WEARABLES 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 using wearables to address the public health issues of non-communicable diseases or to meet the needs of disaster warning or response. At the same time, Wearables, 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 non-communicable diseases or natural and manmade disasters. 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. If a student wishes to complete an independent study, they must work with their school to gain the necessary documentation and permissions. 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

Wearable technology has come a long way since the mood rings of the 1970's. Even the once cutting-edge step-counters of 2010 have evolved into finely tuned fitness trackers, sensing everything from heart rate to sleep efficiency, turning our bodies into data producing machines. This wide range of sensors and microprocessors that are worn on the body take the shape of jewelry, accessories, clothing, pet collars, and medical devices - including implants and even some prosthetics! Thanks to increasing digital connectedness - through technologies like bluetooth, 5G, and the Internet of Things (IoT) - wearables are capable of nearly instantaneous responsiveness. They hold the potential to be game-changing, life saving tools in the face of challenges where the ability to detect data changes in real-time and rapid communication are critical. Commercial wearables also give us an incredible picture into the health and wellbeing at the population level. With proper privacy practices in place, innovators have the opportunity to address our biggest challenges in public health. Advances in the cognitive capabilities of artificial intelligence (AI) offer many new possibilities from access to data, better queries of the data and greater sensitivity to changes in the data. While considering all of the potential, we must also consider the rising importance of privacy and ethics in innovation and research.

Up until now wearables have been primarily used with the individual in mind. How powerful could this individual data collection and response be if it were aggregated and used to address community or global issues in real-time? Take, for instance, disaster management. Whether natural disaster or manmade, a connected system of wearables could be the key to timely and specialized detection, warning and/or response. Or consider non-communicable diseases such

as cancer, heart disease or diabetes. The next generation of wearable technology could be dynamic and targeted tools for public health responses.

Student Challenge: **To design or employ a wearable technology, or network of wearables, that can be utilized to address one of the following key areas:**

1. **public health issues surrounding non-communicable diseases.**
2. **natural or manmade disaster warning or response.**

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

- Consider not only humans as the recipients of the wearable technology but a solution that could be extended to pets or wild animals.
- Consider the ethics in wearable technology and data sharing- what are the pros and cons.

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.

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

- Describe various types of wearable technology.

- Identify opportunities for employing current wearables and cutting edge wearable technologies to address local and global issues.
- Assess the pros and cons of personal data sharing.
- Evaluate the ethics of wearable technology and consider how to keep personal data safe.
- Explain the impact that natural and manmade disasters have on humans on local and global levels.
- Explain the impact that non-communicable diseases have on public health.
- Develop a design solution that could use wearables to address public health or disaster management.
- Understand the variety of career opportunities that exist within the wearables workforce.
- Identify various careers in the field and have the confidence to pursue future learning and/or a career in wearable technology.

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 wearables	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 • Wearable technologies • Disaster management • Non-communicable diseases • 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/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: 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

Wearables Innovation Challenge Background, Launchpad

Wearable Technology, TechTarget

A Survey on Wearable Technology: History, State-of-the-Art and Current Challenges, Computer Networks

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 a sensor? , Tech Target

End-to-end design of wearable sensors, Nature

"What is Bluetooth?": A beginner's guide to the wireless technology, Business Insider

The Disappearing Computer - and a World Where You Can Take AI Everywhere, TED Talk

Noncommunicable Diseases, World Health Organization

What is public health?, Harvard School of Public Health

Our Wearable Future, Part 1: What Will New Tech Look Like?, WebMD

Our Wearable Future, Part 2: How Will New Tech Work? , WebMD

11 Ways Wearable Technology Can Do Good in Disasters, American Red Cross

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

The New York Academy of Sciences

WEARABLES 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:	Presentation delivery is exceptionally clear and concise; addresses each required element.	Delivery is clear and concise and addresses each required element effectively.	Delivery explains how design works, but is wordy,	Delivery is unclear, inaccurate, or missing required elements.

• **Is this concept concisely and clearly explained?** **10 Points**	Visuals are used to enhance the presentation and slide guidelines are followed.	Length and number of slides have adequate information and visually make sense..	repetitious, or missing some key elements. Length and number of slides have adequate information and visually make sense..	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.