TMJ3M

Manufacturing

Candle Holder Project

Abstract

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Project Overview

This project enables students to develop and demonstrate knowledge and skills related to the design process, project planning and production in a Manufacturing environment. Students will use a broad range of tools and equipment as they combine modern manufacturing techniques and processes within a project framework that develops strong project-management skills. The project is intended to be flexible as it can be developed to reflect individual interests and abilities of the learner. Accommodations have been embedded within the project framework to enable all learners to be successful and challenged.

Project Challenge

In manufacturing environments there are numerous pieces of equipment and processes that are involved in designing and manufacturing products. This project provides opportunities for students to develop and practice skills on conventional and modern automated manufacturing equipment. Students are given a variety of sample Candle Holders that they will manufacture in the school manufacturing teaching and learning space.

Students will research designs and/or choose traditional designs that reflect their cultural backgrounds. Designs will be communicated through sketches and/or CAD drawings. A key area of focus for this project is enhancing student knowledge and understanding of manufacturing processes in the application of designing and producing products. Students will also gain valuable hands-on skill development as they create the project using manufacturing equipment.

Connections

Science, Technology, Engineering and Mathematics (STEM)
This project supports the fundamental principles around STEM. It encompasses all aspects of STEM; material properties, engineering concepts, computer aided design, and mathematics and technologies
Innovative, Creativity, Entrepreneurship (ICE)
This project can be part of an ICE initiative through collaboration with the school settlement worker, business and/or art teacher - students can be connected to expertise around designs linked to cultural backgrounds helping them to know more about their culture and reflect it in the project design. Students could look to marketing and selling the candle holders as a school fundraiser.

SEF Component 2 Classroom Leadership Connections

Indicator 2.1- Collaborate with design/construction/manufacturing/special education teachers in establishing team-teaching opportunities or joint lesson planning in the context of a design/build approach. Investigate how other materials and processes can be used in other programs/subjects to make the same project.
Education Strategy - As a strategy in applying equity and inclusion, engage community partners thereby engaging the diversity of the community and investigate how cultural designs can be reflected in the project

Project Criteria

Examples

Criteria can be adjusted to reflect the actual equipment available at the given school ● Blended learning will be utilized when possible: research, activating prior knowledge safety considerations, manufacturing processes and project management techniques ● A variety of materials can be chosen: aluminum, brass, wood ● Students may select an existing design from provided samples or create their own design ● Sketches and/or CAD drawings are required to support the manufacturing process ● A variety of manufacturing equipment will be utilized: lathe, mills, CNC, CAD, welding, other – both the lathe and mill must be utilized ● Students will present their completed project and a concept map demonstrating knowledge and understanding of manufacturing processes, equipment use supporting the processes, and project management	A  B  C  D  Note: designs must draw in the use of lathes and milling machines – in the case of example B/D, the project would require an additional base to demonstrate skills development on the milling machine

Project Synopsis and Timelines

Act #	Activity Title/Name	Time (hrs.)	Curriculum Expectations	Assessment & Evaluation	Connections?
1	Research and Review (Blended Environment 2hrs.) - Websites - Design considerations - Technological Concepts - Equipment Safety	2	A1.1, A1.3, B2.3	K/U T C	▪ Ontario Curriculum ▪ Growing Success ▪ DI ▪ SEF ▪ STEM ▪ Math Literacy ▪ Literacy ▪ Equity Inclusive… ▪ ICE and FNMI
2	Planning and Production **Process Planning** (2 hours) - Routing - Speeds & Feeds **Spindle** (6 hours) - Rough turn - Finish turn - Thread **Base** (4 hours) - Square - Size & finish **CNC** (2 hours) - Program & machine **Other** (2 others) - Welding - Additional parts	16	A1.2 A2.1, A2.2 A2.3, A2.4 A3.4 A4.1, A4.2, A4.3, A4.4 B1.1, B1.2, B1.3, B1.4, B3.1, B3.2, B3.3, B3.4 D1.2, D1.4, D1.5, D1.7	K/U T C A	▪ DI ▪ SEF ▪ STEM ▪ Math Literacy ▪ Literacy ▪ Equity Inclusive
3	Portfolio and Presentation **Mind map graphic** (2 hours blended learning) - portfolio creation outside of class 3hrs. "blended learning" **Presentation** (15 mins. class) - Technological Concepts - Design - Demonstrating K&U Manufacturing Processes - Electronic Portfolio and product	4	A1.3 A1.4 A3.4 B4.1 C1.1 C2.1 D2.6	K/U T C A	▪ Ontario Curriculum ▪ Growing Success ▪ DI ▪ SEF ▪ Math Literacy ▪ Literacy ▪ Equity Inclusive… ▪ ICE FNMI

CONNECTIONS RESOURCE LIST

1	The Ontario Curriculum, Grade 11-12, Revised 2009	http://www.edu.gov.on.ca/eng/curriculum/secondary/2009teched1112curr.pdf
2	2 Growing Success	http://www.edu.gov.on.ca/eng/policyfunding/growSuccess.pdf
3	Student Success: Differentiated Instructions Educator's Package,2010(DI)	http://www.edugains.ca/resourcesDI/EducatorsPackages/DIEducatorsPackage2010/2010EducatorsGuide.pdf
4	2013 (SEF) School Effectiveness Framework	http://www.edu.gov.on.ca/eng/literacynumeracy/SEF2013.pdf
5	Think Literacy	http://www.edu.gov.on.ca/eng/studentsuccess/thinkliteracy/
6	Leading Math Success	http://www.edu.gov.on.ca/eng/document/reports/numeracy/numeracyreport.pdf
7	Ontario First Nations, Metis, and Inuit Education Policy Framework (FNMI)	http://www.edu.gov.on.ca/eng/aboriginal/fnmiFramework.pdf
8	Ontario's Equity and Inclusive Education Strategy	http://www.edu.gov.on.ca/eng/policyfunding/equity.pdf
9	Ontario Skills Passport (OSP)	http://www.skills.edu.gov.on.ca/OSP2Web/EDU/DisplayEssentialSkills.xhtml
10	OCTE Resources: SafeDocs, SafetyNet, Emphasis Courses	http://www.octelab.com/
11		http://www.edu.gov.on.ca/eng/general/elemsec/speced/LearningforAll2013.pdf

	Learning for All, Universal Design and Differentiated Instruction	
12	Kahoot	https://getkahoot.com/ways-to-play
13	Professional Learning Framework	http://www.oct.ca/-/media/PDF/Professional%20Learning%20Framework/framework_e.pdf
14	Mind Mapping – Barrie Bennet : “Beyond Monet”	http://jgerow.lakeheadu.ca/Jamie_Gerow/Teaching_Resources_files/beyondmonet.pdf
15	ICE – Innovation Creativity Entreprenuership	https://edu.gov.on.ca/eng/policyfunding/memos/sept2015/ice_training_shsm.pdf

MINDS ON ENGAGING PRIOR KNOWLEDGE

Activity 1 Project Research and Information Gathering

Activity Description:
Project based learning activities engage students when the project is connected to student interests and/or student background. This project allows students to work through project based activities where they design projects to suit their interests. Making projects meaningful will act as a motivator for students, resulting in student engagement and increased student success. This Candle Holder project encourages students to research and design a candle holder reflecting personal interest or background. When designing products, it is important for the designer/manufacturer to consider Technological Concepts related to their project.

Activity 1 Criteria and Instructions

Design Considerations

- Research a variety of candle holder styles/designs
- Design consideration should be given to aesthetics, environment, ergonomics, fabrication, function, innovation, material and safety
- Final design to take into account a theme linked to a culture or personal background
- Planning consideration must be given to address feasibility of producing multiple items when considering fabricating a set of candle holders – i.e. more than one

Research

- Use a variety of resources to collect information and final designs: websites, photos, magazines, speaking to relatives, etc.

Archiving Project Progress

- Evidence of research and design considerations to be posted into your class google folder and/or your engineering notebook
- Your final portfolio will include evidence of acquired skills and competencies and will be presented to the class at the end of the project duration/term
- Students have a role to play in assessment through peer evaluation

Activity 1 Prior Knowledge	Connections
The student will have: ● Group work skills and an understanding of norms of collaboration ● Practiced research skills ● Been exposed to google groups, google folders and google classroom (dependent on teacher prior instruction) ● Knowledge of the Design Process, and Fundamental Technological Concepts ● Reviewed related safety information and videos for key equipment used to fabricate the project ● Understand the expectation of the Blended Learning classroom as it pertains to completing work outside of class time ● Be familiar with expectations for creating a portfolio and presentations that demonstrate their ability of how to convey knowledge and understanding of product design, manufacturing operations and processes to effectively create a product ● Have previously developed skills, knowledge and understanding of how to operate project related equipment	**Teacher Tips** Explain to students the expectations around blended learning environments – guide them as to work that is to be conducted outside of class time. **SEF Component 1 Assessment for, as and of Learning - Indicator 1.1 Assessment is connected to the curriculum Fundamental Technological Concepts page 5,6** **OCTE Resources:** SafeDocs, SafetyNet
Activity 1 Planning Notes	**Connections**
Teacher ● Provide links to access safety information and videos ● Post a list of the Norms of Collaboration on the class wall and have a discussion to deepen student understanding ● Ensure students are comfortable and able to utilize google classroom and/or google folders – available collaboration tools ● Book time in computer lab if needed for developing drawings: CAD ● Have all photocopied material prepared, and/or electronically uploaded to the google classroom, and collaboration forums ● Review learning goals and assessment methods ensuring student understanding ● Student use of PED's is encouraged (personal electronic devices) ● Discuss with students that the majority of research is to be done as blended learning (research outside of the class time) ● Walk students through an exercise to co-construct a project timeline to facilitate full understanding of criteria and expectations over time ● Create and post ahead of the unit start, and/or co-create with class a word wall of key terminology in preparation for the unit/project. Effective word walls: - support the teaching of key-words and subject-specific terminology. - promote independence in reading and writing by building vocabulary - provide visual clues and reference for language learners	OCTE Resources: SafeDocs, SafetyNet **DI Connection** Collaborate with students to construct learning goals. Check to ensure that learning goals are clearly understood by students. Reference **Appendix C**: Project Management for tools to monitor and track project flow **THINK LITERACY -** posting Word Walls that identifies explicit vocabulary and terminology that will be part of the unit of study

- help students remember connections between words and concepts Effective methods to support student acquisition of terminology and key vocabulary can be achieved by using Word Walls around the classroom.	

Action Introduce or Extend Learning

Activity 1 Instructional Strategies	Connections
Teacher The Project • Introduce the project by releasing the Project Scope electronically through the collaboration forum (may be done prior to class for previewing) and walk students through it using available multimedia systems. (Appendix A - Project Scope) • Engage the class in a skype session with an Ontario Aboriginal school or cultural center where students are exposed to First Nations, Metis and Inuit designs and cultural heritage. • Prepare class for safe conduct and operation of related equipment. Project Purpose • Introduce the skills and competencies that students will develop and acquire through completion of the project. Reference specific expectations as they are linked to project activities (Appendix B). Competencies related to all destinations: workplace and apprenticeships, and post-secondary studies and pathways Project Management • Conduct class activity to investigate "what successful project management looks like" (Appendix C - Project Management) • Discuss purposeful routing of part production for efficient production and cost effective manufacturing (Appendix D - Flow Chart for Part Routing) • Review exemplary concept map which communicates logical manufacturing process flows, and student concept attainment (Appendix E - Concept Map) • Engineering Notebook – review and check for understanding around recording ideas, iterations, and key project information, daily journals – both hard copies and/or soft copy format • Inform students of expectations for them to create a Project Flow along with the importance of tracking the complete manufacturing	**Learning for All**, pg. 16 Planning learning opportunities that will extend the learning of all students, whatever their level of achievement, and help each one reach his or her potential. **FNMI** All students in Ontario will have knowledge and appreciation of contemporary and traditional First Nation, Métis, and Inuit traditions, cultures, and perspectives. ICE – connection: Allow students to understand the world from the perspectives of others, generate new ideas, and give students the confidence to develop strategies to implement and sustain their ideas OCTE SAFEdocs and SAFETYnet **Safety Passport** Ensure all students have attended safety demos and are tracked as passed in the safety passport Mind Mapping – Barrie Bennet

process from design through to project completion and presentation **Student:** • Review and utilize templates provided to guide project management – students will begin to draft project flows based on project design and machine operations required • Provide evidence of ongoing progress by documenting in the engineering notebook, journals and electronic forum • Communicate design decisions based on technological concepts as they relate to design considerations • Conduct research and select a project design/theme that suits their personal need • Have an understanding of how to Manufacture at least one candle holder using lathe, milling and CNC machines, and other manufacturing equipment and tools, based on project design • Create an electronic portfolio and presentation for purposes of showcasing skills acquisition, and depth of knowledge and understanding of manufacturing production and processes	See link for : "Beyond Monet" http://jgerow.lakeheadu.ca/Jamie_Gerow/Teaching_Resources_files/beyondmonet.pdf
Activity 1 Assessment and Evaluation	**Connections**
Assessment and evaluation tools and strategies will be used throughout this module/project by both the teacher and student to guide student learning and to inform instruction. Key indicators for success will be surfaced by intentional use of triangulation: evidence of achievement by observation, conversation and product. Students and teacher should engage in co-constructing assessment and evaluation tools for peer evaluation (Appendix F, and Appendix L) **Knowledge and Understanding** • Assessing student knowledge and understanding of manufacturing processes, part production and safe use of equipment **Thinking** • Assessing students ability to calculate appropriate speeds and feeds - mathematical calculations • Identifying and implementing process routing details for effective manufacturing of the project • Gathering evidence through conversation (portfolio and presentation) of critical thinking to manufacture component parts **Communication** • Assessing students ability to select and use explicit	**Edugains** - *Self Assessment Viewing Guide* - Highlight and integrate assessment language and skills into all learning experiences. - Share with students up front what you are doing with criteria, and why. *Self-assessment can be useful in any subject. If students produce it, they can assess it; and if they can assess it, they can improve it.* *Andrade (2007)* **Leading Math Success:** Mathematical literacy includes the ability to put mathematical knowledge and skills to functional use rather than just mastering them within a school curriculum.

vocabulary, accurately communicating proper manufacturing processes using related terminology (as per the achievement chart and the manufacturing expectations
- Graphically communicating production flow and manufacturing processes and project design through CAD drawings

Application

- Assessing student's ability to demonstrate proper practice in the manufacturing facility to operate equipment manufacture products
- Assessing final product as manufactured according to specifications and stated criteria

Learning Skills

Teachers can engage students through a group activity where they use the placemat strategy to identify what an Unsatisfactory, and an Excellent looks like for each of the learning skills. They will also share aloud the results to bring all the class members to a common understanding of the Learning Skills. Students will move forward to consciously target their efforts to reach higher levels of achievement.

- Through observation and conferencing, students will be assessed formally or informally.
- The teacher will document the following:
  - the student's skills pertaining to conflict management skills;
  - student's ability to work effectively as a team member;
  - student initiative, leadership and participation in a group.
- Conferencing assessment can take place on a daily basis. Be sure to provide encouragement and praising effort as tasks are complete building on self-confidence.

Learning Skills are addressed in Appendix L as stated below.

Assessment Tools – using Appendix L, students will identify their level of competencies prior to the start of the unit/project. This will allow students and teacher to assess the student current level of comfort of the competencies etc. The result will also inform the teacher of the starting position of the student so that the teacher may adjust their teaching delivery to personalize instruction to the student readiness point.

Ontario Skills Passport

Numeracy skills in measurement and calculations.

Growing Success – Learning Skills: Teachers can assist students in developing capacity to understand their own interpretation of their achievement through learning skills.

Growing Success

The five strategies, adapted from Black and William (p. 8), are:
• identifying and clarifying learning goals and success criteria;
• engineering effective classroom discussions and other learning tasks that elicit information about student learning;
• providing feedback that helps learners move forward;
• through targeted instruction and guidance, engaging students as learning resources for one another;
• through targeted instruction and guidance, helping students understand what it means to "own"
their own learning, and empowering them to do so.

Activity 1 Accommodations	Connections
Teachers should review Individual Education Plans (IEP's) in an effort to implement prescribed accommodations to for students in addition to consulting with appropriate support staff. Teacher can support students by understanding learner profiles so they can personalize instruction to the individual student through prescribed modifications. Differentiated Instructional Strategies for all students and those with special needs may include: - Learning materials, including print, electronic, and interactive texts, are within comfortable reach of all students - Communicating consistent and achievable expectations - Arranging information sequentially to clarify its relative importance - Breaking instructions down into small steps - Providing descriptive feedback during the learning - Providing alternative instructional and assessment activities - Challenging students at an appropriate level - Use a variety of groupings to meet student needs – groupings students according abilities and building in peer support. Modify groupings and include opportunities for individual work depending strengths and weaknesses. Strategic pairing of students with experienced students to stretch student ability - Providing varying levels of text targeting the learner level ability - Collaborating with support staff to build in strategies that will assist the teacher in targeting the learner gaps resulting in more personalized instruction that engages and motivates the student	**Learning for All** Provide the accommodations and/or modifications that are specified in the IEPs of students who have special education needs. **Learning for All - Universal Design and Differentiated Instruction:** In differentiating instruction according to students' interests, a teacher attempts to increase the likelihood that any given lesson or project is highly engaging and personally meaningful for each student in the class. Teachers who know students' interests can vary projects, themes, and examples used in instruction to reflect those interests.

Consolidation & Connections (Provide Opportunities for Reflection)

Activity 1 Reflection Activities	Connections
It is important to gather information to check for student understanding. Teachers may prepare an activity for students to engage in that will reveal their level of understanding at the end of the class. Any class ending diagnostic activity can be quick and fun: have elbow buddies listen to their peer's summary and vice versus so that they can together ensure understanding of the bid ideas of the class. **Engineering Notebook** ● Have students record the important topics or big ideas that were discussed during the class ● Have students write a statement about the key understandings of the class and make a connection by writing a statement that reflects: what was discussed, what is important to remember, and what are the student next steps or action items. This statement will provide evidence of the students' level of understanding and will inform the teacher of necessary clarifications that may be required **Exit Card** Students can reflect on the daily activities by completing an "exit card". The exit card will have specific questions related to the activities of the class. Reserve 10 minutes at the end of the class for exit card completion. Questions may ask: - List key things learned through the day's activities - What questions, ideas and feelings have been raised by the lesson? - Evaluate your participation in class today. What did you do well? What would you like to do differently next time? Teachers can provide the last 5 minutes of class for the students to share their engineering notes and/or exit cards with an elbow buddy. This collaborative discussion will provide opportunities for immediate feedback while checking for student understanding. Teachers may elect to collect the engineering notebooks and exit cards for review and preparation for the starting point of the next class. This will ensure student readiness going forward.	**Edugains -** Using assessment to gather information about students' readiness, interests and learning preferences **Learning for All:** "Readiness" does not refer to the student's general ability level, but to the current knowledge, understanding, and skill level a student has in relation to a particular sequence of learning. … Differentiating instruction based on student readiness involves knowing where particular students are on the learning continuum, then planning program features and instructional strategies, resources, and supports to meet them where they are and move them along this continuum. Some students may require remediation or modified expectations; others may need extensions or opportunities for independent study. *(Ontario Ministry of Education, 2004b, p. 4)*

Materials, Tools and Resources

Activity 1 Materials and Tools
Project Tracking Template – Appendix Project Part Routing – Appendix Concept Map – Mind Map sample – Appendix Speed and Feed Calculations template – Appendix Material Selection – Wood, Steel, Aluminum dependent of design Design Process Matrix – guide to making design decisions (decision making chart)
Activity 1 Websites
International Candles http://www.calibex.com/International-Candle/shop-html?nxtg=3ab0a1c0505-E18B5AE0723A7707 Italian Candles http://www.bing.com/images/search?q=italian+candle+holders&view=detailv2&qpvt=italian+candle+holders&id=17AD661939E42593556BEC4B463EDC0198BCF184&selectedindex=32&ccid=u9UR9aUv&simid=608018983370951229&thid=OIP.Mbbd511f5a52f541847a5afdb8dbf2bbeo0&mode=overlay&first=1 Excel Project Management https://www.smartsheet.com/top-project-management-excel-templates-b Flow Chart Drawing Tools https://www.draw.io/ Concept Mapping Tools http://www.inspiration.com/visual-learning/concept-mapping Mind Mapping – Barrie Bennet : “Beyond Monet” http://jgerow.lakeheadu.ca/Jamie_Gerow/Teaching_Resources_files/beyondmonet.pdf

Activity 1 Publications

Textbook - Steve F. **Krar** - **Technology Of Machine Tools** (6th **Sixth Edition**): Steve F. **Krar**: 8601400058077

Activity 1 Computer Software

- Word Processing
- Internet Accessibility
- Accessibility to Google, Google Classroom, Google Drive

Activity 1 Human Resources

- Guest Speakers: First Nations, Metis, Inuit
- Local craftsperson, Cultural Centre staff
- Special Education, Guidance, Resource Support Staff
- Math and English department staff
- IT support
- Project examples from within local community to showcase

Activity 1 Other

- Understanding of school board and school guidelines/policies around computer use, and protocols for student/teacher connections beyond the school day: blended learning, google forums etc.

Activity 1 Appendices

- Appendix A: Project Scope – project at a glance
- Appendix B: Connection to Curriculum Expectations
- Appendix C: Project Management tools
- Appendix D: Project Routing templates
- Appendix E: Concept Map – project flow and manufacturing processes
- Appendix F: Peer Evaluation – co-constructing activities

Activity 2 Project Development and Production

Activity Description:

In this activity the students will identify the steps for planning the manufacturing processes required to fabricate their candle holders. Using sketches of their design choice, and/or CAD drawings (CAD drawings to extend the learning), students will map out the project flow as it pertains to manufacturing processes. This activity is designed to develop efficient project management skills required in the manufacturing industry. Students will also use manufacturing equipment to machine/fabricate the parts of the project, and assemble the final product. Emphasis is placed on demonstrated knowledge and understanding of project flow and effective use of equipment. The scope of the project can be modified to accommodate varying learner abilities: sketches in place of CAD drawings, simple designs versus complex designs that demand higher skill levels using the equipment, employing senior mentoring students and the addition of using automated machinery versus conventional machinery.

MINDS ON ENGAGING PRIOR KNOWLEDGE

Activity 2 Prior Knowledge	Connections
Prior Knowledge Required; The student will have: ● Basic skills in creating sketches and/or CAD drawings for part production ● Mathematical skills relevant to interpret measurement from sketches/drawings, and to calculate appropriate speeds and feeds required to manufacture parts accurately to specified dimensions ● Mathematical skills to understand the cartesian coordinate system relevant to machine axis; X, Y, and Z for drills, mills, lathes **Process Planning** ● Students will recall previous course exercises that introduced them to process planning templates, part routing templates, and other templates such as for calculating speeds and feeds. These templates assist students in effectively planning logical steps and sequences to improve progress, efficiency and part/project completion. See Appendix C ● Part Routing – understanding the importance of carefully planning flow of equipment use from start to end of the fabrication process **Manufacturing/Fabrication** ● Students will have prior knowledge of operating and performing part production on shop equipment. They will continue to further develop the following competencies based around the need driven by their project designs: - Metrology - basic and advanced - Layout processes and tools - Machine operations: lathe, mill, cnc, saw - Related safety, general and machine specific - Hand tools - Finishing tools and equipment Specific machine operations that students have previously practiced will be reflected in their projects. Most of the operations listed below will be incorporated in student project design, and will be demonstrated using major program equipment: **Saw** - rough cut off for efficient material use **Lathe** - Turning, facing, drilling, knurling, grooving **Mill** - squaring, facing, drilling, tapping, profiling, pocketing **CNC** – graphic, engraving, grooving, detailing (extended learning)	**Teacher Tips** It may be helpful to check student readiness by engaging them in a diagnostic activity using Kahoot to identify concepts and developing familiarity through explicit vocabulary - this fun activity will inform the teacher of student readiness. Kahoot inspires student learning and is fun way to do recall **SEF Component 4 Curriculum Teaching and Learning Indicator 4.2** - Numeracy specific concepts are explicitly used to deepen student learning **Appendix C** - Process Planning Templates **OCTE Resources: SafeDocs, SafetyNet, Emphasis Courses** Available resource documents: safety, machine operations, lesson plans

Activity 2 Planning Notes	Connections
• Ensure learners feel safe and are appropriately challenged. There may be students who are new to Manufacturing for which the project criteria can be adjusted. Choosing to use more complex machine operations for the project can challenge the more comfortable and appendices related to discussion or next steps • This project activity is multi-phased incorporating process planning, materials selection, tooling selection, and incorporating advanced processes such as CNC. • Prepare a topic list for discussion/lessons with the class to direct students to relevant resources/links ensuring their preparedness to complete project tasks. E.g. machine operations - knurling, facing, grooving, squaring blocks and videos • Some students may be new to the manufacturing shop for a variety of reasons, it will then be important to accommodate new students: the teacher may spend extra time with that student so that instruction is personalized. Furthermore, students can be paired up with strong student mentors. • Consider organizing students into pairs to provide a sense of safety and comfort utilizing manufacturing equipment while stretching student ability • Prepare templates that facilitate student calculating of speeds and feeds that they will use in the production of the project (encourage use of templates during production) • When reviewing sketching techniques, teachers should demonstrate the techniques in progression starting with simple two-dimensional shapes progressing to three-skilled students - e.g. using CNC, indexing on the milling machine • Prepare handouts and post necessary support documents to google group/forum/classroom: • dimensional representation and Orthographic projection. Students should have several practice exercises through each progression. These exercises can be used as diagnostic assessments in determining individual levels of proficiencies and readiness. • Graphic communication requires a lot of practice exercises to	**DI, Edugains pg. 19** A safe and non-threatening learning environment encourages learning. Learners who experience discomfort in connection with rejection, failure, pressure, or intimidation may not feel safe in the learning context. **2.** Learners must be appropriately challenged. The content of new learning should be neither too difficult nor too easy, so that learners can be comfortable enough to accept the challenge that new learning offers. **Learning for All – A Guide to Effective Assessment and Instruction** **Personalization** – Education that puts the learner at the centre, providing assessment and instruction that are tailored to students' particular learning and motivational needs. Speeds and Feeds resource https://www.youtube.com/watch?v=gIUS_0xfeGg **Professional Learning Framework** - PL Communities - develop strategies with

develop drawing skills, some of which may be completed for homework. (blended learning opportunity) • Student Project management can be assisted through the use of available tools to help students track progress and monitor task sequence: flow chart for manufacturing processes and project sequence of operations • Ensure availability of material required for project production. This includes having available a variety of materials that suit diverse project designs: aluminum for spindle and base – where some designs may choose to be wall mounted, thereby requiring wood materials to act as a base plate	colleagues to ensure delivery of effective practices: have design teacher co-teach the class an activity around sketching, CAD drawings - rotate students between both classes **Appendix C** Use excel spreadsheets - "flowcharts" for tracking project progress

ACTION Introduce or Extend Learning

Activity 2 Instructional Strategies	Connections
TEACHER Project • Review design decisions based on personal preference and consideration given to Fundamental Technological Concepts from student homework. Students can reveal design ideas by a short presentation of ideas to the class • Discuss material selection based on availability and feasibility of project criteria and environmental considerations • Speeds and Feeds can be reviewed to ensure a common approach by all students when actively performing machine operations on equipment • Check in with students that they have planned out the process and product flow based around the machine operations • Ensure all required materials are available Equipment Selection Listed here are possible operations and demonstrations required on equipment dependent on project designs. Have class discussions	**The Ontario Curriculum, Grade 11-12, Revised 2009** Fundamental Technological Concepts pg. 7 **Think Literacy -** Oral Communications-Whole Class Discussion-Discussion Etiquette Small group discussion strategies can also apply here. **SEF Component 2 Classroom Leadership Connections** **Indicator 2.5:** By introducing students to 'Discussion Etiquette', classroom practice reflects safe, accepting, inclusive, caring, respectful and healthy learning environments - Norms of Collaboration

around these operations and direct student attention to supporting resources ● Lathes: turning, forming - grooving-knurling, facing, threads, finishing ● Mills: squaring, facing, forming, tapping, pocketing ● CNC: engraving, pocketing, profiling ● Welding: fusion, bonding, forming **Lessons** Can be selected from OCTE Emphasis course development ● Lessons can be delivered JIT, or may have been delivered prior to the unit near the start of the course ● Key lesson information can be obtained by students outside of class time via blended learning ● Teacher to deliver formal lessons on key manufacturing process during class time including demonstrations ● Students will have previously had multiple activities to develop skills that will be evaluated throughout the project **Safety** ● Explain to students potential hazards that may be associated to this type of project: machining long slender parts, grooving, machine operation; reference textbook and OCTE SAFETYnet and SAFEdocs ● Students must be recorded a passed safety practices related to required project equipment ● Using LCD projector and/or SMARTboard, to engage class in exercise for utilizing "Excel" as a sample tool for tracking project progress - covering "work-flow, production schedules". Appendix D ● Teacher will monitor students for safe work practice throughout the project. In the case the teacher observed a safety infraction - it is worthwhile to stop the class and have a conversation (as you would when discussing a case study) **STUDENT** Project ● Provide evidence of referencing Fundamental Technological Concepts with inclusion of personal influence to reach design decisions ● Present design to teacher prior to cutting rough stock of material ● Student may choose to extend learning by incorporating advanced machinery and processes in the product production; e.g. CNC, extensive detailing. *student is	**OCTE Resources:** SafeDocs, SafetyNet, Emphasis Courses **Safety Passport** **The Ontario Curriculum, Grade 11-12, Revised 2009** Achievement Chart **Textbook Machine Operations** **Technology Of Machine Tools** **OCTE Resources** See website archives **Growing Success** Ensuring multiple opportunities for students to demonstrate the full range of their learning by having practiced key skill development, and have received clear, specific and timely feedback to improve student learning **Think Literacy** - Developing and organizing ideas - understanding how to track project progress using tracking tools as recommended

encouraged to set up a time to review with teacher or mentoring students a focused session to plan in the case of including a CNC component ● Students have planned for, researched and practiced related machine operations relevant to project ● Select material based on availability, design, skill and comfort level, and number of intended completed products: i.e. one, two or three candle holders ● Perform sawing operations with planning to minimize material waste **Equipment** ● Students have previously had multiple opportunities to practice and develop specific skills, machine operations and other project processes prior to this project: i.e. machining round objects on the lathe, squaring up blocks on mills, locating reference points, using hand-cutting tools to perform tapping operations and product finishing **Equipment Selection and Use** Operations and demonstrations required to be performed on equipment dependent on project designs ● Part routing and machine operations will have already been planned out using templates ● All speeds and feeds will be calculated and present at machines by students ● Saws – cut material in preparation for machine operations ● Lathes: most likely used for the machining of the candle body – operations may include drilling, facing, turning, forming - grooving-knurling, threads, finishing ● Mills: most likely used for the candle holder base and must be used to demonstrate milling competencies – operations may include squaring, facing, forming, tapping, pocketing ● CNC: Prior planning by student with teacher if intending to include CNC as some CAD and CNC programming will occur – operations may include engraving, pocketing, profiling ● Welding: students may want more elaborate designs and will require welding processes – processes may include fusion, bonding, forming **Lessons** ● Have attended all teacher led demonstrations and lessons related to project	**Teacher Tip** If you have access to strong students, and/or a senior student, have them mentor during the shop time to support students who may be less comfortable on machinery

• Will have review all related support documents as recommended by teacher (blended learning activity) **Safety** Students will demonstrate that they have the knowledge, skills, and habits of mind required for safe participation in Technology activities when they: • maintain a well-organized and uncluttered workspace • follow established safety procedures • identify possible safety concerns on an ongoing basis • suggest and implement appropriate safety procedures • carefully follow the instructions and example of the Teacher • consistently show care and concern for their own safety and that of others • Students will conduct themselves so that they demonstrate understanding of potential hazards that may be associated to this type of project: machining long slender parts, grooving, machine operation; reference textbook and OCTE SAFETYnet and SAFEdocs • Students must have previously passed safety practices related to project equipment before they can continue **Portfolio and Presentation Preparation** Students will be documenting all processes within the project for inclusion into their concept map to be presented at the end of the project timeline – see appendices for exemplars; tracking templates and concept maps. Students will be posting all work into their electronic portfolios.	**Teacher Tip** Reference the SAFEdoc http://www.octelab.com/content/safedoc-manufacturing - site has multiple resources; lessons, templates, safety information sheets, tests etc.
Activity 2 Assessment and Evaluation	Connections
Knowledge and Understanding • Assessing student knowledge and understanding of manufacturing processes, part production and safe use of equipment – teacher will observe student behavior and ability using equipment demonstrating student knowledge and understanding the tasks they are performing **Thinking** • Assessing students ability to calculate appropriate speeds and feeds – students will provide ongoing evidence of calculations for speeds and feeds during their performance of each machine operation (written evidence) • Identifying and implementing process routing details for	**Appendix K** – order of operations and speed, feed calculations template

effective manufacturing of the project – students will have documentation of pre-planning for process and part routing available via their draft portfolio
- Gathering evidence of critical thinking employed by students to manufacture component parts – the teacher will engage students daily in conversation to capture gage level of critical thinking and actions of inquiry

Communication
- Assessing students ability to select and use explicit vocabulary, accurately communicating proper manufacturing processes using related terminology (as per the achievement chart and the manufacturing expectations – the teacher can collect evidence of student ability to reflect key terminology and vocabulary through daily conversations
- Graphically communicating production flow and manufacturing processes and project design through CAD drawings – evidence will be available in student draft portfolios

Application
- Assessing student's ability to demonstrate proper practice in the manufacturing facility to operate equipment manufacture products – evidence will be obvious as teacher supervises students as they perform machine routines/operations
- Assessing final product as manufactured according to specifications and stated criteria – assessment "For Learning" will be ongoing through teacher/student/peer observations and conversations occurring daily – further evidence will result at project completion stage

Learning Skills and Assessment tools
- Through observation and conferencing, students will be assessed formally or informally
- The teacher will document the following:

- the student's skills pertaining to conflict management skills
- student's ability to work effectively as a team member
- student's initiative, leadership and participation in a group, and when providing mentorship

- Conferencing assessment can take place on a daily basis. Be sure to provide encouragement and praising effort as tasks are complete building on self-confidence
  Assessment Tools: Rubric **(Appendix H)**

Growing Success
Provide ongoing descriptive feedback that is clear, specific, meaningful, and timely to support improved learning and achievement

Growing Success
As part of assessment for learning, teachers provide students with descriptive feedback and coaching for improvement.

Triangulation…
Growing Success: Learning skills and work habits
The six skills and habits are: responsibility, organization, independent work, collaboration, initiative, and self-regulation.

Learning Connections

Indicator 1.6-
The final rubric for this activity addresses the 'assessment of learning' which is based on the performance standards set out in the Achievement Chart. The assessment criteria of this activity align with the overall expectations and form the basis of assessment of learning. Students use the rubric the assessment of learning results to set new goals and strategies for the next phase of their design.

Learning skills and work habits are evaluated regularly through monitoring and progress and regular conferencing with individual students.

Indicator 2.2- Provide explicit feedback about their engagement and learning as educators and advocate for what they need as learners
Assessments will include communications, observation,

	performance assessment, and conferencing.
Activity 2 Accommodations	Connections
There are multiple needs that may require accommodations in a manufacturing environments – ● Weak, or new to class students needing mentoring, and/or additional assistance. This can be addressed by strong students being partnered with weak students and/or the student could book extra time outside of the class to hone skills under teacher supervision ● Physically disadvantaged students my need special attention to ensure they are comfortable operating machines – an example may be a raised platform is employed when this student operates machinery – or other assistive devices as needed ● Shop routines and procedures can be clearly communicated to ensure anyone disadvantaged will not be affected: if a student has difficulty hearing, a flickering of light switches may indicate or evoke certain signals and responses ● Expectations can be adjusted to reflect the student's readiness: previous manufacturing shop experiences versus new students in an "Open" course ● Students with IEP's must also be accommodated ● In the event of a combined class – i.e. Applied with College, it is helpful to ensure all students understand expectations. Student understanding can be supported through opportunities where teachers collaborate on delivery of instruction that is targeted to the variety of learning profiles of all students	**SEF Component 1** **Assessment for, as and of Learning Connections** **Indicator 1.2 & 1.4:** Reviewing student profiles, learning portfolios, IEPs and assessment data will inform decisions regarding assessment tools and strategies. **SEF TIP** It is recommended that there is regular collaboration in the development of assessment tasks, tools (e.g. rubrics) and practices supports consistency of practice in and between grades, departments and courses. This is especially important with when working with identified students.

Consolidation & Connections (Provide Opportunities for Reflection)

Activity 2 Reflection	Connections

Student daily journals can be written and posted by students in their google folder for access by the teacher. Students can write down their achievements during the class as well as perform self-assessment. When possible, the beginning of each new class might start with a class open discussion; “any ah-ha’s” from the day before that students can share. Or, having students review their journal entries with peer buddies and asking for feedback. – Appendix J	**Growing Success**: ***gradual release of responsibility*****.** A high-yield instructional strategy that involves scaffolding instruction and providing appropriate amounts of support to students based on their needs – As students share their thoughts, the teacher can nuture conditions supporting scaffolding thereby elevating understanding across the whole class for all learners

Materials, Tools and Resources

Activity 2 Materials and Tools (part production)

Project Guiding Templates
- Speeds and Feeds calculation template and part routing
- Project Tracking, Flow Charts, Checklist

Hand Tools
- Files, Wrenches, Hammer, Mallet, Emery Paper

Layout Tools
- Scribers, Calipers, Set Square, Angle Plate, Sine Vise

Metrology
- Scales, Set Square, Vernier Calipers, Micrometers, Vernier Height Gage

Saw Cutting
- Horizontal Band Saw, Vertical Band Saw, Cutting Fluids

Cutting Tool Selection, Speeds and Feeds
- Based on project material selected: Wood, Steel, Aluminum

Metal Lathe
- 3 Jaw Chuck, High Speed Tool-bits, Carbide Tool-bits, Live Dead Centers, Jacobs Drill Chuck
- Cutting Fluids, Grooving/Parting tools, Roughing/Finishing Turning Tools, Knurling, Hand Tap, Tap Wrench, Counter Sinking Tool, Centre Drill, High Speed Drills

Vertical Milling Machine and/or Horizontal Milling Machine
- Vise, Carbide Face Mill, End Mills, Drills, Taps and Tap Wrench, Jacobs Chuck, Number/letter Drills, Chamfer Tool

Welding

- Mig, and/or Tig (optional - only if needed)

Forming

- Bender (in the case of scrolling steel shapes for mounting to wall etc.)

CNC

- Computer Controlled Machining Centre and/or Mill (optional if wanting to extend learning using automated equipment – engraving – pocketing – profiling)

Activity 2 Websites

Speeds and Feeds
https://www.youtube.com/watch?v=gIUS_0xfeGg

https://www.google.ca/search?q=milling+machine+speed+and+feed+calculation+template&biw=1455&bih=732&tbm=isch&imgil=9TLMWtTwl3J76M%253A%253Bl-xannZrysNw2M%253Bhttp%25253A%25252F%25252Fwww.ns-tool.com%25252Fenglish%25252Ftechnology%25252Ftechnology_03.html&source=iu&pf=m&fir=9TLMWtTwl3J76M%253A%252Cl-xannZrysNw2M%252C_&usg=__kV2QSuX6PJ7vzjX6tzbxdvst-fs%3D&ved=0ahUKEwjej7bkx4zOAhWo7oMKHR9AAs4QyjcIKA&ei=MfKUV56zBajdjwSfgInwDA#imgrc=9TLMWtTwl3J76M%3A

OCTE – Access to machine related activity sheets, safety sheets, videos and machine operations can be reviewed and/or referenced http://www.octelab.com/

Activity 2 Publications

Textbook - Steve F. **Krar** - **Technology Of Machine Tools** (6th **Sixth Edition**): Steve F. **Krar**: 860140005807

Activity 2 Computer Software

CAD Software
V-carve
CAD/CAM Software
Excel
MSWord

Activity 2 Human Resources

Peer Mentors
Senior Student Mentors
Outside of class teacher/mentor supports
Special Education/Resource Staff
Educational Assistants
Guidance Counselor – SHSM tracking and participation
Guest speakers from industry – local manufacturing sectors

Activity 2 Other

Skills Development for Skills Ontario participation
Mentors - Senior students, and industry experts from PEO, Universities and Colleges

Activity 2 Appendices

Appendix C – Project Tracker Template
Appendix D – Project Flow Part Routing
Appendix H – Full Evaluation Rubric
Appendix J – Candle Holder Spindle and Base CAD Drawings
Appendix JJ – Candle Holder Spindle

Activity 3 Project Portfolio and Presentation

Activity Description:
This consolidation activity allows students to demonstrate skills acquired throughout the project from concept introduction to product completion. The ongoing creation of a student portfolio will provide students with a visual that they can showcase to the class near the end of this activity timeline. The portfolio may consist of graphic displays and/or virtual links which can be used to demonstrate the scope of the related project management and product manufacturing process. The goal of this activity is to provide a means whereby students can

communicate what they have learned, the skills developed and honed, and their depth and breadth understanding project management in a manufacturing environment.

Activity 3 Criteria and Instructions
The portfolio will include: • Challenge Statement • Design considerations • Project associated planning templates • Sketches and/or CAD drawings • Visuals (e.g. concept map – to allow student to reference during the presentation when as they communicate their project experience and overall growth) • Electronic posting of all work – electronic portfolio • Student Skills Achievement – Appendix L completed • Reflection/Concluding remarks

MINDS ON ENGAGING PRIOR KNOWLEDGE

Activity 3 Prior Knowledge	Connections
Prior Knowledge Required; The student will have: • Collaboration skills – Norms of Collaboration - students to work in groups to peer evaluate each other • Understanding of the course expectations related to the project – **Appendix B** identified expectations • Co-constructed assessment and evaluation tools based on the	Student Norms of Collaboration link included http://www.thinkingcollaborative.com/stj/student-norms-collaboration/

curriculum Achievement Chart (class review of the rubric prior to presentations - seek out student contributions where possible) • Referenced project assessment rubric in preparation for project completion including the presentation - Appendix H	**The Ontario Curriculum, Grade 11-12, Revised 2009** Achievement Chart
Activity 3 Planning Notes	Connections
• Ensure students have all had access to and reviewed/collaborated on the assessment rubric for the presentation – Appendix H • Set up a schedule and get students to register for a presentation spot/appointment – perhaps using google calendar and allow students discretion to choose their presentation time slot • Make sure multimedia equipment is available and functional for the presentations • Have available memory sticks and or access to internet to allow access to student google folders for their presentation materials	**Teacher Tip:** Build in opportunities for students to practice their presentations inside or outside of the class time. This will ensure elevated student success and raise student confidence in demonstrating their achievement

ACTION Introduce or Extend Learning

Activity 3 Instructional Strategies	Connections
Teacher • Review criteria for presentations – model an exemplary presentation – “What do effective and successful presentations look like”? • Check for student understanding around assessment criteria - ensure all students have reviewed the full rubric – Appendix H • Ensure all technology is available and functional for start of presentations • Perform a quick review to “check for completion” of necessary templates and/or documents that students are expected to include in presentation	**Guide to Effective Presentations** - https://www.enar.org/meetings/spring2016/program/presentation_guidelines.pdf

Student ● Select via online class calendar a presentation appointment time to present portfolio ● Review Appendix H – the full rubric to gain full understanding of expectations around the Activity 3 Practice presentation with a buddy. Ensure student has referenced the "Guidelines for Effective Presentations" ● Upload electronic version of all project work and support materials, to the google class and/or submit in hard copy if necessary – includes completed templates, charts, evaluation tools, speed & feed calculations: Appendices C,D,E,G,K,L	**Ontario Skills Passport** Numeracy skills in measurement and calculations.
Activity 3 Assessment and Evaluation	Connections
Knowledge and Understanding ● Assessing student knowledge and understanding of manufacturing processes, part production and safe use of equipment – using the rubric, the teacher will assess the student during the presentation. Keep in mind that evidence should be ongoing, and "most recent", so evaluate accordingly **Thinking** ● Assessing the student's ability to rationalize the overall steps taken in planning and executing the management of the project ● Can the student make relevant connections with regard to manufacturing's effect on society and the environment? ● Student will end the project unit by completing and submitting a Self-Assessment of their Learning Skills (Appendix F) **Communication** ● Assessing students ability to select and use explicit vocabulary, accurately communicating proper manufacturing processes using related terminology (as per the achievement chart and the manufacturing expectations ● Graphically communicating overall project management; production flow and student selected manufacturing processes that have resulted in meeting the need of the project design **Application** ● Assessing student's ability to demonstrate proper practice in the manufacturing facility to operate equipment to manufacture their project	**Teacher Tip:** Track student progress throughout the project as evaluation, and then assess achievement at end using rubric **Achievement Chart** for explicit use of vocabulary and terminology (embedded in rubric H) Edugains - Self-Assessment Guide, page 20 Teachers gradually release responsibility to students – they move from:

• Assessing final product as manufactured according to specifications and stated criteria, including elevated degrees of complexity, variety of processes demonstrated • Is the final product functional, aesthetically pleasing Overall Project Assessment Tools: • Checklist (Appendix G) • Rubric (Appendix H)	• modelling applying the criteria, • to guiding students in applying the criteria, • to having students apply the criteria together • ultimately apply them on their own.
Activity 3 Accommodations	Connections
• Teachers are to be familiar with exceptional students' Individual Education Plans (IEPs) for legislated accommodations, and consult with the appropriate staff. By doing this, teachers will be aware of and can implement prescribed modifications accommodations and/or alternative program goals. • Strategies for all students and those with special needs may include: - Presentation materials, including print, electronic, and interactive texts, are within comfortable reach of all students; Students may choose to present via video, webinar, and or google – thereby providing alternative instructional and assessment activities - Presentation expectations may be modified to suit the individual circumstance of the student – setting expectations of student to an appropriate level - Final checklist can be given to the student so that the information is sequential and to clarify its relative importance (Appendix G) - Presentation outline and/or conversation with student to break instructions down into small steps - Providing encouragement during the presentation - Strategic pairing of students with experienced students to stretch student ability through coaching prior to presentation - Providing varying levels of text targeting the learner level ability – can be done on the rubrics - Collaborating with support staff so that student is comfortable and ready to present. Consider allowing the student to present in the Student Support room rather than in your class - Allow extra time for the student to prepare the presentation	**SEF Connections** Accommodations are to be made so students do not lose dignity because of disability, poverty, lack of success, linguistic diversity or race. Teachers foster a positive atmosphere accepting of individual's uniqueness, values, and needs.

Consolidation & Connections Provide Opportunities for Reflection

Activity 3 Peer and Self-Assessment	Connections
Assessment and Evaluation as an Exit Card Assessment "OF" Learning: the students and teacher will complete associated checklists, rubrics and engage in peer evaluations to gain evidence of demonstrated learning ● Journal entry and Self-Assessment - Prompt students prior to them writing in their journals by asking them to consider completing these statements: - I need to get better at… - Evidence I will need is… - I plan to improve by… - The support I will need is... ● Learning Skills Self-Assessment - Have students complete the Learning Skills self-assessment form **(**Appendix I**).** This will increase responsibility for students' own learning as a result of more opportunities for self-reflection. ● Overall Project Rubric – allow student to reflect and assess themselves on the same rubric the teacher will use ● Peer to Peer Evaluation – group students into groups of four and have them collaborate to complete an evaluation form (Appendix F) for each presentation ● Project Review – teacher can have students create a Kahoot game that is used as a review tool of all the learnings of the unit. This is a great way to archive review materials that students can reference toward the summative/final assessment period. And the activity is engaging, fun and creates a passion for learning. If students are in	**Growing Success** **SEF Component 1** **Assessment for, as and of Learning Connections** **Indicator 1.5** - Students are explicitly taught and regularly use self-assessment skills to monitor, improve, and communicate their learning. **Math Literacy - TIPS4RM** Teach self-evaluation strategies and involve students in self-monitoring their own learning.

teams/groups, they can collaborate and compete for the highest level of responses! ● Additional extension for reflection - have students re-connect with First Nations, Metis and Inuit communities showcasing the project that reflect that culture. Perhaps a skype session and encourage ongoing collaboration between schools/students ● Extension discussion around mass production if the class wanted to choose the best design of candle holder and then layout a plan to mass produce, market and sell the candle holders. Additionally, have discussions to raising awareness of the environmental impacts and societal impacts of Manufacturing production plants	FNMI extension **ICE connection:** Give students the confidence to develop strategies to implement and sustain their ideas while considering the impacts and consequences their innovation has on the world around them

Materials, Tools and Resources

Activity 3 Materials and Tools
• **Supporting Appendices** completed and referenced throughout project and ready for presentation • **Concept Map and related project monitoring** tools to be utilized in the presentation to demonstrate the full scope of student knowledge and understanding of design elements, planning manufacturing processes and part production, and project completion. Using visuals as a vehicle to speak to and to articulate the student's understanding, the student's ability to think critically and plan strategically, will demonstrate student depth and breadth of the manufacturing industry.
Activity 3 Websites
Guidelines for Effective Presentations https://www.enar.org/meetings/spring2016/program/presentation_guidelines.pdf
Activity 3 Computer Software
• Graphics related • MSWord • Excel • Virtual presentation via. Skype, Google, Webinars
Activity 3 Human Resources
• Peers for evaluation purposes to provide feedback • Special Education and/or Educational Assistants

Activity 3 Other
● Special Educational Learning Space – if student is more comfortable presenting here ● Virtual presentation via. Skype, Google, Webinars
Activity 3 Appendices
Appendix C – Project Tracker Appendix D – Project Flow Part Routing Appendix E – Project Scope Concept Map Appendix F - Peer - Self - Teacher Evaluation Appendix G – Project & Student Checklist Appendix H - Project Evaluation Rubric Appendix K – Order of Operations Template Appendix L - Skills Achievement Evaluation