TDJ3M1

Technological Design

3D Computer Modelling: Wooden Toy Vehicle

Abstract

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Table of Contents (do not edit!!!)

Project Overview

This project requires students to design and model a solution to a design challenge, meeting project criteria, specifications, and restrictions. Student will work through a design process, including research, design development, modelling, design representation, and product evaluation. They will need to manage time and resources, create a 3D computer model, animate its assembly, and generate a fully dimensioned set of working drawings.

Project Challenge

International toy conglomerate “Toyz Iz We” believes that they have a new and exciting idea in children’s toys: wooden toy vehicles. You are a toy designer at Toyz Iz We and have been asked to design a toy for the new line.

Design and model a wooden toy vehicle representative of an actual vehicle, past or present. You are required to create a computer model, an assembly animation, and a full set of working drawings

Connections

SEF
Indicator 1.1 Assessment is connected to the curriculum, collaboratively developed by educators and used to inform next steps in learning and instruction.

Indicator 4.4: Learning is deepened through authentic, relevant and meaningful student inquiry.

Indicator 3.1 Learning experiences are engaging, promote collaboration, innovation and creativity (i.e. are clear, meaningful, challenging, productive and include problem solving and critical thinking on a variety of issues).

Indicator 4.1 A culture of high expectations supports the belief that all students can learn, progress and achieve.

Indicator 5.2 Opportunities for authentic learning experiences and experiential learning exist in all classrooms and programs.

Indicator 3.4: Community partnerships fostered through ICE programs can provide positive peer, teacher, school and community relationships

ICE
If a community partner engaged in toymaking (for eg, a local craftsman) could be involved, this project could be presented as an ICE challenge. Although the project criteria may change based on the problem posed by the ICE partner, the process of design and modeling would be similar

DI TIPS
The open-ended nature of the project provides opportunity for success. Each student can develop a design that challenges his or her skills and

	abilities while enabling him or her to experience success and complete the entire project
Project Criteria	Examples
• The model must be representative of an actual vehicle, past, present, or fictional (e.g The Batmobile, or a Star Wars vehicle) • The model must be designed to be made primarily from wood, though small amounts of other materials, such as metal or plastic, may be used • The model must have multiple parts. • The size of the model must be such that a child of 3 to 6 years old could play with it. • For safety reasons, the model must have no sharp edges, corners, or small pieces that could break off and pose a choking hazard. • The parts of the vehicle should have complex geometry and not just be rectangular prisms, cylinders, and other simple shapes. • The model should be feasible to build using standard woodworking tools and equipment and commercially available parts such as dowels and wheels. • Create an animation showing how the model is assembled • Create a fully-dimensioned set of working drawings for the model that could be used to fabricate the model in the shop Refer to Appendix A for design challenge handout	 

Project Synopsis and Timelines

Activity Number	Activity Title/Name	Time (hrs.)	Curriculum Expectations	Assessment & Evaluation	Connections?
1	Project Research and Design Development	4 hrs	A1,A1.2, A1.3, A1.4 A2, A2.1 A3 A3.3 A5, A5.1, A5.4 B1,B1.1 B2,B2.1, B2.3	K/U T C	▪ Ontario Curriculum ▪ Growing Success ▪ DI ▪ SEF ▪ STEM ▪ Literacy ▪ ICE ▪ FMNI
2	3D Computer Model- parts & assembly	19 hrs	A2, A2.2 A4, A4.1, A4.2, A4.3 A5, A5.1, A5.3 B3 B3.2	K/U T A	▪ Ontario Curriculum ▪ Growing Success ▪ DI ▪ SEF ▪ STEM ▪ Math Literacy ▪ ICE
3	Assembly presentation	5 hrs	A5 A5.3	K/U T A C	▪ Ontario Curriculum ▪ Growing Success ▪ DI ▪ SEF ▪ STEM ▪ ICE
4	Working Drawings	5 hrs	A3 A3.1 A3.2 A5 A5.1 B2 B2.4 B2.5	K A C	▪ Ontario Curriculum ▪ Growing Success ▪ DI ▪ SEF ▪ STEM ▪ Math Literacy ▪ Literacy ▪ ICE

CONNECTIONS RESOURCE LIST		
1	The Ontario Curriculum, Grade 11-12, Revised 2009	http://www.edu.gov.on.ca/eng/curriculum/secondary/2009teched1112curr.pdf
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	School Effectiveness Framework, 2013 (SEF)	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	http://www.octelab.com/

Activity 1 - Research & Design Development

Activity 1: Research & Design Development

Activity Description:

Before beginning to develop solutions to a design challenge, it is important to look at what has been done by others to meet that challenge or a similar challenge. By looking at others' designs, the novice designer will gain understanding about how wooden toys are constructed, including the size, shape, and number of pieces, and methods of joinery. Using original ideas in conjunction with ideas from existing designs, a preliminary design can be sketched before proceeding to the computer model.

In this activity, students are asked to examine numerous existing wooden toy designs, particularly those that are the same type of vehicle that they intend to design. Using their own ideas and information from their research, students will make isometric sketches of a unique design that they intend to model

Activity 1 Criteria and Instructions

Instructions:

- Examine photos and plans for a number of wooden toy vehicles, from very simple designs with few parts to complex, detailed wooden models.
- Evaluate existing designs using criteria such as complexity, number of parts, representation of vehicle, modelling feasibility, and overall aesthetic design
- Save online images, photocopy plans, and make sketches.
- Make note of the information you glean from each design, including size, shape, number of parts, complexity
- Be prepared to include your research in the project design report that will document your design process
- Be sure to cite all sources of information
- Using isometric graph paper (Appendix B), make to-scale sketches of your own original design. Sketches should include the assembled vehicle and an exploded view showing the individual parts.

Criteria:

Students will submit a research report that will include a completed Research Worksheet (Appendix C), to-scale sketches, at least one photo, working drawings, and a bill of materials for each of 3 existing designs.
Students will provide an analysis of the complexity of each existing design and comments on its representation of an actual vehicle

Refer to Appendix C for handout that can be given to students to record research information

Minds On (Engaging Prior Knowledge)

Activity 1 Prior Knowledge	Connections
• Reading technical drawings (orthographic and isometric) • Technical sketching & isometric sketching	**SEF** **Indicator 4.2:** A clear emphasis on high levels of achievement in literacy and numeracy is evident throughout the school.
Activity 1 Planning Notes	**Connections**
• If possible, provide computer access for online research. The internet is a good source of photos which will give students a good overall impression of wooden toy vehicle. However, it is difficult to find full sets of plans online (for free). • Woodworking books and magazines will provide full sets of plans and will give students a better understanding of how the wooden toys are built. • For sketching, isometric grid paper will help students to sketch to scale and to sketch in 3D	

Action (Introduce or Extend Learning)

Activity 1 Instructional Strategies	Connections
Teacher ● Introduce design challenge and give overview of entire project ● Discuss the role of 3D modelling in the design and fabrication of products ● Show students sample pictures of wooden toys with varying degrees of complexity(Appendix D) ● Suggest search terms such as 'wooden toys', 'wooden toy vehicle plans', 'woodworking plans', or 'wooden toy firetruck' ● Review techniques for making isometric annotated sketches **Student** 1) Examine existing designs online, in books, or in magazines. For at least 3 existing designs: ● Note the source for each design ● Make isometric sketches of the existing designs, Save or photocopy at least one photo of each vehicle ● Save or photocopy the plans or bills of material for the existing designs ● Complete the Research Worksheet (Appendix C) for each vehicle, paying particular attention to the number and complexity of parts, and how the toys emulate existing vehicles without trying to duplicate every detail of those vehicles ● consider how you would make a 3D model for each part of the toys ● Write a research report summarizing your findings. Photos, and plans to illustrate your report 2) Make isometric to-scale sketches of an original design, including a sketch of the assembled vehicle, a sketch of the exploded vehicle, and sketches of individual parts	**FNMI** To address the FNMI document, schools will strive to "employ instructional methods designed to enhance the learning of all First Nation, Métis, and Inuit students", it is recommended that students research some First Nation, Métis, and Inuit toys. **SEF** Indicator 1.1 Assessment is connected to the curriculum, collaboratively developed by educators and used to inform next steps in learning and instruction. Indicator 4.4: Learning is deepened through authentic, relevant and meaningful student inquiry.
Activity 1 Assessment and Evaluation	Connections

Knowledge ● Described a variety of existing designs, woodworking techniques and standards **Thinking** ● Works through a series of sketches to develop design ● Design is unique and not a copy of or obviously derivative of an existing design **Communication** ● Made detailed notes while evaluating existing wooden toys, based on project criteria; made note of construction techniques and standards ● Formatted images and notes in a readable format ● Made detailed, to-scale sketches of the overall model and an exploded view **Learning Skills** ● 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. ● 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 Tool(s)** Use the rubric in Appendix C1 to evaluate students`reports on Ideas, Organization, Voice, Word Choice, Sentence Fluency, Conventions, and Presentation  Use the rubric in Appendix C2 to evaluate students` design sketches on originality, feasibility, completeness, clarity, and following conventions	**SEF** Indicator 1.1: there is the opportunity to co-construct criteria for this project; give students input into deciding what a good design will look like, have, and be Indicator 3.1 The teaching and learning environment is inclusive, promotes the intellectual engagement of all students and reflects individual student strengths, needs, learning preferences and cultural perspectives. Indicator 4.5 Instruction and assessment are differentiated in response to student strengths, needs and prior learning. **Literacy** writing an information report
Activity 1 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	SEF Indicator 4.5 Instruction and assessment are differentiated in

can implement prescribed modifications accommodations and/or alternative program goals. Teaching Strategies for students with special needs may include: ● Chunk materials, providing only one task at a time ● Be prepared to redirect students who get off-task or distracted when given internet access ● Provide a structured form to assist students in recording information about designs (Appendix C) ● Provide hardcopy resources (books, magazines) as well as online resources ● the use of a support staff to assist students in reaching their IEP goals.	response to student strengths, needs and prior learning. **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.

Consolidation & Connections (Provide Opportunities for Reflection)

Activity 1 Verbal and Written Peer feedback	Connections
Give students opportunity to provide peer feedback regarding preliminary designs, for example: In groups of two or three, each student can explain his or her design sketches; using the evaluation rubric (Appendix C2) as a guide, students can provide peer feedback in verbal or written form Following peer feedback, students must have the opportunity to improve design sketches before moving on to the next step If undertaken as an ICE project, community partners may be engaged to provide feedback to students after the design phase of the project	**SEF, DI, GS:** giving students the opportunity to provide peer feedback is an example of assessment as learning; **SEF** Indicator 1.1: Multiple and varied opportunities are provided for students to demonstrate, communicate and refine their learning. Student learning is regularly documented to inform educator and student next steps. Provide students the opportunity to improve designs prior to moving on to the modeling Indicator 3.1: Ongoing feedback between and among students and

	teachers enables students to refine both thinking and products.

Materials, Tools and Resources

Activity 1 Websites

www.etsy.com
www.bellalunatoys.com
www.toysandjoys.com
www.greenvillewoodworkers.com
www.leevalley.com

Activity 1 Publications

Today's Woodworker magazine
Woodworker's Journal
Great Book of Wooden Toys
Tremendous Toy Trucks
Making Great Wooden Toys

Activity 1 Computer Software

Internet access and browser

Activity 1 Human Resources

Construction or woodworking teacher
Art teacher

Activity 1 Appendices

Appendix A - Project Handout
Appendix B - Isometric grid paper
Appendix C - Research Worksheet

Appendix D - difficulty level slideshow

Activity 2 - 3D Computer Model

Activity 2 - 3D Computer Model

Activity Description:

Using a parametric modelling program such as Autodesk Inventor or Solidworks, create a 3D computer model based on the sketches developed in Activity 1. This will include creating the necessary parts and assembling them.

Activity 2 Criteria and Instructions

Instructions

- Use 3D modelling tools such as Extrude, Revolve, Fillet, Chamfer, Loft, Array, and Mirror to create the parts for the vehicle.
- Use “purposeful” dimensions (whole mm in metric, common fractions in Imperial), rather than random dimensions.
- Assemble the parts such that they are fully constrained. That is, they cannot be dragged out of position
- Apply colours and materials to make the vehicle aesthetically pleasing.

Criteria

Students are required to:

- Create all parts for wooden toy model using 3D parametric modelling program
- Use a variety of tools to create parts of complex geometry
- Accurately duplicate commercially available parts
- Assemble the parts so that they are fully constrained in their proper position in the finished model
- Adjust the geometry, sizes, proportions, and details to ensure that the toy accurately emulates and existing vehicle

Minds On (Engaging Prior Knowledge)

Activity 2 Prior Knowledge	Connections
• Knowledge of software; • Sketching and dimensioning tools in modelling software • Modelling tools such as extrude, revolve, fillet, chamfer, loft,array • assembly tools: mate, flush, tangent, insert, angle constraints • Changing part materials from default	
Activity 2 Planning Notes	**Connections**
• Create a few sample models of varying complexity to show to students as examples; alternatively, save students' work from previous years to use as exemplars (Appendices E1, E2, E3,E4,E5) • Make sure that software is running efficiently before assigning project • Create narrated screen-shot videos demonstrating basic modelling tools and save the videos where students can view them • Search Autodesk Education, YouTube, GrabCAD, Instructables and other sites to which you can direct students for help.	

Action (Introduce or Extend Learning)

Activity 2 Instructional Strategies	Connections
Teacher • Show students sample models • As review, demonstrate basic modelling tools to class as a whole • Direct students to teacher-made tutorial videos that can be used to review or prompt memory	**SEF Component 4 Curriculum Teaching and Learning** Indicator 4.2-Numeracy specific concepts are explicitly used to deepen student learning and understanding in all subjects. Indicator 4.5 Instruction and assessment are differentiated in

• Circulate and provide instruction, review, and help one-on-one and in small groups as necessary and to monitor students' progress **Student** • Create all parts for wooden toy model using 3D parametric modelling program, adjusting and altering design as necessary • Use a variety of tools to create parts of complex geometry • Accurately duplicate commercially available parts • Assemble the parts so that they are fully constrained in their proper position in the finished model • Adjust the geometry, sizes, proportions, and details to ensure that the toy accurately emulates and existing vehicle	response to student strengths, needs and prior learning. **Ontario Skills Passport** Numeracy skills in measurement and calculations. **DI:** custom teacher-made videos will help students to review what was shown in the class demonstration; they will also allow each student to work at his/her own pace. Videos will also free up the teacher to provide more one-on-one instruction to students that require it.
Activity 2 Assessment and Evaluation	**Connections**
Knowledge • Demonstrates knowledge of software. • Demonstrate knowledge of woodworking standards and techniques **Thinking** • The model is an original design and not a duplication of or obviously derivative of an existing design • The model emulates an actual vehicle, past, present, or fictional • The student demonstrates problem solving and troubleshooting in the creation of the parts and model • The model meets project criteria and specifications **Application** • 10-15 unique parts have been made • The parts demonstrate the use of a variety of modelling tools • The assembled model is fully constrained • A variety of materials have been applied **Learning Skills** • 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;	**SEF** Indicator 1.2 A variety of assessment strategies and tools that meet the needs of all students are used to improve learning and inform instructional decisions (e.g., observations, demonstrations and presentations, projects, work samples, conversations, portfolios of student work). Indicator 1.6 A range of evidence for the assessment of learning is collected through observations, conversations and student products. Indicator 1.6 Assessment of learning provides relevant and meaningful evidence to evaluate the quality of student achievement at or near the end of a cycle of learning and to determine next steps. Indicator 4.5 Instruction and assessment are differentiated in **Growing Success**: evidence of students' software knowledge can be assessed thru observation and conversation during class

○ student's 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. **Assessment Tool(s)** See Appendix F for Parts & Assembly Evaluation rubric	
Activity 2 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. Teaching Strategies for students with special needs may include: ● Chunk materials, providing only one task at a time ● Be prepared to redirect students who get off-task or distracted when given internet access ● Provide a structured form to assist students in recording information about designs (Appendix C) ● Provide hardcopy resources (books, magazines) as well as online resources ● the use of a support staff to assist students in reaching their IEP goals. ● Screen shot tutorial videos can be made to provide students on-demand help or review; ● Whole-class demonstrations are a good introduction, but many students will need instruction one-on-one or in a small group ● Encourage students to design a project they are capable of finishing; ● Students should start with the simplest parts and progress to the more complex parts; focus students on finishing one part at a time.	**DI**: provide students with a variety of instruction delivery models: whole class demonstration, small group, one-on-one; video **SEF** Indicator 4.1 A culture of high expectations supports the belief that all students can learn, progress and achieve. Indicator 4.5 Instruction and assessment are differentiated in response to student strengths, needs and prior learning.

Consolidation & Connections (Provide Opportunities for Reflection)

Activity 2 Written feedback and self-assessment checklist	**Connections**
Provide students written feedback on their work to date. See Appendix G for a written feedback sheet. Teachers can use the sheet to provide feedback throughout the project Students can use Appendix H - 3D model checklist to assess their progress If undertaken as an ICE project, community partners may be engaged to provide feedback to students after the computer model is completed	**Growing Success:** Providing descriptive feedback to enable students to improve **SEF** Indicator 1.1 Multiple and varied opportunities are provided for students to demonstrate, communicate and refine their learning. Student learning is regularly documented to inform educator and student next steps. Indicator 3.1: Ongoing feedback between and among students and teachers enables students to refine both thinking and products.

Materials, Tools and Resources

Activity 2 Websites
Note: Tutorial videos for a variety of software and different versions of software are available on software producers' websites (such as Autodesk), YouTube, and CAD community sites such as GrabCAD and Instructables. Some examples are below http://www.autodesk.com/education/learn-and-teach www.youtube.com http://www.instructables.com/id/Autodesk-Inventor-Tutorial/ www.grabcad.com

Activity 2 Publications

Reference books are available for different types of software and different versions of software. SDC Publications offers textbooks aimed at student users (as opposed to engineers and other design professionals)

Tools for Design Using AutoCAD 2017 and Autodesk Inventor 2017 **ISBN: 978-1-63057-042-2**

Learning Autodesk Inventor 2017 **ISBN: 978-1-63057-046-0**

Activity 2 Computer Software

Autodesk Inventor
SMART Board Tools video recorder

Activity 2 Appendices

Appendices E1 thru E5-sample models
Appendix F- Parts and assembly evaluation rubric
Appendix G - 3D model feedback sheet
Appendix H- 3D model checklist

Activity 3 - Assembly Animation

Activity 3 - Assembly Animation

Activity Description:

After the model is assembled, import it into a Presentation file to create an animation that will become video assembly instructions for the model.

Activity 3 Criteria and Instructions

Instructions

After the model has been imported into a Presentation file, pull the model apart, separating the pieces to create an exploded model. When the Presentation file is played, the pieces will move back into position in the reverse order that they were pulled apart. Change the sequence of the animation so that the model is assembled in a logical order, similar to the way the physical model would be put together. There should be no physical impossibilities, such as parts passing through each other. Group parts together where it makes sense to group them (for example, the wheels on the same side of the vehicle moving together), but do not group so many parts together that it is difficult for the viewer to follow. You may also group together two moves for a single part. For example, a horizontal move and a vertical move grouped together will result in a part moving diagonally; a wheel or an airplane propellor can be made to spin as it moves into position.

Once the sequence and grouping is set, hide the parts so that each part is revealed in turn and moves into position. Finally, move the camera position and zoom in and out to provide the viewer the best presentation of how the model is assembled.

Criteria

- Presentation video must serve as ``video assembly instructions`` and clearly show how the model is assembled
- All parts must be exploded (that is, pulled apart)
- Parts must be assembled in a logical sequence, similar to the way the physical model would be assembled
- Parts should be grouped together where it makes sense to group them; do not have so many parts grouped that it is difficult for the viewer to follow the assembly sequence
- Rotate parts where it makes to do so (for example, wheels, propellers)
- There should be no physical impossibilities (for example, parts passing through each other)
- Hide parts until it is time for each to move into position
- Move the camera angle and zoom in to best show how each part moves into position; isometric camera angles are preferred; do not move the camera so much that it causes the viewer to feel disoriented or `seasick`

Minds On (Engaging Prior Knowledge)

Activity 3 Prior Knowledge	Connections
• Knowledge of Part Files and Assembly Files in parametric modelling software such as Autodesk Inventor • Knowledge of how wooden toy models are put together (from Activity 1) • Students may or may not have previous exposure to Presentation Files	
Activity 3 Planning Notes	**Connections**
• Create a few sample Presentation Files to students as examples; alternatively, save students' work from previous years to use as exemplars • Make sure that software is running efficiently before assigning project • Create narrated screen-shot videos demonstrating basic modelling tools and save the videos where students can view them • Search Autodesk Education, YouTube, GrabCAD, Instructables and other sites to which you can direct students for help.	

Action (Introduce or Extend Learning)

Activity 3 Instructional Strategies	Connections
Teacher • Show students sample Presentation Files • At first, give whole class demonstration of how to pull parts out of position, and how to group and resequence the movements • After students have had a class or two to work on above, demonstrate how to hide parts and move the camera • Direct students to teacher-made tutorial videos that can be used to review or prompt memory • Circulate and provide instruction, review, and help one-on-one and in small groups as necessary and to monitor students' progress **Student** • Open a new Presentation file and import completed Assembly file • Apply `tweaks` to the parts and fully explode the model; only a base piece should remain in its original position • Sequence and group the part movements to reflect the way the physical model would be assembled; avoid having parts pass through each other • Hide the parts and reveal each part or group of parts just before it moves into position • Move the camera to best show the placement of each part or group of parts; the final camera position should show the entire model from a top/front isometric view	**DI**: custom teacher-made videos will help students to review what was shown in the class demonstration; they will also allow each student to work at his/her own pace. Videos will also free up the teacher to provide more one-on-one instruction to students that require it.
Activity 3 Assessment and Evaluation	**Connections**
Knowledge • Demonstrates knowledge of software. • Demonstrates knowledge of how wooden toys are put together **Thinking** • The starting position of parts, the sequencing of the assembly, and the grouping of parts are logical and reasonable, and reflect how a physical model would be	**Growing Success**: evidence of students' software knowledge can be assessed thru observation and conversation during class **SEF** Indicator 1.6 Assessment of learning provides relevant and meaningful evidence to evaluate the quality of student achievement at or

assembled ● The student demonstrates problem solving and troubleshooting in the creation of the Presentation ● The Presentation meets project criteria and specifications **Application** ● Demonstrates use of tools in presentation files, including moving parts, sequencing moves, grouping moves, hiding parts, and moving the camera **Communication** ● The finished Presentation clearly shows the viewer how the model is assembled, using sequencing, grouping, and camera moves **Learning Skills** ● 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. ● 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 Tool(s)** See Appendix J for Presentation evaluation rubric	near the end of a cycle of learning and to determine next steps. Indicator 4.5 Instruction and assessment are differentiated in response to student strengths, needs and prior learning.
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. Teaching Strategies for students with special needs may include: ● Chunk materials, providing only one task at a time	**DI:** provide students with a variety of instructional delivery models: whole class demonstration, small group, one-on-one; video **SEF** Indicator 4.1 A culture of high expectations supports the belief that all

• Be prepared to redirect students who get off-task or distracted when given internet access • Provide a structured form to assist students in recording information about designs (Appendix C) • Provide hardcopy resources (books, magazines) as well as online resources • the use of a support staff to assist students in reaching their IEP goals. • Screen shot tutorial videos can be made to provide students on-demand help or review; • Whole-class demonstrations are a good introduction, but many students will need instruction one-on-one or in a small group • "Chunk" materials and show students one tool at a time. (how to move parts, how to group them, how to change sequence order, how to hide parts, how to move the camera)	students can learn, progress and achieve. Indicator 4.5 Instruction and assessment are differentiated in response to student strengths, needs and prior learning.

Consolidation & Connections (Provide Opportunities for Reflection)

Activity 3 Written and verbal feedback; self-assessment checklist	**Connections**
Provide students written and feedback on their work to date. See Appendix G for a written and verbal feedback sheet. Teachers can use the sheet to provide feedback throughout the project Students can use Appendix H - 3D model checklist to assess their progress If undertaken as an ICE project, community partners may be engaged to provide feedback to students	**Growing Success:** Providing descriptive feedback to enable students to improve **SEF** Indicator 1.1 Multiple and varied opportunities are provided for students to demonstrate, communicate and refine their learning. Student learning is regularly documented to inform educator and student next steps.

	Indicator 3.1: Ongoing feedback between and among students and teachers enables students to refine both thinking and products.

Materials, Tools and Resources

Activity 3 Websites

Note: Tutorial videos for a variety of software and different versions of software are available on software producers' websites (such as Autodesk), YouTube, and CAD community sites such as GrabCAD and Instructables. Some examples are below

http://www.autodesk.com/education/learn-and-teach
www.youtube.com
http://www.instructables.com/id/Autodesk-Inventor-Tutorial/
www.grabcad.com

Activity 3 Publications

Reference books are available for different types of software and different versions of software. SDC Publications offers textbooks aimed at student users (as opposed to engineers and other design professionals)

Tools for Design Using AutoCAD 2017 and Autodesk Inventor 2017 ISBN: 978-1-63057-042-2
Learning Autodesk Inventor 2017 ISBN: 978-1-63057-046-0

Activity 3 Computer Software

Autodesk Inventor Professional

Activity 3 Appendices

Appendix G written feedback form
Appendix H 3D Model Checklist
Appendix J Presentation File Evaluation Rubric

Activity 4 - Working Drawings

Activity 4 Working Drawings

Activity Description:

Use the 3D computer model and the Presentation File to create a fully dimensioned, annotated set of working drawings, including orthographic, isometric, section, and detail drawings, with an exploded view and parts list.

The set of working drawings should have enough information to enable someone to build the project

Activity 4 Criteria and Instructions

Instructions

- Create a 3-view orthographic drawing and isometric drawing of the assembled model. The isometric drawing should be fully rendered.
- Create and dimension orthographic and isometric drawings for each part such that all information to make the part is included
- From the presentation file, create an exploded isometric view of the model and generate a parts list
- Include hidden lines in orthographic views of parts; include centerlines for circular and cylindrical features.

Criteria

Students will generate a set of working drawings for their design, including:

- A 3-view orthographic drawing of the assembled model, with overall dimensions
- An isometric drawing of the assembled model, in full colour
- An exploded isometric drawing of the model, with each part labeled by number or letter and a corresponding parts list
- Dimensioned isometric, orthographic, section, and detail views for each part that describe the part fully and completely, but do not contain repeated or redundant information
- hidden lines and centerlines where necessary
- A completed title block on each sheet indicating the project, the drawing title, the date, the scale

of the drawing, the designer, and the sheet number

Minds On (Engaging Prior Knowledge)

Activity 4 Prior Knowledge	Connections
• 3 view orthographic drawing • Standard linetypes (object, hidden, center) • Isometric drawing • Dimensioning • Units of measurement (metric and Imperial)	**Numeracy:** SEF 4.2:Numeracy specific concepts are explicitly used to deepen student learning and understanding in all subjects.
Activity 4 Planning Notes	**Connections**
Provide sample drawings for students to use as a guide while developing their own drawings (Appendix K)	

Action (Introduce or Extend Learning)

Activity 4 Instructional Strategies	Connections
• Whole class demonstration of how to generate drawings from computer model • While circulating through class to assess student progress, provide reinforcement, review, and instructions to individual students or small groups as necessary	**SEF** Indicator 4.5 Instruction and assessment are differentiated in response to student strengths, needs and prior learning.
Activity 4 Assessment and Evaluation	**Connections**
Knowledge • Knowledge of types of technical drawings (orthographic, isometric, detail, section) • Knowledge of technical drawing standards and conventions • Knowledge of software tools **Application**	**SEF** Indicator 4.5 Instruction and assessment are differentiated in response to student strengths, needs and prior learning.

- Use of software to create drawing set
- Completeness of working drawings
- Accuracy of working drawing

Communication

- Layout, clarity, and readability of drawings
- Inclusion of all information`

Learning Skills

- 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.
- 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 Tool(s)

Refer to Appendix L for Drawings evaluation rubric

Activity 4 Accommodations

- Screen shot tutorial videos can be made to provide students on-demand help or review;
- Make sample drawings available as an exemplar or template (Appendix L)
- Whole-class demonstrations are a good introduction, but many students will need instruction one-on-one or in a small group

Connections

DI:

provide students with a variety of instructional delivery models: whole class demonstration, small group, one-on-one; video

SEF

Indicator 4.1 A culture of high expectations supports the belief that all students can learn, progress and achieve.

Indicator 4.5 Instruction and assessment are differentiated in response to student strengths, needs and prior learning.

Consolidation & Connections (Provide Opportunities for Reflection)

Activity 4-Written and verbal feedback; self-assessment checklist	**Connections**
Provide students written feedback on their work to date. See Appendix G for a written feedback sheet. Teachers can use the sheet to provide feedback throughout the project Students can use Appendix H - 3D model checklist to assess their progress If undertaken as an ICE project, community partners may be engaged to provide feedback to students regarding the set of working drawings	**Growing Success:** Providing descriptive feedback to enable students to improve **SEF** Indicator 3.1: Ongoing feedback between and among students and teachers enables students to refine both thinking and products. **Literacy:** graphic communication; reading drawings

Materials, Tools and Resources

Activity 4 Websites
Note: Tutorial videos for a variety of software and different versions of software are available on software producers' websites (such as Autodesk), YouTube, and CAD community sites such as GrabCAD and Instructables. Some examples are below http://www.autodesk.com/education/learn-and-teach www.youtube.com http://www.instructables.com/id/Autodesk-Inventor-Tutorial/ www.grabcad.com

Activity 4 Publications

Introduction to Technical Drawing-Stirling

Reference books are available for different types of software and different versions of software. SDC Publications offers textbooks aimed at student users (as opposed to engineers and other design professionals)
Tools for Design Using AutoCAD 2017 and Autodesk Inventor 2017 ISBN: 978-1-63057-042-2
Learning Autodesk Inventor 2017 ISBN: 978-1-63057-046-0

Activity 4 Computer Software

Autodesk Inventor Professional

Activity 4 Human Resources

Construction Technology teacher or students may help to assess the completeness and clarity of students' working drawings

Activity 4 Appendices

Appendix G written feedback form
Appendix H 3D Model Checklist
Appendix L-sample drawings