

CLIMATIZING INFRASTRUCTURE: GREEN RETROFIT 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 Climatizing Infrastructure: Green Retrofit 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 real-world Climate Change problems 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

A transition to clean and efficient energy use is essential for the successful progression of society in a world of increasing climate change effects and decreasing reliance on fossil fuels. Retrofitting existing infrastructure provides the opportunity to make changes right away rather than waiting for new development. Retrofitting can also be less expensive, more accessible, and more efficient than complete rebuilds. Possible retrofitting solutions could offer strategies for decreasing costly energy consumption and increasing efficient renewable energy production.

Innovative approaches to retrofitting can support energy conservation and allow individuals and communities to produce and even push clean energy back into the main grid. How could you use design thinking to thoughtfully and intentionally retrofit existing infrastructure and systems to maximize renewable energy production and/or efficient energy use? How could individuals and

institutions work together to implement your solution on a community-wide, city-wide, or regional scale?

Student Challenge: To design an innovative solution for communities and urban areas to retrofit existing infrastructure for renewable energy production and efficient energy use.

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

- Your solution should be based on available data and research. Solutions may include new innovations and/or alterations and expansions of existing technology.
- You may define and delimit a specific territory for your study, like choosing a particular city or region for a case study.
- What will motivate industry to implement your solution?
- Your solution should focus on technical solutions, but you may include advocacy-based recommendations for increasing awareness and buy-in from various stakeholders in the community for the required infrastructure changes.
- How can you scale your solution to work for more regions or cities?
- How can you make your solution accessible to more communities? Consider affordability, cultural adoption, and accessibility of resources.
- Could you incorporate AI into your solution? If so, how will you ensure that the water and energy demands of AI do not counteract the benefits of your solution?
- How could your solution also incorporate strategies for ongoing energy monitoring to ensure long-term sustainability?
- 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
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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

Climatizing Infrastructure: Green Retrofit Challenge Background, Launchpad

- [What Is Retrofitting? – Unlocking A Building's Potential](#) (City Changers)
- [Building Retrofits: Why upgrade our existing buildings](#) (World Green Building Council)

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

[A guide to retrofitting \(and how it could help us reach net zero\)](#) (University of the Built Environment)
[Healthy and Efficient Retrofitted Buildings Tool \(HERB\)](#)
[Deep retrofits: how repurposing old buildings can mitigate climate change](#) (World Economic Forum)
[How to achieve net zero in building retrofits: Challenges and expert advice](#) (Civil Engineering Source)
[Retrofitting Community Buildings to Support Climate Resilience](#) (Canada Green Municipal Fund)
[Energy Efficiency 101](#)
[Energy Efficiency 2025](#)
[Retrofitting Existing Infrastructure for Energy Efficiency](#) (Earth.org)
[Mayor Mamdani, Governor Hochul and MTA Announce Plan to Lower Subway Platform Temperatures and Harness Thermal Energy in Lower Manhattan](#) (NYC Government)
[What are the challenges of renewable energy in power markets?](#) (Montel)
[Transitioning to renewable energy: Challenges and opportunities](#) (PennState Institute of Energy and the Environment)
[Renewable energy sources: Progress, challenges, and environmental benefits](#) (Renewable and Sustainable Energy Reviews)
[Renewable Integration](#) (Pacific Northwest National Laboratory)
[Renewable energy – powering a safer and prosperous future](#) (United Nations)
[Exploring Renewable Energy and Sustainability for a Better Future](#) (International Journal of Environmental & Agriculture Research)
[2026 Trends: Renewable Energy and Solar Research](#) (Rated Power)
[What is Energy Flexibility](#) – video (Digital Catapult)
[Energy Flexibility](#) (GridX)
[Load Flexibility](#) (California Energy Commission)
[Consumer vs Prosumer: What's the Difference?](#)
[Are Prosumers the Future of the Renewable Energy Transition?](#)
[What is Biomimicry?](#) (Miomimicry Institute)
[10 Biomimicry Examples in Renewable Energy](#) (Learn Biomimicry)
[Biomimicry, an Approach, for Energy Efficient Building Skin Design](#) (Procedia Environmental Sciences)
[How artificial intelligence can help achieve a clean energy future](#) (MIT News)
[AI for energy optimisation and innovation](#) (International Energy Agency)
[AI's impact on energy efficiency and electricity consumption: Evidence from AI green computing power in China's National Green Data Centers](#) (International Review of Economics and Finance)
[What is Green Infrastructure?](#)
[Ecosystem service delivery by urban agriculture and green infrastructure – a systematic review](#)
[Building green infrastructure to enhance urban resilience to climate change and pandemics](#)
[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