Career-related Programme career-related study outline

Complete one form for each career-related study being offered at the school

Name of the school	School code
Amundsen High School	001145

Career-related study area	Career-related study provider
Design Innovation	School

Language of instruction	Number of years this career-related study has been provided for students at the school
English	2 (Design Course Only)

Name of the person completing this outline	Role of the person completing this outline
Colleen Murray, Minh Nguyen, Aleksander Rusic and Eman Sarhan	CP Coordinator, DP Coordinator, and CRS Teachers

1. What was the school's rationale for selecting this career-related study?

This career-related study in design innovation builds upon existing programs to provide IBCP students with a career pathway that gives them the tools to innovate in a range of sectors and fields. By learning how to solve human problems through engineering design our students will be able to have an impact. In addition, by learning to connect the design process to business entrepreneurship, our students will know how to take an idea from ideation to successful start-up business. Most high school engineering programs focus merely on building future engineers. Our program will focus on building future problem-solvers. We know that not all of our students will become engineers, but we want them to have the mindset, skills and experiences necessary to innovate and to make positive change regardless of the path they ultimately choose.

2. Provider

a. Who will deliver the career-related study?

[X] The school

[ ] Another entity in partnership with the school

If the career-related study is being delivered in partnership with another entity:

i. provide the name of the partner entity:

Not Applicable

ii. describe how the school has familiarized the partner entity with the CP:

Not Applicable

Accreditation

a. Who is the accrediting body for this career related study? Please enter the name of the organization in the appropriate place below.

X	government body:	The State of Illinois accredits all programs in the Chicago Public Schools including all the courses in this career-related study.
	awarding body:	
	appropriate employer organization or professional body:	
	further/higher education institution:	
	other:	

Please describe the accrediting body.

The State of Illinois is a local government body that oversees education at both the secondary and post-secondary level. It delegates a certain amount of responsibility for these programs to the Chicago Public Schools. This career pathway has been developed by Chicago Public Schools staff in conjunction with external partners from the James Dyson Foundation. In addition, every program we offer is subject to review by the Chicago Public Schools and the State of Illinois because of how we receive our funding. Our district files reports for state and Federal grant accountability. There is also monitoring of teacher credentials. This is all done at a district level, so there is no specific documentation for Amundsen High School.

Please describe the process of accreditation the school went through for this career-related study.

There is no specific process required by our state and district for us to offer this course. We are able to do so as a result of our status as a state-recognized high school. Evidence of this status has been previously submitted to IB.

Please describe how this career-related study will be subject to a demonstrable form of external quality assurance and/or reaccreditation, including the frequency of this review.

Our programs are reviewed by the Chicago Public Schools on an annual basis as part of our school quality review process. In addition, our schools must be recognized by the State of Illinois on an annual basis. The complete rules and procedures governing this process are available at the Illinois State Board of Education website. A copy of our recognized status is attached to our application for authorization.

This recognition extends to all institutions of higher learning in the state which means that credits earned in our schools are accepted as contributing to entry at state universities and colleges without further requirements.

All classes in our CRS are eligible for career or elective credit. These credits form the basis of admission requirements at almost all Illinois universities and colleges.

A document has been previously submitted to IB under our action plan that shows how elective and/or career credit, such as is earned in this program, contributes to entry at those schools. Please see hi-lighted portions of page 5 of State Universities in Illinois at a Glance 2017-18 published by the Illinois Association for College Admissions Counseling.

Please provide official evidence of this accreditation or recognition (e.g., certificate, official letter, appearance on accrediting organization website, etc.). If the evidence is not in one of the three IB working languages, please provide a certified translation.

Note: If this documentation is not uploaded by the time of the verification visit, there may be a delay in authorization.

Does successful completion of this career-related study result in a certification or qualification?

[X] Yes

[ ] No

If so, what is it?

Autodesk Inventor Certification. In addition, students will participate in a number of public competitions and

In addition, students in this program may compete in the following events and other opportunities as they arise:

- Dyson Global Makeathon in which student teams engage in a collaborative engineering design project with students in Bath, England

- Chicago Public Schools Science Fair which has a category for design. This event is judged by STEM professionals and educators. Students who compete in this event are eligible to win scholarships from a wide variety and organizations. A copy of the Science Fair handbook is attached to our application. Winners can move on to the state and international science fairs.
- Lumity Stem Fair—this event is the culmination of a competition run by our partner, Lumity, which also provides our students with access to STEM professionals and work place experiences.
- Youth Entrepreneurs Market Day competition. This is an entrepreneurship competition in which students pitch their ideas similar to "Shark Tank". We will be looking into other similar competitions for our students.

What specific post-secondary pathways will this career-related study provide to students *(e.g., apprenticeships, post-secondary degree, employment)*?

This CRS will open up a number of post-secondary pathways for students including the study of and work in the following technical careers of Civil Engineer, Aerospace Engineer, Agricultural Engineer, Automotive Engineer, Biochemical Engineer, Biological Technician, Biomedical Engineer, Cartographer, Chemical Engineer, Chemist, City Planning Aide, Environmental Science Technician, Industrial Engineering Technologist, Nanotechnology Engineering Technologist, Robotics Technician.

In addition, the students can take their knowledge of design and entrepreneurship to a much broader range of career areas including product design and development, social innovation consulting, business consulting, etc. They will also be familiar with the process of creating a business startup and so will be better prepared to work for or to create a new business.

Please describe the structure of the career-related study *(coursework, online learning, work placement, etc.)*.

This Design Innovation pathway will be offered in a face-to-face format via a three-course sequence and will be taught by Amundsen faculty in collaboration with industry partners from the James Dyson Foundation. The three-course sequence is as follows:

Year I

Design and Innovation I (150 contact hours)—this course will provide students with a foundation in engineering design. Students will be introduced to the tools of the maker lab and the design process. They will engage in a range or projects that incorporate aspects of the design process including a community project. This course will also prepare students for Autodesk Inventor certification. Students will also participate in the Dyson Global Makeathon. The reflective project will be introduced during this course and opportunities will be provided for students to engage in service learning via this course. To the extent possible, learning in this course will be aligned to the Next Generation Science Standards for Engineering Design and incorporate all relevant and developmentally appropriate core ideas and engineering practices.

Year II

Design and Innovation II (150 contact hours)—this course provides students with an opportunity to improve their skill at using various tools in the maker lab. In addition, they will engage in more team projects that require students to apply their knowledge of the design process to human problems in the local and global community. Students will complete their reflective projects. To the extent possible, learning in this course will be aligned to the Next Generation Science Standards for Engineering Design and incorporate all relevant and developmentally appropriate core ideas and engineering practices.

Innovation and Entrepreneurship (150 contact hours)—this course teaches students basic business concepts and entrepreneurial skills. Taught in conjunction with the Design and Innovation II course, Innovation and Entrepreneurship encourages students to learn about how to create a startup using the Business Canvas model and encourages them to take an active approach to learning how to run a business. Students will work with a local community business on a customer development problem before beginning their own projects. Students will also participate in a “Shark Tank”-like competition. Other external startup competitions may also be introduced to students.

A sample student schedule for students in this career-related study has been previously submitted to IB.

Teaching hours/schedules

a. How many total teaching hours per student will be part of the career-related study?

Students will have more 450 hours over two years to focus on the career-related study. Students will complete 150 hours during the first year and 300 hours during the second year. Some of this time will be used to support student work on the Reflective Project and Service Learning.

How many teaching (clock) hours are there per week for the career-related study?

Students will spend more than 4 hours a week engaging in the career-related study during Year I and more than 8 hours a week during Year II.

Please upload a sample schedule for an **individual student** enrolled in this career-related study for year 1 and year 2 of the CP. The schedule should include the elements of the career-related study, the DP courses and CP core components.

Content

Please describe the content of this career-related study in detail.

a. Topics covered

Design and Innovation I

1. Introduction to the design cycle and teambuilding

2. Safety and Lab inventory
    a. Proper use of tools
    b. Protective Gear
    c. Lab set up and clean up
    d. Emergency protocols
    e. Ethical behavior

3. Design Cycle
    a. Introduction: Design cycle overview
        i. Project ID
        ii. Specification Development
        iii. Conceptual Design
        iv. Delivery Phase
        v. Service/Maintenance
        vi. Design or Retirement Phase
    b. Real world applications
        i. Researching the problem
        ii. Brainstorming solution
        iii. Analyzing solutions
        iv. Teamwork/Collaboration
        v. Creating a prototype
        vi. Applying “design cycle” to problem solve

c. Backpack project
    i. Students assume designer & stakeholder roles
    ii. Design cycle
    iii. Researching
    iv. Exchanging feedback
    v. Testing prototype
d. Using the Design Cycle to identify and solve community problems
    i. Interview with community member
    ii. Field-based interview
    iii. Written report discussing
        1. findings and implications for design process
        2. Proposed solutions
    iv. Oral Presentation

4. Drafting
    a. Scaling & converting units
    b. Representing 3D models in isometric
    c. Deconstructing isometric drawings into orthogonal views
    d. Creating a 3D drawing given orthogonal views
    e. Construct prototypes given
        i. Isometric drawing
        ii. Orthogonal views

5. Prototyping
    a. Sketching & measuring
    b. Scoring & cutting
    c. Reinforcing
    d. Joining
    e. 3D modeling
    f. Engineering challenges
    g. Rapid Prototyping

6. Engineering Box Project
    a. Reverse Engineering
    b. Disassembly and Reassembly of Machine
    c. Exploring Engineering Career Paths
    d. Prototyping

7. Bridge contest
    a. Forces and trusses
    b. Sketches of the bridge
    c. Blueprint of the bridge
    d. Truss of the bridge, designed in GeoGebra
    e. Image of the prototype

8. Auto Desk Inventor 3D Software (External Certification)
    a. User Interface and Navigation
    b. Advanced Modeling
    c. Assembly Modeling
    d. Drawing
    e. Part Modeling
    f. Create Parts
    g. Project Files
    h. Sketching
    i. Editing Features

9. Dyson Global Makeathon Junior Project
    a. Sketches
    b. Blueprint
    c. Digital model
    d. Prototype
    e. Final product

f. Market research
g. Testing

Design and Innovation II

1. Review of **Design and Innovation I** Knowledge and Skills

2. SAMs Labs
    a. Discover coding in accessible and interactive way
    b. Programing logic
    c. Data capture and data analysis
    d. Exposing students to both physical and digital computing
    e. Discover various electronics components and their functions
    f. Project incorporating ideas from SAMs curriculum

3. Scratch
    a. Coding
    b. Programing Logic
    c. Problem solving
    d. Programing Finch robots
    e. Capture and analyze data

4. Microbits
    a. Programing microcontrollers
    b. Understanding functions of various electronic components (LED, servo motor, DC motor)
    c. Solving real-life problems through micro controllers

5. Photon
    a. Programming microcontrollers
    b. Understanding the functions of various sensors (humidity, light, motion)
    c. Using sensors to collecting data

d. Analyze and implement collected data
e. circuit / electronics

6. Dyson Global Makeathon Senior Project
    a. Sketches
    b. Blueprint
    c. Digital model
    d. Prototype
    e. Final product
    f. Market research
    g. Testing

Innovation and Entrepreneurship

1. Foundations of entrepreneurship
    a. What is entrepreneurship?
    b. Your starting idea
    c. Skills needed for entrepreneurship
    d. Building a team
    e. Execution
    f. Business model & plan b

2. Customer development
    a. Introduction to marketing
    b. The value proposition
    c. Competition
    d. Visualizing the customer
    e. Channels of distribution
    f. Positioning, brand, pricing & promotion
    g. The art of selling
    h. Key marketing insights

i. Marketing plan

3. Operations management
    a. Basic financial concepts
    b. Refining your business model
    c. How much money will you need?
    d. Operations plan

4. Ethical leadership
    a. Leadership
    b. The role of ethics
    c. Leading oneself

5. Pitching a business
    a. The funding decision
    b. The pitch
    c. Presenting

b. Skills acquired

Design and Innovation I

1. Safely use and maintain laboratory equipment

2. Understand and explain the Design Cycle including
    a. Project ID
    b. Specification Development
    c. Conceptual Design
    d. Delivery Phase
    e. Service/Maintenance
    f. Design or Retirement Phase

3. Apply the Design Cycle to real world problems by
    a. Researching the problem
    b. Brainstorming solution
    c. Analyzing solutions
    d. Collaborating in teams
    e. Creating a prototype
    f. Applying “design cycle” to problem solve

4. Draft accurate models by
    a. Scaling & converting units
    b. Representing 3D models in isometric
    c. Deconstructing isometric drawings into orthogonal views
    d. Creating a 3D drawing given orthogonal views
    e. Construct prototypes given
        i. Isometric drawing
        ii. Orthogonal views

5. Reverse engineer machines to identify the root cause of problems

6. Prototype models by
    a. Sketching & measuring
    b. Scoring & cutting
    c. Reinforcing
    d. Joining
    e. 3D modeling
    f. Engineering challenges
    g. Rapid Prototyping

7. Utilize Auto Desk Inventor Software (External Certification) and demonstrate the following skills:
    a. Navigate the Inventor Interface
    b. Use the ViewCube
    c. Set the environment
    d. Manage views
    e. Create a sweep feature
    f. Apply and use assembly constraints
    g. Create a part in the context of an assembly
    h. Add centerlines to a drawing
    i. Identify views
    j. Modify a style in a drawing
    k. Add Balloons to a View
    l. Apply fillets and chamfers
    m. Create a pattern of features
    n. Create a Rib Feature
    o. Create a shell feature
    p. Create extrude features
    q. Create hole features
    r. Create revolve features
    s. Create work features

t. View parts
u. Control a project file
v. Assign parameters
w. Identify dimension types
x. Share sketches
y. Use sketch constraints
z. Project geometry
aa. Reorder features
bb. Delete features

8. Collaborate effectively with Global and Local Partners to Create and Test Designs that solve human problems

Design and Innovation II

1. Utilize electronic components in engineering designs

2. Utilize programming logic

3. Capture and analyze Data

4. Code in Scratch to solve problems

5. Effectively utilize Microbits
    a. Program microcontrollers
    b. Effectively use various electronic components (LED, servo motor, DC motor)
    c. Solve real-life problems through micro controllers

6. Effectively utilize Photon
    a. Program microcontrollers
    b. Effectively use various sensors (humidity, light, motion)
    c. Use sensors to collecting data

d. Analyze and implement collected data

7. Lead Design Teams through the Design Process to effectively solve human problems

8. **Demonstrate advanced levels of competence in all Design and Innovation I skills including Autodesk Inventor certification skills.**

Innovation and Entrepreneurship

1. Students will be able to define and describe Principled Entrepreneurship.
    a. Students will be able to interpret the term “entrepreneurship”.
    b. Students will be able to explain that the role of business in a market economy is to create value.
    c. Students will be able to compare and contrast “profit” with “value creation”.
    d. Students will be able to self-assess what the market values relative to their skill set.

2. Students will be able to develop and to apply an entrepreneurial mindset.
    a. Students will be able to identify the customer and solutions that create value for both parties.
    b. Students will be able to define a customer as anyone they are trying to create value for, in or out of business.
    c. Students will be able to utilize the Cost Price Value Triangle to analyze the mutual benefits of trade.
    d. Students will be able to identify a problem in the market and articulate a value proposition for how they can solve it.
    e. Students will be able to engage in calculated risk-taking activities that demonstrate their understanding of the innovative mindset.

3. Students will be able to apply economic problem-solving skills by defining and applying the concepts of:
    a. scarcity
    b. opportunity cost
    c. supply and demand.
    d. sunk costs.
    e. incentives
    f. subjective value
    g. comparative advantage
    h. tragedy of the commons
    i. self-interest

j. property rights
k. business cycles
l. trade-offs
m. risk
n. voluntary exchange.

4. Students will be able explain and to **apply** marketing concepts to projects including
    a. The role and function of marketing
    b. market research in an effort to create real value for others
    c. market analysis in an effort to create real value for others
    d. channels of distribution that create value for their customers.
    e. market strategies in an effort to create real value for others.

5. Students will be able explain and to **apply** business operations concepts to projects including:
    a. basic forms of business organizations
    b. a SWOT analysis in the planning process.
    c. S.M.A.R.T. goals in the planning process.
    d. networking skills

6. Students will be able to manage and leverage resources in creating and implementing business models.

7. Students will be able to identify key support services as they relate to the concept of comparative advantage.

8. Students will use iterative thinking to create new ways to create value for others.
    a. Students will be able to use the process of innovation to meet the real needs of customers.
    b. Students will be able to utilize research methods to learn about what customers value in order to spur innovations.
    c. Students will be able to describe the limitations of customer input in relation to a new product or service.

9. Students will be able to value feedback from failure in order to pivot to an improved iteration.

10. Students will be able to seek and embrace feedback as a way to improve.

11. Students will be able to deploy a minimum viable product/service that adds value to society.
    a. Students will be able to evaluate necessary resources needed to deploy a minimum viable product/service
    b. Students will be able to define clear objectives and measures for an experimental product/service.

12. Students will be able to take steps to innovate and create new opportunities for themselves.
    a. Students will be able to concisely define and apply the concept of creative destruction.
    b. Students will be able to recognize the costs of innovation and creative destruction
    c. Students will be able to recognize the value of creative destruction.

13. Students will use be able to utilize financial tools to maximize opportunities to create real value.
    a. Students will be able to identify profit and loss margins by solving for ROI.
    b. Students will be able to estimate sales and profits by completing a project sales forecast.
    c. Students will be able to calculate fixed and variable costs by listing the seven common operating costs.
    d. Students will be able to calculate gross profit.
    e. Students will be able to calculate the economics of one unit to determine profitable price points.
    f. Students will be able to create an income statement to evaluate profitability.
    g. Students will be able to solve for the break-even point.
    h. Students will be able to determine net income, gross income, sales, and profit.
    i. Students will be able to define marginal analysis.
    j. Students will be able to describe the time value of money.
    k. Students will be able to define and to apply the concept of cost.
    l. Students will be able to define and to apply the concept of profit.

14. Students will be able to identify sources of venture capital.
    a. Students will be able to summarize the benefits and risks of debt and to identify available tools for borrowing.
    b. Students will be able to contrast the benefits and risks of debt versus equity financing.

Internship/work experience (if applicable)

Internship experiences are available through external partners of the Chicago Public Schools. As we continue to develop the programme, we expect to rely on these relationships in order to provide a range of opportunities tailored to individual students.

Additional information

Student assessment

a. How will students be assessed in this career-related study? Please clearly indicate any elements of the assessment plan that are required by the accrediting body for this career-related study.

Students in this course are assessed in accordance with the Amundsen High School Grading Policy. A variety of measures are used including: • Projects • Performance Assessments aligned to content and skills listed above • Quizzes • Homework (based on completeness, quality, and timeliness) • Class participation (includes being prepared for class, attendance, respect for classmates, group participation) Completion of Autodesk Inventor Certified User Certification is expected of all students enrolling in Design and Innovation I and II.

Who will assess students in this career related study?

X	School
X	Partner entity—Autodesk Inventor Certification through Certiport

☐ External assessment body

☐ Other *(please describe)*:

DP courses

a. Which DP courses will be offered in connection with this career-related study?

Language A Literature SL, Math Studies SL, Visual Art SL, Spanish B SL/HL, Biology SL, Chemistry SL, Music SL, and Global Politics HL.

What was the school's reasoning for selecting the DP courses that will be made available to the students enrolled in this career-related study?

These courses were chosen for several reasons. Some are courses in which our students have experienced a great deal of success in the DP but othes have been added to provide a range of options for students in the CP whose academic backgrounds may vary. In addition, the language courses may provide an additional option for students to pursue their language development study provided they are enrolled in other CP coursework.