Week 1

Week of August 21st

This week we were introduced to the concept of human-centered design and the design process.

After reading an article titled “The Uninhabitable Earth” from the New York Magazine, we selected a topic to focus on over the course of the semester as a team.

Our team decided to focus on the issue of pollution in the ocean and its effect on coral reefs and marine life.
The Design Process:
1. Establish requirements
2. Design alternatives
3. Prototype
4. Evaluate

Methods of Establishing Requirements:
1. Gather data
2. Analyze and interpret data
3. Extract/establish requirements
4. Iterate
Week 2

Week of August 28th

This week we learned about the ideation process. In class we discussed various ideation methods that could help guide our thought process throughout the course of our product’s development. Important factors to consider included the form of the product, its technical aspects and the expected behavior of the artifact.

In the initial phase of the ideation process, our team began by drawing a mind map illustrating the issue of pollution in the ocean and branching out to demonstrate its repercussional effects. Then, we began brainstorming individually to try to define the products’ potential form and functions.

An idea we had was to use the metaphor of time running out and to analogize our product to an alarm clock that would remind people that their time on this Earth is precious and must be protected by being mindful about their recycling behavior.
Ideation kinds:
1. Mindmapping
2. Storyboards
3. Sketching
4. Co-design
5. Moodboards
6. Collage
7. Analogy & metaphor
8. Morphological chart
9. SCAMPER

Metaphor:
To convey that our time on Earth is precious, our team initially found the phrase “time is running out” particularly meaningful to our design.
Pollution in the Ocean

**Causes**
- Loss of reefs, which support as much as a quarter of all marine life and supply food for half a billion people
- Eating food with low pH can lead to higher acidity in human blood, which induces seizures, comas, and sudden death
- Dead zones can spread out, killing off marine species and giving off gas that poisons air above seas
- Failure in reproductive system of sea animals
- Disrupts the food chain
- "Coral bleaching," which refers to coral dying

**Effects**
- Loss of reefs, which support as much as a quarter of all marine life and supply food for half a billion people
- Ocean acidification
- Carbon absorption
- Coral bleaching
- Endangering marine life
- Disrupts the food chain

**Definition**
The spreading of harmful substances including oil, plastic, industrial/agricultural waste, and chemical particles into the ocean

**Pollution from landfills**
- Dumping is often considered the cheapest way of getting rid of garbage
- Can debilitate the growth of naturally growing fish

**Sewage**
- May contain harmful chemicals like mercury and cryolite

**Toxic chemicals from industries**
- Toxic liquids can directly affect marine life and increase the temperature of the ocean
- Can last for many years and invade ecosystems in the ocean
- When run-off occurs, man-made, harmful contaminants can enter the sea

**Noise pollution**
- From sonar devices and oil rigs
- Can disrupt the migration patterns and reproduction of whales
- Can snag or choke animals and harm them over a long period of time

**Large-scale oil spills**
- Can last for many years and invade ecosystems in the ocean
- Drilling for silver, gold, copper, etc., can create sulfide deposits deep in the ocean

**Ocean-mining**
- Can disrupt the migration patterns and reproduction of whales
- Cannot decompose, remains in the ocean for years
- Particularly harmful to turtles, dolphins, fish, sharks, and crocodiles

**Littering**
- Debris, especially plastic
- Cannot decompose, remains in the ocean for years
- Particularly harmful to turtles, dolphins, fish, sharks, and crocodiles

**Mindmap**
Source: New York Magazine
Week 3

Week of September 4th

This week our team focused on developing our idea through the creation of a mindmap. Initially, we mapped the issue of global warming broadly. However, throughout the duration of the course, we realized our project addressed the issue of pollution in the ocean more specifically, so we created a new mindmap that addressed its definition, causes, and effects.

To identify ways to alleviate the issue of sea pollution, we looked at its root causes. As shown in the mind map, several causes we found through research were poor waste management from landfills, sewage, toxic chemicals from industries, land run-off, oil spills, ocean-mining, noise pollution and littering.

After mapping out the various concepts, our team then narrowed down our focus to the issue of littering, particularly the waste management of non-recyclable materials. We found this topic particularly compelling since we see potential to improve student attitudes and behaviors regarding recycling on college campuses directly.

Image courtesy of Pinterest
A storyboard was used to illustrate the intended interaction between a user and Pandora’s Box. As shown below, the user would dispose of his waste after a meal. If he does not sort his trash correctly, Pandora’s Box would sense it and use visual and/or auditory cues to alert and motivate him to throw it into the correct bin.
A moodboard was used to illustrate the look and feel of Pandora’s Box. Using Pinterest, our team members compiled a series of images that resonated with the issue of plastic waste in the ocean. These ranged from products to elements of interior architecture.

While these images may not directly translate into the final prototype, they did help us to get a sense of colors and schemes that could help communicate the issue at hand. We also took into consideration different forms and materials.
This week our team created user personas. Our first persona was Aubrey Graham, a user whose qualities represented a typical Cornell student. She is aware of the environment but not always mindful of her actions and their consequences.

**PERSONA: Aubrey Graham, Student, 20**

Aubrey is a student athlete in ILR. She has a full schedule from 10am to 5pm, working and taking classes. She rides her bike or walks to class to stay in shape and tries to eat healthy. She has only short breaks for meals and is always in a rush. She is an extrovert, family oriented, and a lover of the outdoors.

**GOALS:**
- Save time
- Be healthy/mindful
- Succeed academically

**FRUSTRATIONS:**
- Time pressure
- Overwhelmed by decisions
- Long lines

**MOTIVATIONS:**
- Achievement
- Growth
- Social Pressure

User personas
After some reflection, our team decided to develop our personas further by creating Ken Kooke, a DEA faculty member whose responsibilities include teaching students, conducting research and publishing a paper. By diversifying our user personas and expanding our age range to an adult faculty member, we sought to refine our vision for the target user and create more diverse scenarios for our product’s potential users.
Collage

Week 6
Week of September 25th

In class, we learned about more ideation strategies that could help guide our design process including collage, co-design and morphological charts.

Co-design involved collaborating with a Senior in Design+Environmental Analysis to refine our product further. He said the model was very well executed, communicated the design well, and he would be more likely to recycle if it were implemented. However, he said a limitation of the design was that it was too static and needed to be more interactive. He suggested adding two separate light sources to help distinguish the scenes more.
This is a morphological chart our group used to illustrate the features and functions of our product. The strategy was both a brainstorming process and method of illustrating ideas. Although not all the features were included in the final prototype, they pushed us to consider different visual and auditory tactics that may alert potential users about the issue at hand.

<table>
<thead>
<tr>
<th>Displaying Box</th>
<th>Informing the scene</th>
<th>Scaring the viewers</th>
<th>Shocking the viewers (Scenes)</th>
<th>Where to situate</th>
</tr>
</thead>
<tbody>
<tr>
<td>[Diagram]</td>
<td>[Image: Diorama]</td>
<td>[Image: Red light blinking]</td>
<td>[Image: Scene]</td>
<td>[Diagram: Above the trash bin]</td>
</tr>
<tr>
<td>[Diagram]</td>
<td>[Image: Pop-up]</td>
<td>[Image: Vibration]</td>
<td>[Image: Scene]</td>
<td>[Diagram: On the wall]</td>
</tr>
<tr>
<td>[Diagram]</td>
<td>[Image: Paper cutting]</td>
<td>[Image: Warning sound]</td>
<td>[Image: Scene]</td>
<td>[Diagram: In front of the trash bin]</td>
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After learning about the process of ideation and prototyping, our team gathered together to build a quick mock-up of our vision so that we could test it with users and critics in an interactive way. Translating our design concept into 3D form allowed us to visualize the direction of the design as a team.

In our critique session, we learned that the curved shape of our prototype would be challenging to build so we revised our design to make it more rectangular. Receiving feedback also led us to consider the different materials we could use in our prototype. This led Pandora’s Box to evolve from using cardboard to wood and then to plastic.
The acronym SCAMPER refers to a process of revision that stands for Substitute, Combine, Adapt, Modify, Put to another use, Eliminate, and Reverse. Based on the feedback we received, our team used SCAMPER to alter and improve our design.

To substitute, we decided to use colorful paper instead of white. To combine, we decided that rather than having two scenes depict a polluted ocean and clean ocean, it would be more effective to unite the scenes into a single scene that succinctly conveyed the issue of pollution in the ocean. To adapt, we used wood instead of cardboard as our primary material. To modify, we changed our approach from applying both positive and negative reinforcement theories, to focusing on a single type of reinforcement that would alert the user about the issue at hand and avoid confusion. Putting our product to another use, we discussed the possibility of placing our product next to the sink, where it could also prompt people to conserve water. To eliminate, we decided to get rid of the doors that would open and close in our initial design. To reverse, we considered using light as a visual cue to grab people’s attention before showing them the scene of a polluted ocean.
The user suggested that the phrase “time is running out” was printed unclearly and suggested altering the trash to make it appear more obvious.

In the proceeding prototype, we decided not to include the phrase in our design as we found that the analogy was no longer relevant to our design and the name “Pandora’s Box” captured the essence of our design more effectively.

I think the words could be displayed more clearly. I did not immediately notice the phrase “time is running out,” primarily because it was sideways. I think I think that varying the color of the trash may also help it seem more obvious.
This user mentioned that it was difficult to see details of the scene in the gif/video. This comment was helpful because it led us to take more close-up shots of our product in our film documentation.

“It was hard to see details of scene in video, probably would be more clear in person.”

Week 8

Week of October 9th

These are samples of usability interviews of several students and the revisions our team made based on their responses. We developed features in our design which they said lacked clarity in communication of intent.
Week 9

Week of October 16th

These are samples of more usability surveys one member of our team conducted. Note that we sought to survey students of different ages of 19, 20, 21, and 22 to get a comprehensive understanding of our user group.

“There needs to be a message explaining what it is for passerby to know what it is.”

Even though our team considered this comment, we decided *not* to include a message because we believe that an effective visual illustration should be able to communicate the message without a literal message describing it.
“I think the lights can be more prevalent or brighter. I think they should use green instead of red. For the graphics, I think the left one should look more different from the right. In the future, I suggest mounting this higher up so it isn’t confused as miscellaneous trash.

Our team largely agreed with this comment. This led us to experiment with different colors of light (see next page) and consider how to place our design most effectively.
Week 10

Week of October 23rd

This week we did usability interviews asking students to rate our design in terms of their first impression of it, the extent to which its intention was achieved, and the effectiveness of our graphics. In addition, we asked five students about their impressions of different colors and what associations they brought to mind so that we could choose what color to light up our design with.

Tabulation of student survey results when asked to rate criteria out of scale of 1-5:

<table>
<thead>
<tr>
<th>First impression</th>
<th>Intention</th>
<th>Achievement</th>
<th>Graphic Communication</th>
<th>Effectiveness</th>
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Average 3.8          3.2          4

“It would be better to print the text on top, it would be less busy, more functional, and could get the idea across better and faster.”
1. How do you feel when you see this source of light?

Red
student 1: club
student 2: alertness, anxiety, anger
student 3: christmas, stopping, not move, go the direction
student 4: sex, action, high energy, underwhelmed
student 5: bad, negative thing

Orange
student 1: nice, elegant, normal color, aesthetically nice
student 2: more neutral, positive
student 3: a star on top of the tree (christmas), more of the daylight color, neutral
student 4: less depressed
student 5: neutral

Green
student 1: calmer than blue, natural
student 2: action, acceptance,
student 3: mint, most inviting, taste, move towards,
student 4: artificial mint chip ice cream
student 5: happy vibes

Blue
student 1: calm
student 2: calming, serene
student 3: calm, water, ocean, tide, lake, river, clean
student 4: spacious, bright, greater intensity
student 5: happy vibes but not validated

White
student 1: dont like, too bright, strong, fake color
student 2: neutral, blank slate
student 3: he confuses it with purple, his school color, smog, confused
student 4: relaxed
student 5: neutral, peaceful
Week 11

Week of October 30th

This week our project underwent a series of cognitive walkthroughs. A cognitive walkthrough refers to a usability evaluation method whereby one or more evaluators work through a series of tasks and ask a series of questions from the perspective of the user. The primary goal of the cognitive walkthrough is to develop a better understanding of how effectively new or infrequent users can learn and navigate the system’s features and functions. In this case, the users were asked to speak about his or her experience of the prototype.

"It would be really cool if the scene could move so the user doesn’t get bored."

Stephanie:

- I think it’s good because it makes people care more about the environment at first glance.
- Maybe applying motivational strategies or incentives would be a good way to push people to act.
- I could also see how it could work as a game or toy because I like playing iPhone games myself.
- Maybe change the background to a black material or glass to make it look more polished.

In response to the proposed changes, we designed interchangeable layers into our design.
Brian:

- The trash was not aesthetic enough
- Maybe make the design more consistent
- Text could be printed or engraved horizontally so that it is easier to read
- It would be really cool if the scene could move or if you could change out the scenes for variation so the user doesn’t get bored
- Make sure the lights work in the final presentation
- Only use the app in the final design if it ties into the existing design strongly
After gathering and evaluating user feedback, we discovered that users were products that used social reinforcement strategies gathered over long periods of time. They were also responsive to incentives or rewards.

Bearing this in mind, we thought it would be interesting to iterate a new feature for our product by designing an app that would enable users to track their recycling activities through a live feed and incentivize their recycling behavior through a point system.

Screen 1

This is a mock-up of the app design. Screen 1 shows the welcome screen. We decided to use the laser-cut design as the background to keep the design of the box and the app consistent.

Screen 2

In the second screen, the user can view his or her profile and a live newsfeed of his or her friends’ recycling activities. Each user has a point system that reflects his or her recycling behavior.

Screen 3

By clicking the “My Profile” tab, the user can view his or her progress over several days, weeks, or months. Similarly, the user can track the progress of their friends through the newsfeed.
Screen 3
By clicking the “My Profile” tab, the user can then view his or her recycling progress over the course of several weeks, or months. Similar to a health app, the user could check his or her progress over a time frame.

Screen 4
Proceeding to click the “view progress” button, the user can then see the number of points he or she has accumulated by recycling. In this example, the user is at Level 1 and has 238 points.

Screen 5
When the user achieves a certain number of points, the app will light up to indicate that the user has leveled up. The intention is for the user to treat the app like a game that can incentivize his or her recycling behavior.

Screen 6
Now, the user has reached Level 2 and may continue to gain points. With the “Live Feed” feature, friendly competition may encourage him or her to keep recycling until it becomes a habit.

Market Research
An existing app that inspired this app idea is NikeFuel. The app motivates users to exercise by counting how much exercise he or she has done and converting calories to points that can be accumulated over a period of time.

Images courtesy of Nike, Inc.
Week 13

Week of November 13th

The Delphi Method refers to a process by which a panel of design experts evaluate a designed prototype. The experts answer a series of questionnaires in two or more rounds. After each round, a facilitator provides a summary of the experts’ reviews from the previous round as well as the reasoning behind their judgments. Experts are encouraged to revise their answers based on the replies of other members of the panel.

By conducting the Delphi Method, our team was able to identify the strengths and limitations of our design. Strengths include the prototype’s first impression, its graphics, and its physical design. An area to improve was the lack of clarity in the communication about the issue of plastic waste in the ocean, because some users mistook our design as simply being a scene of the ocean.

During this session, we pitched the idea of an app that could further speak about the relationship between people’s recycling behaviors and their impact on the environment, but since people expressed neutral reviews, we decided that it was not worth pursuing further and decided to focus more fully on the design of Pandora’s Box itself.
DELPHI METHOD

1. What is your first impression of the prototype's look?
   Very Bad 1 2 3 4 5 Very Good

2. How did the intention of the design—making sure people recycle—come across?
   Not well at all 1 2 3 4 5 Very well

3. What do you think of the graphics? More striking color
   Very ineffective 1 2 3 4 5 Very effective

4. What do you think of the physical design?
   Very Bad 1 2 3 4 5 Very Good

5. Do you understand what the scenes are communicating?
   Strongly disagree 1 2 3 4 5 Strongly agree

6. Does this statement apply to you: “This prototype is not relevant at all”?
   Strongly disagree 1 2 3 4 5 Strongly agree

7. Potentially, would you prefer it if there is an app that allows you to interact with the design and be more informed about current problems?
   Strongly disagree 1 2 3 4 5 Strongly agree

8. Which position do you prefer the brand name to be on?
   in front of the box
   Strongly disagree 1 2 3 4 5 Strongly agree

   On top of the box
   Strongly disagree 1 2 3 4 5 Strongly agree

9. What do you think of the name PANDORA for the product? Which one do you prefer: Pandora or Pandora’s Box?
   Pandora’s Box

10. Do you have any general suggestions for the prototype?
    More robotic. Moving whales
    Having a relationship w the recycle.
    Give an option for a positive reinforcement.
    The location of the box is important, located where people are aware of what to do next.
    More trash ..the clear plastic is good
The System Usability Scale is a standardized summative test that informed us about the usability of the devise. We asked people to evaluate our project in terms of how complex, easy to use, and well integrated it was, among other criteria. We interviewed five people ranging from ages 22 to 30. Below are several samples of the survey results.
According to our findings, Pandora’s Box scored in the acceptable range, with one outlier in the low range. This means that it was largely acceptable to the users we tested. Since the SUS scale was conducted at the end of the project and was a summative evaluation, our survey findings did not lead to any changes in our final design.
Week 14

Week of November 21st

This week we developed our prototype further. Two team members worked on the design of the box that would hold the ocean scene, while two team members worked on designing the layers for the scenes. The box was digitally designed and 3D-printed, while the layers were laser-cut. The box was intricately designed with consideration of the placement of the power cord, servo motor, layers of paper inserts, and motion sensor. Six layers of ocean scenes were created, including outlines of the coral reef, endangered whales, trash, and bits of plastic. The bits of plastic were later glued to a layer of acrylic that was placed on the outermost layer as a protective shield.
When choosing the color scheme for our layers, we chose to use complementary colors of orange and blue to create the most visually striking effect.

Several color schemes we considered:
We tested our prototype in Martha Van Rensselaer Hall’s common area. Pandora’s Box was placed on a landfill bin and members of our team observed how students and faculty members interacted with it. While people’s responses varied, the prototype did achieve its main goal of raising awareness about the issue of plastic waste in the ocean.
Week 15

Week of November 28th

This week saw the completion of our prototype of Pandora’s Box! Over the course of several days, our team members took turns designing and developing different components of our design to include in the final prototype.

In response to the feedback we received, our final product features a whale that moves when triggered by a user disposing trash, as detected by a motion sensor. The motion of the whale was made possible by using a servo motor connected to a USB cable.

The modified design features five interchangeable layers of illustrations depicting the ocean and marine life. The layers are laser-cut in different shades of blue. Additionally, the improved design features a glass panel as a protective outermost layer to prevent tampering by users since the design is intended to be implemented in the context of a college campus.

One possibility for future development is to explore how effective Pandora’s Box could be among students at younger ages, such as in elementary schools. After modifying our design, our team noticed that the look and feel of Pandora’s Box resembles a children’s toy, thus may be more effective in igniting the imagination and prompting a child to become more environmentally aware and mindful than a college student or faculty member. Experimenting with this focus user group may be helpful for future market research.