

FREEHOLD REGIONAL HIGH SCHOOL DISTRICT

OFFICE OF CURRICULUM AND INSTRUCTION

INTERNATIONAL BACCALAUREATE PROGRAM

DESIGN TECHNOLOGY SL, YEAR 1

Grade Level: 11

Credits: 2.5

BOARD OF EDUCATION ADOPTION DATE:

AUGUST 28, 2017

[SUPPORTING RESOURCES AVAILABLE IN DISTRICT RESOURCE SHARING](#)

APPENDIX A: ACCOMMODATIONS AND MODIFICATIONS

APPENDIX B: ASSESSMENT EVIDENCE

APPENDIX C: INTERDISCIPLINARY CONNECTIONS

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IB DESIGN TECHNOLOGY SL YEAR 1

COURSE PHILOSOPHY

The International Baccalaureate Organization provides the following philosophy: *“Diploma Programme Design Technology aims to develop internationally- minded people whose enhanced understanding of design and the technological world can facilitate our shared guardianship of the planet and create a better world. Both science and technology have a fundamental relationship with design. Technology preceded science, but now most technological developments are based on scientific understanding. Traditional technology comprised useful artifacts often with little understanding of the science underpinning their production and use. In contrast, modern technology involves the application of scientific discoveries to produce useful artifacts. The application of scientific discovery to solve a problem enables designers to create new technologies and these new technologies, in turn, can impact on the rate of scientific discovery. The aim of the DP Design Technology course is to foster the skill development in students required to use new and existing technologies to create new products, services and systems.”*

COURSE DESCRIPTION

The International Baccalaureate Organization provides the following course description: *“Design Technology focuses on analysis, design development, synthesis and evaluation. The creative tension between theory and practice is what characterizes Design Technology within the DP sciences subject group. Inquiry and problem-solving are at the heart of the subject. DP Design Technology requires the use of the DP design cycle as a tool, which provides the methodology used to structure the inquiry and analysis of problems, the development of feasible solutions, and the testing and evaluation of the solution. In Diploma Programme Design Technology, a solution can be defined as a model, prototype, product or system that students have developed independently. It achieves a high level of design literacy by enabling students to develop critical-thinking and design skills, which they can apply in a practical context. While designing may take various forms, it will involve the selective application of knowledge within an ethical framework. A well-planned design programme enables students to develop not only practical skills but also strategies for creative and critical thinking.”*

COURSE SUMMARY

COURSE GOALS

CG1: Students will communicate and present technological information of their design for client approval.

CG2: Students will construct, analyze and evaluate design briefs, problems, specifications and plans for creating a final product, prototype, or model.

CG3: Students will analyze and evaluate methods, techniques, products, information and technological explanations in order to produce the best possible product, model, or prototype.

CG4: Students will demonstrate the appropriate research, experimentation, modeling, and interpersonal skills in order to carry out innovative, insightful, ethical, and effective designing.

COURSE ENDURING UNDERSTANDINGS

COURSE ESSENTIAL QUESTIONS

CEU1: Designers consider human factors to ensure products meet ergonomic needs.

CEQ1a: How do we design something that is comfortable for humans to use?

CEU2: As our Earth's resources are slowly depleted, ethical use of resources and the use of clean technology worldwide should be on every designer's mind.

CEQ2a: What role does ethics play in the adoption of new technologies?

CEQ2b: How can we reduce the negative impact of humans on our environment?

CEU3: Dimensioned and rendered CAD creations are used by modern industry to create prototype models of new products.

CEQ3a: How do drawings influence a final product?

CEU4: Communicating an engineering design requires effective visual representation and presentation skills that are audience appropriate.

CEQ4a: How does the way you communicate with a client vary by audience?

CEQ4b: Why is it important for an engineer or designer to communicate their solution to a client?

CEU5: The design process is an iterative series of steps taken in order to create a product or solve a problem while simultaneously engaging in self-evaluation and redesign.

CEQ5a: How do we know that we've developed the best solution to a problem?

UNIT GOALS AND PACING

UNIT TITLE	UNIT GOALS	DURATION
Unit 1: Human Factors and Ergonomics	Students will create and defend ergonomic designs and models by utilizing appropriate materials and synthesizing their knowledge of human factor guidelines.	8 weeks
Unit 2: Resource Management and Sustainable Production	LG1: Students will make safe and informed decisions when selecting and using equipment or tools. LG2: Students will utilize design materials and resources in various ways, resulting in more environmentally-friendly, cost-effective, and sustainable designs.	5 weeks
Unit 3: Modeling	LG1: Students will create functional and visually realistic 3D prototypes by safely utilizing CNC machines, 3D printers, and laser engravers. LG2: Students will test and analyze different materials to identify the best material choice for a specific task based on the design need.	5 weeks

UNIT OVERVIEW

UNIT LEARNING GOALS

Students will create and defend ergonomic designs and models by utilizing appropriate materials and synthesizing their knowledge of human factor guidelines.

UNIT LEARNING SCALE

4	In addition to score 3 performances, the student can assist a peer in applying the concepts and/or use the concepts learned in class in another setting.
3	<p>The student can:</p> <ul style="list-style-type: none"> ● identify and describe all steps of the design process; ● analyze static and dynamic anthropometric data; ● collect accurate anthropometric data; ● explain why a design is ergonomic or not and provide reasoning; ● interpret percentile tables for user populations; ● design and create an ergonomic product following the design process.
2	The student sometimes needs assistance from a teacher, makes minor mistakes, and/or can do the majority of score 3 performances.
1	The student needs assistance to avoid major errors in attempting to reach score 3 performances.
0	Even with assistance, the student does not exhibit understanding of the performances listed in score 3.

ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS
CEU1: Designers consider human factors to ensure products meet ergonomic needs.	CEQ1a: How do we design something that is comfortable for humans to use?
CEU3: Dimensioned and rendered CAD creations are used by modern industry to create prototype models of new products.	CEQ3a: How do drawings influence a final product?
CEU5: The design process is an iterative series of steps taken in order to create a product or solve a problem while simultaneously engaging in self-evaluation and redesign.	CEQ5a: How do we know that we've developed the best solution to a problem?

COMMON ASSESSMENT	
ALIGNMENT	DESCRIPTION
LG1 CEU1, 3, 5 CEQ1a, 3a, 5a 8.1.12.D.5 8.1.12.F.1 8.2.12.C.3 8.2.12.D.1 RST.11-12.9 WHST.11-12.7, 8 DOK 4	Students will be given the task of designing a method of holding cash and credit/debit cards for another student. Students will research and conduct interviews to gain a deeper understanding of their user and engage in human-centered design. Students will then follow the design process to create a prototype of their solution. They will then present and defend their solution to their peers.
LG1 CEU1, 3, 5 CEQ1a, 3a, 5a 8.1.12.D.5 8.1.12.F.1 8.2.12.C.3 8.2.12.D.1 RST.11-12.9 WHST.11-12.2, 7, 8 DOK 4	Students will use anthropometric data and the design process to design an everyday object to be more comfortable to the average human user. They will then present and defend their solution to their peers.

TARGETED UNIT STANDARDS

DECLARATIVE KNOWLEDGE	PROCEDURAL KNOWLEDGE	NEW STANDARDS TO INTRODUCE
anthropometrics comfort design process fatigue iterations percentile tables physiological factors psychological factors working drawing	Compare the capabilities of current and emerging technology resources as they apply to a specific design issue (DOK 3)	8.1.12.D.5 Analyze the capabilities and limitations of current and emerging technology resources and assess their potential to address personal, social, lifelong learning, and career needs.
	Evaluate the strengths and limitations of materials and technologies in the creation of a design solution (DOK 3)	8.1.12.F.1 Evaluate the strengths and limitations of emerging technologies and their impact on educational, career, personal and or social needs.
	Analyze a product in order to evaluate its viability and effectiveness (DOK 3) Analyze a the ergonomic features of an object (DOK 3)	8.2.12.C.3 Analyze a product or system for factors such as safety, reliability, economic considerations, quality control, environmental concerns, manufacturability, maintenance and repair, and human factors engineering (ergonomics).
	Design an appropriate solution to an engineering design challenge involving a real world problem utilizing ergonomic principles (DOK 4)	8.2.12.D.1 Design and create a prototype to solve a real world problem using a design process, identify constraints addressed during the creation of the prototype, identify trade-offs made, and present the solution for peer review.
	Conduct research prior to creating a prototype to establish a base of knowledge and good understanding of the design constraints (DOK 3)	RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.
	Write explanatory texts to examine and convey complex design ideas and choices clearly and accurately (DOK 3)	WHST.11-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
	Write explanations to defend design choices and thinking while using domain-specific vocabulary (DOK 3)	WHST.11-12.2.D Use precise language, domain-specific vocabulary and techniques such as metaphor, simile, and analogy to manage the complexity of the topic; convey a knowledgeable stance in a style that responds to the discipline and context as well as to the expertise of likely readers.

DECLARATIVE KNOWLEDGE	PROCEDURAL KNOWLEDGE	NEW STANDARDS TO INTRODUCE
(see above)	Conduct research prior to creating a prototype to establish a base of knowledge and good understanding of the design constraints (DOK 3)	WHST.11-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
	Synthesize relevant information from multiple sources and integrate it into the flow of ideas and design documentation (DOK 4)	WHST.11-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.

UNIT OVERVIEW**UNIT LEARNING GOALS**

LG1: Students will make safe and informed decisions when selecting and using equipment or tools.

LG2: Students will utilize design materials and resources in various ways, resulting in more environmentally-friendly, cost-effective, and sustainable designs.

UNIT LEARNING SCALE: LG1

4	In addition to score 3 performances, the student can safely intervene and assist a peer who is not following appropriate safety protocols.
3	The student can: <ul style="list-style-type: none"> independently follow classroom procedures and interact responsibly; maintain a safe, clean lab environment; identify and perform proper use and maintenance of tools; utilize personal protective equipment (PPE) as needed; analyze safety protocols and the reasoning behind those protocols.
2	The student sometimes needs assistance from a teacher, makes minor mistakes, and/or can do the majority of score 3 performances.
1	The student needs assistance to avoid major errors in attempting to reach score 3 performances.
0	Even with assistance, the student does not exhibit understanding of the performances listed in score 3.

UNIT LEARNING SCALE: LG2	
4	In addition to score 3 performances, the student can apply what they learn in class to promote environmental responsibility in their community.
3	The student can: <ul style="list-style-type: none"> • compare and contrast renewable and nonrenewable resources; • analyze environmental impacts of the life cycle of a product; • examine the economic and political importance of resources for production; • create designs that are environmentally-friendly, cost-effective, sustainable.
2	The student sometimes needs assistance from a teacher, makes minor mistakes, and/or can do the majority of score 3 performances.
1	The student needs assistance to avoid major errors in attempting to reach score 3 performances.
0	Even with assistance, the student does not exhibit understanding of the performances listed in score 3.

ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS
CEU2: As our Earth's resources are slowly depleted, ethical use of resources and the use of clean technology worldwide should be on every designer's mind.	CEQ2a: What role does ethics play in the adoption of new technologies? CEQ2b: How can we reduce the negative impact of humans on our environment?
CEU3: Dimensioned and rendered CAD creations are used by modern industry to create prototype models of new products.	CEQ3a: How do drawings influence a final product?
EU1: There are four possible impacts that a technological product or system has on our lives.	EQ1a: What impacts could new technologies have on society? EQ1b: What tradeoffs exist with any new technology?

COMMON ASSESSMENT

ALIGNMENT	DESCRIPTION
LG1, 2 CEU2, 3, EU 1 CEQ2a-b, 3a; EQ1a-b 8.1.12.F.1 8.2.12.A.2 8.2.12.B.2 8.2.12.C.3 RST. 11-12.4 WHST.11-12.2 DOK 4	Students will use repurposed materials to create an innovative, eco-friendly solution to a design problem. They will demonstrate the ability to select and safely use tools for creating a prototype. The design process will be documented and will include a rationale for cost-effectiveness of the solution. When presenting their design solution to peers, they will need to describe how they accounted for creating a sustainable, environmentally friendly solution.

TARGETED UNIT STANDARDS

DECLARATIVE KNOWLEDGE	PROCEDURAL KNOWLEDGE	NEW STANDARDS TO INTRODUCE
carbon footprint circular economy clean technology cradle-to-cradle cradle-to-grave dematerialization eco-design energy utilization, storage and distribution green design non-renewable resources precautionary principle prevention principle renewable resources resource reserves waste mitigation strategies	Analyze the ways a current technology has an effect on the environment (DOK 3)	8.2.12.A.2 Analyze a current technology and the resources used, to identify the trade-offs in terms of availability, cost, desirability and waste.
	Evaluate and discuss the ethical considerations of using resources that are finite or harmful versus those that are sustainable and green (DOK 3)	8.2.12.B.2 Evaluate ethical considerations regarding the sustainability of environmental resources that are used for the design, creation and maintenance of a chosen product.
	Use symbols and key terms in design sketches and discussions (DOK 2)	RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11-12 texts and topics.

DECLARATIVE KNOWLEDGE	PROCEDURAL KNOWLEDGE	PREVIOUSLY COVERED STANDARDS TO DEVELOP FURTHER
<p>design process iterations working drawing</p>	<p>Analyze limitations of technology resources to determine the implications of their use (DOK 3)</p>	<p>8.1.12.D.5 Analyze the capabilities and limitations of current and emerging technology resources and assess their potential to address personal, social, lifelong learning, and career needs.</p>
	<p>Evaluate the strengths and limitations of materials and technologies in the creation of a design solution that is eco-friendly (DOK 3)</p>	<p>8.1.12.F.1 Evaluate the strengths and limitations of emerging technologies and their impact on educational, career, personal and or social needs.</p>
	<p>Analyze a design solution for environmental concerns to ensure there is no excess waste or environmental concerns (DOK 3)</p>	<p>8.2.12.C.3 Analyze a product or system for factors such as safety, reliability, economic considerations, quality control, environmental concerns, manufacturability, maintenance and repair, and human factors engineering (ergonomics).</p>
	<p>Explain to others how to create a precise object using the laser engraver or 3D printer (DOK 2)</p>	<p>WHST.11-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.</p>
	<p>Use domain specific vocabulary when explaining the procedures for manufacturing a product (DOK 2)</p>	<p>WHST.11-12.2.D Use precise language and domain-specific vocabulary to manage the complexity of the topic and convey a style appropriate to the discipline and context as well as to the expertise of likely readers.</p>

UNIT OVERVIEW

UNIT LEARNING GOALS

LG1: Students will create functional and visually realistic 3D prototypes by safely utilizing CNC machines, 3D printers, and laser engravers.
 LG2: Students will test and analyze different materials to identify the best material choice for a specific task based on the design need.

UNIT LEARNING SCALE: LG1

4	In addition to score 3 performance, the student can help assist another student who is having difficulty with CAD software or CNC machines.
3	The student can: <ul style="list-style-type: none"> ● create 2D and 3D computer models of their designs; ● create functional, realistic prototypes using CNC machines; ● demonstrate safe use of all CNC machines; ● effectively communicate design ideas to a client; ● describe differences between perspective, projection, and assembly drawings.
2	The student sometimes needs assistance from a teacher, makes minor mistakes, and/or can do the majority of score 3 performances.
1	The student needs assistance to avoid major errors in attempting to reach score 3 performances.
0	Even with assistance, the student does not exhibit understanding of the performances listed in score 3.

UNIT LEARNING SCALE: LG2	
4	In addition to score 3 performances, the student can explain the manufacturing methods or material characteristics of newly designed product.
3	The student can: <ul style="list-style-type: none"> ● identify appropriate materials for use; ● conduct tests to determine the tensile or compressive strength of a material; ● explain how certain material properties are beneficial to the design of a product; ● relate the material properties to the ease of production of an object. ● create models using appropriate materials
2	The student sometimes needs assistance from a teacher, makes minor mistakes, and/or can do the majority of level 3 performances.
1	The student needs assistance to avoid major errors in attempting to reach score 3 performances.
0	Even with assistance, the student does not exhibit understanding of the performances listed in score 3.

ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS
CEU2: As our Earth's resources are slowly depleted, ethical use of resources and the use of clean technology worldwide should be on every designer's mind.	CEQ2a: What role does ethics play in the adoption of new technologies? CEQ2b: How can we reduce the negative impact of humans on our environment?
CEU3: Dimensioned and rendered CAD creations are used by modern industry to create prototype models of new products.	CEQ3a: How do drawings influence a final product?
CEU4: Communicating an engineering design requires effective visual representation and presentation skills that are audience appropriate.	CEQ4a: How does the way you communicate with a client vary by audience? CEQ4b: Why is it important for an engineer or designer to communicate their solution to a client?
CEU5: The design process is an iterative series of steps taken in order to create a product or solve a problem while simultaneously engaging in self-evaluation and redesign.	CEQ5a: How do we know that we've developed the best solution to a problem?

COMMON ASSESSMENT

ALIGNMENT	DESCRIPTION
LG1 ,2 CEU 2, 3, 4, 5 CEQ 2a-b, 3a, 4a-b, 5a 8.2.12.C.3, 5 8.2.12.D.1, 3 RST.11-12.3 WHST.11-12.7, 8 DOK 4	Students will synthesize knowledge and information to create an ergonomically correct chair that can support an adult of approximately 200 pounds. Students will document their work as they follow the design process, create CAD drawings, test materials, and create laser cut prototypes. Students will present their final prototype to their peers for critique.

TARGETED UNIT STANDARDS

DECLARATIVE KNOWLEDGE	PROCEDURAL KNOWLEDGE	NEW STANDARDS TO INTRODUCE
3D printing aesthetic models computer numerical control (CNC) computer-aided design (CAD) conceptual modeling graphical modeling Instrumented models laser engraving mock-ups physical modeling prototypes rapid prototyping scale models stereolithography	Create working drawings of their designs using manual drafting and/or using computer aided design (DOK 4)	8.2.12.C.5 Create scaled engineering drawings of products both manually and digitally with materials and measurements labeled.
	Determine and use the best method of creating the part/prototype for the student's design solution (DOK 2)	8.2.12.D.3 Determine and use the appropriate resources (e.g., CNC (Computer Numerical Control) equipment, 3D printers, CAD software) in the design, development and creation of a technological product or system.
	Follow complex, multistep procedures when using the CNC, laser, or 3D printing equipment (DOK 2)	RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

DECLARATIVE KNOWLEDGE	PROCEDURAL KNOWLEDGE	PREVIOUSLY COVERED STANDARDS TO DEVELOP FURTHER
design process eco-design fatigue iterations green design working drawing	Evaluate the strengths and limitations of materials and technologies in the creation of a design solution (DOK 3)	8.1.12.F.1 Evaluate the strengths and limitations of emerging technologies and their impact on educational, career, personal and or social needs.
	Compare the capabilities of current and emerging technology resources as they apply to a specific design issue (DOK 3)	8.2.12.A.2 Analyze a current technology and the resources used, to identify the trade-offs in terms of availability, cost, desirability and waste.
	Analyze the design solution for safety, reliability, quality, human factors, and environmental concerns (DOK 3)	8.2.12.C.3 Analyze a product or system for factors such as safety, reliability, economic considerations, quality control, environmental concerns, manufacturability, maintenance and repair, and human factors engineering (ergonomics).
	Create a physical prototype as well as CAD renderings for presentation to a client (DOK 4)	8.2.12.D.1 Design and create a prototype to solve a real world problem using a design process, identify constraints addressed during the creation of the prototype, identify trade-offs made, and present the solution for peer review.
	Conduct research prior to creating a prototype to establish a base of knowledge and good understanding of the design constraints (DOK 3)	WHST.11-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
	Synthesize relevant information from multiple sources and integrate it into the flow of ideas and design documentation (DOK 4)	WHST.11-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.