Board/Authority Authorized Course Framework Template

School District/Independent School Authority Name: Okanagan Skaha	**School District 67**
Developed by: Nicolas Kast	**Date Developed:** Nov 12, 2018
School Name: Summerland Secondary School	**Principal's Name:** Alan Stel
Superintendent Approval Date (for School Districts only):	**Superintendent Signature (for School Districts only):**
Board/Authority Approval Date:	**Board/Authority Chair Signature:**
Course Name: Maker 12	**Grade Level of Course:** 12
Number of Course Credits: 4	**Number of Hours of Instruction:** 120

Board/Authority Prerequisite(s):

At least two previous courses in the Applied Design, Skills, and Technologies (grade 9-10) and Maker 11

Special Training, Facilities or Equipment Required:

Computer lab, CNC router, 3D printer, laser cutter, electronics testing and prototyping equipment, and periodic access to woodwork and metal shops

Course Synopsis:

This course allows students to experience the act of making. It is a purpose-based course, meaning students should already have a list of project ideas developed to pursue before the course begins. Maker 12 is divided into two main components: foundational skills

development and student-based project learning. The first six weeks of the course are devoted to foundational skills development. This time will be spent introducing students to computer software, electronics components, hand tools, CNC equipment, and digital journaling. The remainder of the course will be devoted to student-based projects where students are encouraged to pursue their personal interests, passions and knowledge. Along the journey, students will gain experience being a creator, inventor, designer and builder of their ideas. Students are expected to create a project plan elaborating the following key elements: project goals, project schedule, supporting plans and ideas, and supporting resources and references. They will also maintain a digital journal to record and reflect on weekly progress and milestones, obstacles and setbacks, mistakes and accomplishments along their individualized learning path.

Goals and Rationale:

Rationale

The Maker 12 curriculum aims to bring key unifying elements of BC's new Applied Design, Skills, and Technologies (ADST) curriculum into one senior level course. These elements include a focus on design thinking, learning of skills, application of new and existing technologies, and acquisition of competencies along a continuum of student learning. Maker 12 engages students in their own learning and fosters skills and expertise needed to succeed in today's demanding world. The course encourages students to take knowledge acquired from STEM subjects (science, technology, engineering and mathematics) and apply it in a meaningful hands-on approach in combination with natural curiosity, inventiveness and the intrinsic desire to create. It takes students' existing curricular knowledge and expands on it through student driven learning interests and blends it with student passions letting them become the creator, designer and builder of their own project from conception to completion.

Goals

Upon successful completion of this course, the student will be able to:

- acquire practical skills and knowledge that they can use to bring their ideas from ideation to creation
- develop a "Learning for Life" passion that will allow students to be influential inventors, innovators, and entrepreneurs in a rapidly changing world
- understand the environmental implications of the products and services they are designing
- investigate and actively explore areas of personal interest, including aspects of 3D design software, electronics, robotics, coding, 3D printing, CNC laser cutting, CNC routing and other emerging fields

- develop practical hands-on skills and make informed decisions about pursuing specialized interests for personal enjoyment or careers
- develop a lifelong interest in designing, creating, making, and evaluating products, services, and processes, and contributing through informed citizenship, volunteer work, and career opportunities, to finding and addressing practical challenges
- Contribute to the sharing philosophy of the maker movement by sharing knowledge, learning experiences, and expertise on an online digital journal

Aboriginal Worldviews and Perspectives:

- explore how First Nations used natural resources to produce tools, art, structures and cultural artifacts
- Respect for community elders as the knowledge holders

BIG IDEAS

User needs and interest drive the design process	Makers require multiple tools, skills and technologies to create	Adapting scientific knowledge and interests for specific purposes	Making is fundamental to what it means to be human	Collaborative approach to learning, sharing knowledge and experiences

Learning Standards

Curricular Competencies	Content
Students are expected to do the following: **Applied Design** ***Understanding context*** • Engage in a period of **self-efficacy** to assess personal skills and abilities needed to meet future challenges ***Defining*** • Establish a point of view for a chosen design opportunity • Identify potential users, intended impacts, and possible unintended negative consequences • Make decisions about premises and **constraints** that define the design space, and develop criteria for success • Determine whether activity is collaborative or self-directed ***Ideating*** • Identify and examine gaps for potential design improvements and innovations • Critically analyze how competing social, ethical, and sustainability considerations impact creation and development of solutions • Generate ideas to create a range of possibilities and add to others' ideas in ways that create additional possibilities • Evaluate suitability of possibilities according to success criteria, constraints, and potential gaps, and prioritize for prototyping • Work with users throughout the design process	***All Students** are expected to know the following course content:* (this is the unifying content for the course and is delivered at the beginning of the course) • **technology to support collaboration** and interaction with others • **technical communication** skills • **interpersonal skills** for interacting with colleagues and clients • 2D and 3D modelling and designs using industry-standard computer programs • use of scale and proportion when outputting to 3D models • rudimentary function and use of 3D printer, laser cutter and CNC router • basic electronics, simple circuit design and construction • **design for the life cycle** • ethics of **cultural appropriation** and plagiarism ***Maker/Drafting Students** are expected to know the following:* (this content is discipline-specific for students with a primary focus in drafting) • interrelationships among **complex drawings** • **components** of working drawings • computer-aided design (CAD) programs and other graphic software • 3D modelling using advanced modelling techniques

Prototyping

- Choose an appropriate form, scale, and level of detail for prototyping, and plan procedures
- Analyze the design for the life cycle and evaluate its **impacts**
- Visualize and construct prototypes, making changes to tools, materials, and procedures as needed
- Record **iterations** of prototyping

Testing

- Identify and communicate with **sources of feedback**
- Develop an **appropriate test** of the prototype, conduct the test, and collect and compile data
- Evaluate design according to critiques, testing results, and success criteria to make changes

Making

- Identify appropriate tools, technologies, materials, processes, cost implications, and time needed
- Create design, incorporating feedback from self, others, and results from testing of the prototypes
- Use materials in ways that minimize waste

Sharing

- Decide how and with whom to **share** creativity, or share and promote design and processes
- Share the product with users and critically evaluate its success
- Critically reflect on plans, products and processes, and identify new design goals
- Evaluate new possibilities for plans, products and processes, including how they or others might build on them

Applied Skills

- Apply safety procedures for themselves, co-workers, and users in both physical and digital environments
- Individually or collaboratively identify and assess skills needed for design interests
- Demonstrate competency and proficiency in skills at various levels involving manual dexterity and industrial coding, design, and production
- Develop specific plans to learn or refine identified skills over time

- file conversion between CAD and other applications
- relationships between manufacturing, drafting, engineering, and industrial design
- **tooling** and tool motion for **computer numerical control (CNC) equipment**
- machining **standards** for working with **different materials**
- product creation through a reproducible means
- multiple **platforms** for manufacturing products

***Maker/Electronics* Students** *are expected to know the following:*
(this content is discipline-specific for students with a primary focus in electronics)

- function and application of common electronic components
- schematic drawings
- circuit board manufacturing processes
- **testing equipment** for measurement and diagnosis
- simple robotics design and production
- relation of **structure** and **power** to **motion**
- relation of **sensors** and **control** to **logic**
- programming related to microcontrollers
- **radio-controlled (RC)** communication

Maker/Coding Students *are expected to know the following:*
(this content is discipline-specific for students with a primary focus in coding)

- **problem decomposition**
- **structures** within existing code
- ways to **modify** existing code to meet a particular purpose
- **strategies** to predict effects of code modification
- programming language constructs to support input/output,
- logic, decision structure, and loops
- **tools** to aid in the development process
- **pre-built libraries** and their **documentation**
- inline commenting to document source code
- collaboration tools for programming

Applied Technologies • Explore existing, new, and emerging tools, technologies, and systems to evaluate suitability for design interests • Evaluate impacts, including unintended negative consequences, of choices made about technology use • Analyze the role that changing technologies play in industrial design and production	• appropriate use of technology, including digital citizenship, etiquette, and literacy ***Maker/Coding Students*** *are expected to know the following:* (this content is discipline-specific for students with a primary focus on entrepreneurship) • entrepreneurship opportunities • **characteristics** of entrepreneurs • creative ways to add value to an existing idea or product • ethics of **cultural appropriation** • differences between **invention** and **innovation** • factors that can promote innovation and entrepreneurial success, including networking, product/service knowledge, and market analysis • **interpersonal and presentation skills** to promote products and/or services and to interact with clients • components of starting a small business

Big Ideas – Elaborations

Curricular Competencies – Elaborations

- **user-centred research:** research done directly with potential users to understand how they do things and why, their physical and emotional needs, how they think about the world, and what is meaningful to them
- **empathetic observation:** aimed at understanding the values and beliefs of other cultures and the diverse motivations and needs of different people may be informed by experiences of people involved; traditional cultural knowledge and approaches; First Peoples worldviews, perspectives, knowledge, and practices; places, including the land and its natural resources and analogous settings; experts and thought leaders
- **constraints:** limiting factors such as task or user requirements, materials, expense, environmental impact
- **impacts:** including social and environmental impacts of extraction and transportation of raw materials; manufacturing, packaging, and transportation to markets; servicing or providing replacement parts; expected usable lifetime; and reuse or recycling of component materials
- **iterations:** repetitions of a process with the aim of approaching a desired result
- **sources of feedback:** may include peers; users; First Nations, Métis, or Inuit community experts; other experts and professionals both online and offline
- **appropriate test:** includes evaluating the degree of authenticity required for the setting of the test, deciding on an appropriate type and number of trials, and collecting and compiling data
- **share:** may include showing to others or use by others, giving away, or marketing and selling

Content – Elaborations

- **technology to support collaboration:** online multi-user tools and services to facilitate collaboration and communication on common projects, regardless of their physical location; for example, online chat/video communication services, document sharing services or sophisticated project management software
- **technical communication:** for example, sketching, technical drawing, computer-aided drafting (CAD), orthographic and pictorial drawings, technical reports, technical journals, end-user documentation, product manuals, catalogues
- **interpersonal skills:** for example, professional communications, collaboration, ways of explaining visuals
- **design for the life cycle:** taking into account economic costs, and social and environmental impacts of the product, from the extraction of raw materials to eventual reuse or recycling of component materials

Content – Elaborations
• **cultural appropriation:** use of a cultural motif, theme, “voice,” image, knowledge, story, song, or drama, shared without permission or without appropriate context or in a way that may misrepresent the real experience of the people from whose culture it is drawn • **complex drawings:** for example, multi-view, working, development • **components:** for example, bill of materials and schedules, tolerances, surface finishes • **tooling:** for example, three- and four-flute cutters, v-cutters, drills • **computer numerical control (CNC) equipment:** for example, lathe, router, mill, waterjet, plasma • **standards:** for example, machine feed and speed, depth of cut • **different materials:** for example, metal, wood, plastic • **platforms:** for example, computer numerical control (CNC), mill, lathe, plasma, water jet, 3D printer, laser • **testing equipment:** for example, oscilloscopes, multimeters, voltmeters, ammeter • **structure:** for example, stress analysis, tension, torsion, bending, shear • **power:** for example, hydraulic, pneumatic, electric • **motion**: for example, rotary, linear, reciprocating, oscillating • **sensors:** for example, bump, line follower, optic, sonic, limit, potentiometer, ultrasonic • **control:** for example, tethered, radio, autonomous • **logic:** if, then, else • **radio-controlled (RC):** for example, crystal, pulse, frequency spectrum • **problem decomposition:** subdivide a problem into manageable, self-contained tasks • **structures:** for example, key elements such as variables, functions, use of Whitespace • **modify:** for example, altering values of variables, parameters of a function or loop • **strategies:** hand tracing code, guess and test (experimentation) • **problem decomposition:** subdivide a problem into manageable, self-contained tasks • **structures:** for example, key elements such as variables, functions, use of Whitespace • **modify:** for example, altering values of variables, parameters of a function or loop • **strategies:** hand tracing code, guess and test (experimentation) • **tools:** for example, integrated development environment (IDE), computer language appropriate for problem/project • **pre-built libraries:** for example, external libraries for graphical user interfaces or gaming, sensor libraries for hardware such as coding devices • **documentation:** interpretation of library documentation/application programming interface (API) • **characteristics:** creative, flexible, tenacious; critical thinkers, communicators, collaborators, risk takers • **invention:** an original idea • **innovation:** changing an existing idea, product, or service into something new

Content – Elaborations
• **interpersonal and presentation skills:** for example, professional communications, collaboration, follow-ups, and courtesies; technological or visual supports to accompany marketing or demonstrations at conferences

Recommended Instructional Components:

- Direct Instruction
- Demonstrations
- Simulations
- Experiential Learning
- Peer Teaching
- Reflective Journaling

Recommended Assessment Components: Ensure alignment with the Principles of Quality Assessment

- Digital Journaling
- Self-Assessment
- Instructor Assessment

Learning Resources:

Korn, P. (2013) *Why We Make Things and Why It Matters: The Education of a Craftsman,* Jaffrey, New Hampshire: Godine

Margolis, M. (2012) *Arduino Cookbook,* Sebastopol, CA: O'Reilly

Monk, S. (2013) *Hacking Electronics: An illustrated DYI guide for makers and hobbyists,* New York, NY: Mc Graw Hill

Banzi, M (2009) Getting Started with Arduino, Sebastopol, CA: O'Reilly

Summerland Chamber of Commerce, www.summerlandchamber.com

Small Business BC, smallbusinessbc.ca

note: the following are all web-based resources and are continually changing

Lynda.com	autodesk.com/education/home	hackaday.com
makezine.com	hackspace.raspberrypi.org	wordpress.com
instructables.com	adafruit.com	tinkercad.com
arduino.cc	lulzbot.com	shopbottools.com

Additional Information: