable for both large hands & small hands

Unique blade design corresponding to the design of the knife handle

Photographed of Final Product in Use



Validation

Product Evaluation Matrix

		Description	weights (scale 1 - 3)									
Handle Comfort	Ergonomics in designing the handle (whether it's flat, sharp or fits nicely)	3	2	2.5	0.5	3	3	2	2	1.2	3	
Blade Sharpness		2.6	2	2.5	1	3	2.9	2.2	2.2	3	2.8	
Safety when Using	If slipping may cause minor cuts more easily	3	2.5	2.7	3	3	3	1	1	2	3	
Safety when not in use	If there are any knife sleeves, would it be safe if there are kids in the household?	1.9	3	2.7	2.5	1	1.5	1	1	3	1.5	
Uniqueness aesthetically	Does it look unique? Is there an interesting design?	1.2	3	1	1	2	2	2	2	2	3	
Overall Weights	Does it require a more strength to hold to knife than usual?	2.5	2	3	2.5	2	2	2.5	2.5	1	1	
Easy to use/ Cut	Is it able to cut food easily?	3	2	2	1	3	2.7	1	2.7	2.7	3	
Easy to Clean	Are there any areas that are hard to clean such as grip?	1.5	3	1	3	2	2	2	2	2	1.5	
Grip Stability	Is there enough friction to allow user to hold the knife more easily?	3	3	3	0.5	3	3	2	1.5	3		
Total			52.5	52.43	34.3	56.1	55.89	39.95	44.8	54.48		