MARINE BIODIVERSITY INNOVATION CHALLENGE
COURSE SYLLABUS

Create Innovative Solutions to Society's Complex Challenges

Instructor: Program Lead: New York Academy of Sciences
Course Time & Format: 10 weeks; approximately 2-4 hours weekly
Format: Blended; Online
Age Level: 13 - 17 years old

COURSE DESCRIPTION & OBJECTIVES

Innovation Challenges are an introduction to foundational concepts of design thinking with an emphasis on developing and testing new solutions to society's greatest challenges. The Marine Biodiversity Innovation Challenge requires students to work in self-selected, distributed teams, requiring cross-cultural communication, dynamic problem solving, deep critical thinking related to society, leadership and project management skills.

Students must first identify their project team and then work together with a mentor to apply design thinking processes to approach the real-world health problems of air pollution in an innovation challenge with the Junior Academy. While each student must identify their own role within the team, together they will learn how to identify and map out a real problem and ways to build and test solutions quickly through an iterative, scientific approach. This course requires extensive student collaboration and regular engagement through The Academy's Junior Academy and its online platform, Launchpad.

THE CHALLENGE

New York City has committed to building a fully renewable electricity grid within the next 15 years. Offshore wind farms are expected to play a large role in meeting that commitment. Not only is offshore wind an abundant and renewable resource, it also provides the greatest amount of energy in the afternoon and evening - just when energy demand is at its peak. Unfortunately, wind farms can present environmental challenges, at the same time that they solve others. Building giant wind turbines in the ocean runs the risk of changing and/or damaging sensitive marine ecosystems and wildlife populations on the seafloor as well as in the water column. While submerged human-made objects can attract wildlife and even provide habitat for marine communities, these communities do not always support as much biodiversity as natural habitats. Innovative solutions are needed to ensure that offshore wind farms offer a truly sustainable

energy source for coastal communities and cities worldwide. How could disruption and damage be minimized? How could you use design thinking to thoughtfully and intentionally plan and build wind farms capable of not only maintaining, but improving marine habitats and increasing biodiversity in the marine ecosystem of New York City?

Student Challenge: **To design an innovative solution that supports marine biodiversity by creating or improving marine habitats within or around offshore wind farms, while also minimizing disruption and damage to the ocean floor and water column during installation and operation.**

Students will work collaboratively to consider the following when designing their teams' solution:

- How could your solution also incorporate strategies for ongoing environmental monitoring and mitigation to ensure long-term ecosystem health?
- What will motivate industry to implement your solution?
- What policies might need to be implemented at the government level to fully realize your solution?
- How will materials be sourced? Will there be a downstream environmental impact?
- What will your solution cost? Will it be a practical choice?

LEARNING OBJECTIVES

INNOVATION CHALLENGE LEARNING OBJECTIVES *At the end of this course, students will be able to*:

- Develop critical thinking and problem-solving skills through brainstorming techniques to develop ideas and design a solution to a complex problem.
- Develop their own arguments and analyze competing perspectives to a complex problem with supporting evidence.
- Develop a deeper, personal civic identity and clearly identify their role in their community.
- Develop a solution that could play a part in transforming a specific societal need regarding a larger issue that is transferable to a specific community and larger global community.
- Use data and insights of an inquiry to answer a research question using scientific terms in charts, tables, or graphs.
- Utilize a social justice lens when applicable to interpret the data and critically think about which groups are not represented around decision making.
- Effectively communicate ideas, data and insights using various forms of media.
- Effectively collaborate with team members with empathy and mutual respect, and develop an expanded perspective about how people from other countries see the world.

- Effectively communicate challenge specific variables that impact the environment, society, and economy including examples of the effect on local communities.
- Understand how to apply Design Thinking methods to understand what users need, and how to develop solutions to meet those needs.
- Learn how to actively listen, work through any disagreements, and solicit input from people in creative ways to generate new ideas.
- Learn how to test ideas and develop rapid prototypes.
- Identify corresponding careers connected to Innovation Challenge.

COURSE OUTLINE

TIME	TOPIC	ASSIGNMENTS	FORMAT
Week 1	• Getting Started w/Junior Academy • Onboarding	• Join Launchpad Platform • Review Junior Academy Orientation • Attend Virtual Kick Off Week • Complete Course Pre-Survey	Individual
PHASE 1 Challenge Team Formation			
Week 2	Challenge introduction • Background on your Challenge • Finding Mentors & Experts • Reaching out to experts	• Complete Required Weekly Reading • Engage in Launchpad Discussions • Complete activities found in resource library	Collaborative
Week 3	Team Building • Forming Your Team • Holding a Virtual Team Building • Creating a Team Comm's Plan	• Engage in Launchpad Discussions • Hold 1st Team Meeting • Complete Required Weekly Reading • Due Milestone #1: Team Dynamics	Collaborative
PHASE 2 Research, Brainstorm & Plan			
Week 4	Researching • Gathering relevant and diverse materials, articles, books, and sources • Developing research questions and interviewing	• Engage in Launchpad Discussions • Engage/Meet with your Team • Complete Required Weekly Reading	Individual Collaborative
Week 5	Brainstorming • Team Concept Brainstorm • Develop How "Might We" Ideas • Building Team Empathy	• Engage in Launchpad Discussions • Engage/Meet with your Team • Complete Required Weekly Reading	Collaborative

Week 6	Design & Plan • Categorizing & Bundling Ideas • Deciding & creating your concept • Developing a user testing plan	• Engage in Launchpad Discussions • Engage/Meet with your Team • Complete Required Weekly Reading • Due: Milestone #2: Design & Test Plan	Individual Collaborative
PHASE 3 Build, Test & Analyze			
Week 7	Build • Creating a Prototype • Build storyboard & journey map • Identifying your variables • Rapid Prototyping	• Engage in Launchpad Discussions • Engage/Meet with your Team • Complete Required Weekly Reading	Collaborative
Week 8	Test & Analyze • Conducting User Testing • Getting User Feedback • Analyzing your data Results	• Engage in Launchpad Discussions • Engage/Meet with your Team • Complete Required Weekly Reading • Due: Milestone #3 Analyze Results	Collaborative
PHASE 4 Iterate & Develop Final Projects			
Week 9	Iterate • Modifying your concept design based on your results • Refining & re-test your prototype	• Engage in Launchpad Discussions • Engage/Meet with your Team • Complete Required Weekly Reading	Individual Collaborative
Week 10	Develop Final Project • Creating draft of Final Project • Project Feedback & revision • Submitting Final Project • Complete Course Post-Survey	• Due: Executive Summary • Due: Final Team Presentation • Due: Personal Reflection • Complete Course Post-Survey	Individual Collaborative
New York Academy Challenge Final Project Review & Grading			

COURSE ASSIGNMENTS	**% of FINAL GRADE**
Milestone #1: Team Dynamics: This assignment is focused on team building and planning for how students will work together.	10%
Milestone #2: Design & Test Plan: This assignment is focused on the Team's proposed solution, hypothesis and test plan.	10%
Milestone #3: Build, Test & Analyze: This assignment is focused on building, testing and analyzing data related to your solution.	10%
Team Collaboration & Online Engagement throughout course	20%
Final Presentation, Executive Summary & Personal Reflection Final Presentation Rubric	50%
	(100%) **Final Grade**

GRADING POLICY

Late-work policy: Milestones 1-3 are allowed to be submitted late for point deduction. Late submissions of the Final Solution Presentation for this course will not be accepted after the due date unless previously arranged with **the Academy** for extenuating circumstances. It is important to stay up-to-date on assignments since much of the work builds on previous assignments and will impact students' ability to be effective in providing solutions for their teams' projects.

Re-grade policy: If a student thinks there has been a technical error in the grading of an assignment, they should email program administration at the Academy within one week of receiving the graded assignment, otherwise the assignment will not be regraded. Feedback is provided upon request.

REQUIRED READING LIST

Students are expected to read and refer to a wide variety of texts throughout this course; all of which can be found in the Launchpad Resource Library.

Please see a sample of the Resource Library reading list for this challenge:

Week 1

- Launchpad Platform, Launchpad
- Junior Academy Orientation, Launchpad

Week 2

- Marine Biodiversity Challenge Background, Launchpad
- Air Pollution, World Health Organization (WHO)
- Air Pollution: Everything You Need to Know, NRDC

Week 3

- What is Human Centered Design?, Video Design Kit, Innovation, Design, Engineering & Organization (IDEO)
- Design Thinking for Problem Solving, Video Design Kit, Innovation, Design, Engineering & Organization (IDEO)

Week 4

- Offshore wind 101 (NYSERDA)
- What is offshore wind energy? (WINDExchange)
- Introduction to floating offshore wind technology (Maine Fishermen's Forum)
- Floating offshore wind outlook (International Renewable Energy Agency)
- Empire Wind: About the Project
- What Does Offshore Wind Energy Look Like Today? (US Dept. of Energy)
- Dogger Bank Offshore Wind Farm (SSE Renewables)
- Hornsea Wind Projects

Detecting seafloor anomalies (NOAA)
Seafloor mapping (NOAA)
Underwater sea vehicles (NOAA)
AI Applications in Wind-Energy Systems (Wind Systems Magazine)
Masoumi, Masoud Machine Learning for Offshore Wind, *J. Mar. Sci. Eng.*, 11(10), 1855 (2023)
8 Types of Dredging Projects US Aqua Services
Fundamentals of Dredging Western Dredging
What is Vibratory Pile Driving and How Does it Compare to Impact Pile Driving? (University of Rhode Island
Nationwide Recommendations for Impact Pile Driving Sound Exposure Modeling and Sound Field Measurement for Offshore Wind Construction Plans (Bureau of Ocean Energy Management)
Wind Energy & Environmental Impacts (University of Maryland Center for Environmental Science)
Impacts of Wind Power (Union of Concerned Scientists)
As Offshore Wind Ramps Up, Scientists Flag Potential Impacts (Undark)
Offshore Wind Development and Marine Mammals (Marine Mammal Commission)
Offshore Wind Energy: Assessing Impacts to Marine Life (NOAA) (also available as PDF)
Potential Impacts of Offshore Wind on the Marine Ecosystem and Associated Species (Undark)
Offshore wind farms could change ocean ecosystems in unexpected ways (Anthropocene)
Offshore wind farms could cause significant ecosystem, economic and human health risks (University of Portsmouth
A Look Underseas (The Nature Conservancy)
Turbine Reefs: Designing Offshore Wind Power to Improve Habitat for Marine Life (Nature)
Offshore wind farms could change ocean ecosystems in unexpected ways (Anthropocene)
Priest, III, Walter I. and Janet Nestlerode Use of Dredged Material for Oyster Habitat Creation in Coastal Virginia, *Oyster Reef Habitat Restoration: A Synopsis and Synthesis of Approaches,* Proceedings from the Symposium, Williamsburg, VA (1995)
Rigs-to-Reefs (US Dept. of the Interior)
Interviewing Experts, Design Kit, Innovation, Design, Engineering & Organization (IDEO)
Interviewing Individuals, Design Kit, Innovation, Design, Engineering & Organization (IDEO)
Interviewing Groups, Design Kit, Innovation, Design, Engineering & Organization (IDEO)

Week 5

How Might We, Design Kit, Innovation, Design, Engineering & Organization (IDEO)
Brainstorming Rules, Design Kit, Innovation, Design, Engineering & Organization (IDEO)
How to Facilitate a Brainstorm, Stanford D School, 2020

Week 6

Bunding Ideas, Design Kit, Innovation, Design, Engineering & Organization (IDEO)
Doing a Gut Check, Design Kit, Innovation, Design, Engineering & Organization (IDEO)
Creating a Concept, Design Kit, Innovation, Design, Engineering & Organization (IDEO)

Week 7

Determine What to Prototype, Design Kit, Innovation, Design, Engineering & Organization (IDEO)
Rapid Prototyping, Design Kit, Innovation, Design, Engineering & Organization (IDEO)
Prototype to Test, Design Kit, Innovation, Design, Engineering & Organization (IDEO)
Identify a Variable, Design Kit, Innovation, Design, Engineering & Organization (IDEO)

Storyboards & Journey Maps, Design Kit, Innovation, Design, Engineering & Organization (IDEO)
Tinkercad, Autodesk

Week 8

Get Feedback, Design Kit, Innovation, Design, Engineering & Organization (IDEO)

Testing with Users, Design Kit, Innovation, Design, Engineering & Organization (IDEO)

Research Methods, Launchpad

Week 9 - Week 10

Integrate Feedback & Iterate, Design Kit, Innovation, Design, Engineering & Organization (IDEO)

How to Create a Presentation, Launchpad

How to Create Video Presentations, Movavi
Presentation Guidelines, Launchpad