CIRCULAR TEXTILES INNOVATION CHALLENGE
INDEPENDENT STUDY 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

INDEPENDENT STUDY CREDIT

While core courses required for graduation cannot typically be replaced with independent study credit at most schools, students can seek "alternate" credit for an Independent study in order to satisfy an elective requirement at most Schools. Moreover, pending school approval, students at IB Schools may be able to gain credit from this course as part of their CAS Project.

While Independent Study credit approval policies vary from school to school; the general criteria for earning Independent study credit at IB World Schools is typically as follows:

- The International Baccalaureate Organization does not allow an Independent Study to replace any core IB courses, but alternate credits and/or CAS credit may be permitted with school approval.
- The maximum value for a single Independent Study alternate credit is 0.5 credit.
- Independent study courses must be teacher-directed, supervised by a certified teacher and approved by the School Principal/HeadMaster/Dean of Curriculum.
- It is expected that the student will complete the work independently and the teacher will provide guidance, oversight, and assign a grade.
- Students need to seek approval for an independent study application from their home school prior to student work commencing.

COURSE DESCRIPTION & OBJECTIVES

This is an online independent study course serving as an introduction to foundational concepts of design thinking with an emphasis on developing and testing new solutions that adapt steps in the "take-make-waste" textile supply chain to fit the circular textile model. At the same time, Circular Textiles, like many STEM Innovation Challenges, requires students to work in cross-cultural, distributed teams, requiring cross-cultural communication, dynamic problem solving, 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 problems of the unsustainable "take-make-waste" supply chain model. 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 NYAS's Junior Academy and its online platform, Launchpad. Students interested in pursuing this path should notify Program Administration (education@nyas.org) at the beginning of their Junior Academy challenge. Students can request a course or challenge grade, according to the challenge rubric, from The New York Academy of Sciences at the end of their challenge.

THE CHALLENGE

The textile industry has a significant impact on the environment and society, one example is its linear "take-make-waste" model. Clothing production has doubled in the past 15 years, leading to overproduction, resource depletion, and environmental degradation. This not only applies to clothing but the technical or industrial industries that rely heavily on textiles such as the medical field, agriculture, and hospitality. In this challenge, participants are tasked with designing innovative solutions that address the social, environmental, and economic issues within every aspect of the textile value chain. We encourage participants to think not only about clothing and fast-fashion, but other industries that use textiles on a large scale in a take-make-waste model. The goal is to promote a sustainable and circular textile industry that delivers better outcomes in terms of social impact- including the labor aspect, environmental responsibility, and economic efficiency.

Student Challenge: **To choose one aspect of the "take-make-waste" textile supply chain and design an innovative adaptation to fit the circular textile model**. Students will work collaboratively to consider the following when designing their teams' solution:

- Go beyond fast fashion to consider additional industries such as medical, agricultural, and hospitality industries, among others.
- Consider approaching the challenge from different issues including environmental, social and/or economic perspectives.
- Consider addressing one or more of the various points along the life of a textile such as raw materials, various stages of manufacturing, design, training and human resources, transportation and shipping, etc.

- Consider what agents of change can be part of the solution: designers, consumers, farmers, policy makers, shop clerks, influencers, etc.

LEARNING OBJECTIVES

NEXT GENERATION SCIENCE STANDARDS (NGSS):

Engineering Design *At the end of this course, students will be able to:*
ETS1-1 Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

ETS1-1 Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

ETS-2 Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

ETS1-3 Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

ETS1-3 Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural and environmental impacts.

ETSI-4 Develop a model to generate data for interactive testing and modification of a proposed object, tool or process such that an optimal design can be achieved.

ETSI-4 Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions between systems relevant to the problem.

One or more additional standards may be met depending on the student's approach to the challenge.

Energy *At the end of this course, students will be able to*:
PS3-3 Apply scientific principles to design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

Earth & Human Activity *At the end of this course, students will be able to*:

ESS3-2 Evaluate competing design solutions for developing, managing and utilizing energy based on cost-benefit ratios.

Ecosystems: Interactions, Energy & Dynamics *At the end of this course, students will be able to*:
L2-5 Evaluate competing design solutions for maintaining biodiversity and/or ecosystem services.

INNOVATION & DESIGN THINKING 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.
- Use data and insights of an inquiry to answer a research question using scientific terms in charts, tables, or graphs.
- Effectively communicate ideas, data and insights using various forms of media.
- Effectively collaborate with team members and develop an expanded perspective about how people from other countries see the world.
- 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 and solicit input from people in creative ways to generate new ideas.
- Learn how to test ideas and develop rapid prototypes.

CIRCULAR TEXTILES LEARNING OBJECTIVES *At the end of this course, students will be able to*:
- Differentiate between a "take-make-waste" economic model and a circular economic model.
- Describe the various steps along the "take-make-waste" textile production model.
- Be able to articulate various factors that make the current linear production system unsustainable.
- Explain the impact of the current textile production system on the environment, society, and economy.
- Design a solution that could play a part in transforming the textile industry into a circular model.
- Understand the variety of career opportunities that exist within the textile industry.
- Identify various careers in the field and have the confidence to pursue future learning and/or a career in textiles, circular production and/or sustainability.

COURSE OUTLINE

TIME	TOPIC	ASSIGNMENTS	FORMAT
Week 1	• Getting Started w/Junior Academy • Complete Course Pre-Survey	• 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 on circular economy	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 • Circular economies and textile production • 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 <u>Analyze Results</u>	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: <u>Executive Summary</u> • Due: <u>FInal Team Presentation</u> • Due: <u>Personal Reflection</u> • 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: Late work 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.

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 and are organized by week below.

Week 1

Launchpad Platform, Launchpad

Junior Academy Orientation, Launchpad

Week 2

Circular Textiles Innovation Challenge Background, Launchpad

What is the linear economy?, Ellen MacArthur Foundation

Sustainability and Circularity in the Textile Value Chain - A Global Roadmap, UN Environmental Programme

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

What is Circular Economy and Why does it Matter?, United Nations Climate Promise

Stahel, Walter R., "The Circular Economy", *Nature*, V531, 435-438, 2016.

How to Build a Circular Economy, World Resources Institute

The Actual Definition of Textile & Its Surprising Difference from Fabric, Contrado

What are the five different types of textiles? , Yorkshire Fabric Shop

Environmental impact of textile fibers – what we know and what we don't know, Mistra Future Fashion

Filho, Perry, Heim, Pimenta Dinis, Moda, Ebhuoma & Paco, "An overview of the contribution of the textiles sector to climate change", Frontiers, V10, 2022.

Planned Obsolescence vs Perceived Obsolescence, Intentionally Sustainable

Redesigning the Future of Fashion, Ellen MacArthur Foundation

Fighting Fast Fashion: Innovation for a Circular Economy, Clean Tech

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)

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

CIRCULAR TEXTILES INNOVATION CHALLENGE
Evaluation Rubric

	Exemplar (8-10 points)	Proficient (5-7 points)	Developing (3-4 points)	Emerging (1-2 points)
Innovation & Design Thinking: ● **Is the design and approach unique and/or Innovative? Does the design show a high degree of originality and imagination?** **10 Points**	The solution and approach is highly unique and/or innovative and represents a breakthrough in thinking about the problem. The design shows a high degree of originality and imagination.	At least one major element of the solution is novel.	Minor elements of design or solution are novel.	Design or solution is a copy of an existing design or exists in everyday life. The design is presented without alteration. .
Scientific Quality: ● **Are the appropriate references and analytical methods used and are the insights derived correctly?** **10 Points**	Team clearly describes and explains their solution to the challenge statement. Team also provides numerous examples supporting their solution and why they chose to pursue them.	Team mostly describes and explains their solution to the challenge statement. More examples and supporting material to their solution could be helpful.	Team somewhat describes the solution in the challenge statement and provides a few examples that support their solution.	Design or solution does not describe or explain their solution to the challenge statement. Team does not provide examples or methods used.
Presentation Quality: ● **Is this concept concisely and clearly explained?** **10 Points**	Presentation delivery is exceptionally clear and concise; addresses each required element. Visuals are used to enhance the presentation and slide guidelines are followed.	Delivery is clear and concise and addresses each required element effectively. Length and number of slides have adequate information and visually make sense..	Delivery explains how design works, but is wordy, repetitious, or missing some key elements. Length and number of slides have adequate information and visually make sense..	Delivery is unclear, inaccurate, or missing required elements. Length or includes too many or too few slides.

Commercial viability/Potential ● **Does the solution have the potential to make a difference?** **10 Points**	It is clear that many people or everyone in the target audience would use this solution and it could be realized with existing technology or only one "large" invention step.	It is clear that many people would use this solution. This solution requires 2 or more "large" invention steps.	A select group of people would use this solution. Many new technologies must be invented to implement this solution widely.	It is not clear who would use the solution. Many new technologies must be invented to implement this solution widely.
Sustainability ● **What is the social impact? How does the solution incorporate positive environmental objectives? Is the solution in line with a sustainable future?** **10 Points**	The solution would have significant social impact over a large area. The technology could easily be scaled to any size.	The solution would have significant social impact within a limited area. The technology could be scaled somewhat.	The solution would have moderate social impact. The technology could be scaled somewhat.	The solution would have little social impact. The technology could not easily be scaled.
Teamwork & Collaboration ● **Was the experience a collaborative endeavor? (From Personal Reflection)** **10 Points**	The Team functioned well with all members contributing AND members worked to encourage and teach each other.	The Team functioned well with all members contributing.	The Team functioned well most of the time, but some members were more engaged than others.	The Team required a lot of adult intervention to ensure all members contributed/were included or not all team members contributed equally.