TTJ3C

Transportation Technology

Four Stroke Engine Fundamentals

Abstract

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Project Overview

This unit provides students with the opportunity to discover the inner workings of an internal combustion engine through theoretical lessons and hands-on engine experience. Using shop models, students learn the names and purposes of major engine components as well as the four-stroke/cycle theory and the automotive machining involved with engine rebuilding. Students develop skill in using simple and specialized automotive tools and measuring instruments. This Unit involves students acquiring a comprehensive knowledge base in the concepts, terminology, and operation of single and multiple cylinder engines. Activities range from engine disassembly, assembly, engine model, cylinder head removal, and engine math. Developing skills in reading and applying technical information will help students become more effective communicators. Respect for the environment, and wise use of resources are identified as key responsibilities throughout the unit. Proper tool use and safety procedures will be emphasized.

Project Challenge

Through classroom theory and various hands on activities, students will gain an insight on the function and operation of an internal combustion engine. During this unit, students will be exposed to engine terms, techniques, measurement, and engine math. Students will use these skills to become successful in the culminating activities which will be the complete disassemble and reassemble of an engine. Students will be able to properly use specific tools and techniques to become successful.

Connections

SEF Component 2 Classroom Leadership Connections Indicator 2.2: Processes and practices are designed to deepen understanding of the curriculum and refine instruction to improve student learning and achievement

SEF Component 3 Student Engagement Indicator 3.4: Students demonstrate a wide range of transferable skills, such as teamwork, advocacy, leadership and global citizenship.

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

Differentiated Instructions (DI): All students focus on their learning goals and learn in ways that are motivating and challenging.

Differentiated Instructions (DI) Flexible Learning Groups In a differentiated classroom, students are grouped and regrouped, frequently and flexibly based on their; readiness to learn a concept; interest in a concept learning preferences in working with or thinking about a concept; or environmental or social sensitivities

Project Criteria	Examples
Must use proper PPE Must follow safety procedures Must use organizational skills Must be able to use measurement tools correctly Must be able to set torque wrench Engine must be able to turn after reassembly Able to install pistons into cylinders correctly Able to identify engine components Able to describe purpose of engine components Able to describe the four stroke cycle	   

Project Synopsis and Timelines

Act #	Activity Title/Name	Time (hrs.)	Curriculum Expectations	Assessment & Evaluation	Connections?
1	Engine Components- Theory and Operation	4	A1 A.3, A.4 A1.1, A1.2, A1.5 A4, A4.1, A4.3 D2 D2.4, D2.5, D2.6	• K/U • T • C	Ontario Curriculum Growing Success DI SEF Think Literacy STEM Ontario Skills Passport
2	Engine Disassembly	10	A1 A1.3 A4 A4.1 B1 B1.2, B1.4 B4 B4.1 C1 C1.1, C1.2,C1.3 D1 D1.1, D1.2, D1.3, D1.4, D1.5, D1.6 D2 D2.4, D2.5	• K/U • T • A • C	Ontario Curriculum Growing Success DI SEF Think Literacy STEM Ontario Skills Passport

3	Engine Components Inspection and Measuring	2	A1 A1.3, A1.6, A1.7 A4 A4.1, A4.2, A4.3 B1, B1.1, B1.2, B1.3, B1.4 B4 B4.2, B4.3 C1 C1.1, C1.2,C1.3 D1 D1.1, D1.2, D1.3, D1.4, D1.5, D1.6 D2 D2.4, D2.5	• K/U • T • C • A	Ontario Curriculum Growing Success DI SEF Thinking Math Success Think Literacy STEM Ontario Skills Passport
4	Engine Reassembly	10	A1 A1.3, A1.6 A4 A4.1, A4.3 B1 B1.1, B1.2, B1.3, B1.4 B4 B4.1 C1 C1.1, C1.2,C1.3 D1 D1.1, D1.2, D1.3, D1.4, D1.5, D1.6 D2 D2.4, D2.5	• K/U • T • C • A	Ontario Curriculum Growing Success DI SEF Think Literacy STEM Ontario Skills Passport

Connection 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 Skills Passport (OSP)	http://www.skills.edu.gov.on.ca/OSP2Web/EDU/DisplayEssentialSkills.xhtml
8	OCTE Resources: SafeDocs, SafetyNet	http://www.octelab.com/

Activity 1 Engine Components- Theory and Operation

Activity Description:
This activity will help students name and identify the different components of a four cycle engine and know the purpose of each. Using shop models, students learn the names and purposes of major engine components as well as the four-stroke/cycle.

Activity 1 Instructions

1. Students brainstorm to label parts brake-downs and diagrams on the different engine components. (Appendix J)
2.Students will label diagrams outlining the four strokes of an engine (Appendix B)
3. Students will fill out a sheet where they can list and later discuss some of the terminologies that pertain to engines. (Appendix C)
The teacher will first discuss the different engine components before attempting to teach the four stroke principle.

Minds On (Engaging Prior Knowledge)

Activity 1 Prior Knowledge	Connections
No prior knowledge or skills are necessary for this activity as it is mostly a theory introduction. However a basic understanding of engines will be useful.	**DI Tip:** create student/class profile of learning preferences based on individual students
Activity 1 Planning Notes	**Connections**
• Check all recommended resources prior to beginning lessons and activity. • Be sure that all computers are in working order and that the Internet access is available. • Review all activities and prepare all resources (handouts, and materials) necessary for the delivery of content.	**The Ontario Curriculum, Grade 11-12, Revised 2009** Overall Expectations: A1 Specific Expectations: A1.1, A1.2 **STEM**

• Use of a projector will be useful for PowerPoint presentations • Use of models or cut-out engines is strongly recommended. • Prepare various engine components to pass around the class during the lesson • Invite a guest speaker to speak with the class about the career opportunities in automotive engine rebuilding and race engine design.	**SEF** Component 1 Assessment for, as and of Learning Indicator 1.7: Describe what students are expected to learn. Provide students a clear vision. **SEF** Component 4 Curriculum, Teaching, and Learning Indicator 4.5: Instruction and assessment are differentiated in response to student strengths, needs and prior learning. **Growing Success** (Diagnostic assessment: • occurs before instruction begins so teachers can determine students' readiness to learn new knowledge and skills, as well as obtain information about their interests and learning preferences.)

Action (Introduce or Extend Learning)

Activity 1 Instructional Strategies	Connections
Teacher: Introduce activity and student learning goals Discuss how this activity aligns with practical Activities 2, 3, and 4 so students understand the progression. Introduce a lesson on Internal combustion principles and engine components Explain the purpose of main engine components Using a chart, ask students to identify each engine component (parts provided - Appendix A) Explain the four stroke engine cycle Explain key engine terms (e.g.; stroke, cycle, Top Dead Centre, etc.) Cross-curricular opportunities may exist in math and science **Student:** • Participate in collaborative/cooperative learning through individual/groups • Students are to identify engine components and their purpose • Students will write a test referring to the following: -name the four different cycles -describe the mechanical occurrences during each of the four cycles.	**SEF** Component 4 Curriculum, Teaching, and Learning Indicator 4.4: Learning is deepened through authentic, relevant and meaningful student inquiry. **Ontario Skills Passport** Literacy skills in reading, writing, oral communications, document and computer use. **Differentiated Instructions (DI):** Refer to pg 27 of the DI document for Instruction Strategies that Impact Student Achievement **Think Literacy Relationship Building Skills IS3:** ask questions to assess situations, identify problems, and seek solutions

-describe each stroke of the four stroke cycle (Appendix B) -label a diagram of the different internal components. (Appendix J) -have to describe the purpose of certain internal engine components.	
Activity 1 Assessment and Evaluation	**Connections**
Assessment strategies and tools in this activity will include opportunities in monitoring students' achievement levels as well as learning skills. Written quizzes and tests are given at appropriate points of the activity. Student-teacher conferencing occurs regularly throughout the activity to check for student understanding Assignments, notes, and diagnostic charts are collected and assessed for correctness. A test is given to determine student learning. Student's daily classroom participation will also be an indicator of success. **Knowledge and Understanding** To assess students on their knowledge and understanding, teachers will evaluate students' quiz and test results. **Thinking** To assess students on their thinking skills, teachers will evaluate students' on their four cycle charts, engine component descriptions, and engine worksheets. **Communications** The work log report will be assessed in terms of format and content. (Appendix I) **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 Tools** Engine Test	**SEF** Component 1 Assessment for, as and of Learning Indicator 1.1: Assessment is connected to the curriculum, collaboratively developed by educators and used to inform next steps in learning and instruction. **The Ontario Curriculum, Grade 11-12, Revised 2009** reference to the Achievement Chart (pg 28-29) or through **Growing Success** (pg 22-23) Assessments will include communications, observation, performance assessment, and conferencing.
Activity 1 Accommodations	**Connections**
Some program accommodations and strategies may include: ● Reviewing students' IEPs and making the necessary accommodations. ● Providing teacher and peer assistance where appropriate.	**SEF** Component 1 Assessment for, as and of Learning Connections Indicator 1.2 & 1.4**:** Reviewing student profiles, learning portfolios, IEPs and assessment

• Providing additional one-on-one time with the teacher or peer tutors. • Having peer tutors assist in the handling of equipment. • Allowing for adjusted timelines for the completion of this activity. • Allowing for additional time after class to continue study. • Verbal testing may be done for students with special needs. • Consultation with parents may also be used	data will inform decisions regarding assessment tools and strategies. **Growing Success:** mods for students with special needs **Differentiated Instructions (DI):** Engaging and interesting tasks (that address the same skills) for all learning preferences, interests and levels of readiness).

Consolidation & Connections (Provide Opportunities for Reflection)

Activity 1 Daily Work Log	Connections
Students will be asked to write a daily work log of this activity. The log will include a summary of the activity. The purpose of this log is to allow students to practice the use of proper written language skills. It will also help students reflect on their experiences throughout this activity in preparation for the unit test. This log should include key terms discussed throughout the activity. **Appendix I:** Daily Work Log	**Think Literacy Standard 12L:** Document processes and procedures and communicate them to different audiences using appropriate oral and written techniques

Materials, Tools and Resources

Activity 1 Websites

Grade 11 Transportation Technology Curriculum Document
http://auto.howstuffworks.com/engine.htm
https://en.wikipedia.org/wiki/Four-stroke_engine
https://www.briggsandstratton.com/na/en_us/support/videos/browse/4-cycle-theory.html

Activity 1 Publications

Gilles, Tim , Automotive Service: Inspection, Maintenance, Repair, 4th Edition, Nelson,2012,
ISBN10: 1-111-12861-8
Halderman, James D. ,Automotive Technology: Principles, Diagnosis, and Service, 5th Edition, Pearson, 2016 ISBN13: 9780133994612
Duffy, James E., Modern Automotive Technology 8th Edition, Goodheart-Willcox, 2013
ISBN: 1619603705 / 9781619603707

Activity 1 Video Resources

Learn360
YouTube
Auto Maintenance and Light Repair Video Clip Library, Goodheart-Willcox , 2015 ISBN: 978-1-61960-912-9

Activity 1 Computer Software

CDX Auto
Word Processing

Activity 1 Materials

Main Engine Components
Engine Cutaway

Activity 1 Human Resources

Guest speakers: local professionals, racing community, Local College Instructors
Special Education/Resource staff
Math/Science teachers

Activity 1 Other

Automotive Society of Engineers
Automotive Service Excellence
Niagara College
Local Automotive Service Centres
Local Automotive Dealers

Activity 1 Appendices

- Appendix A: Engine Component Identification
- Appendix B: Four Stroke Chart
- Appendix C: Engine Terms
- Appendix I : Daily Work Log
- Appendix J: Engine Diagram

Activity 2 Engine Disassembly

Activity Description:
This activity provides students with the opportunity to discover the inner workings of an internal combustion engine through theoretical lessons and hands-on experience. Using shop models, students will follow step-by-step work sheets to completely dismantle a four cycle engine. Students develop skills in using simple and specialized automotive tools and are completely aware that the engines are to be reassembled later. At the beginning of this activity, students will learn of the environmental issues involved in dealing with automotive fluids. They will also learn the proper disposal methods of these fluids and the refinery involved.

Activity 2 Instructions

1. Students are instructed to bring proper work clothing (preferably coveralls) prior to commencing this activity. Safety shoes are also recommended. The teacher acquaints students with a basic set of hand tools and their correct usage, care, and safety concerns. The need for other safety equipment such as safety glasses and their proper usage is also discussed.
2. The teacher assists students in locating the correct service information for the engine on which they will be assigned. Students work with the teacher to develop a sequential procedural sheet, including a checklist to be completed at various stages of work. Precautions and special points of interest can be noted on this worksheet. The procedures are reviewed before commencing the activity. The teacher assists students with all aspects of the procedures and checklist, as required.
3. Students work in small groups of two or three, to reduce the number of engines required and to provide partners to help with heavier components. Groups may be selected by either the teacher or by the students. The teacher may alter the group arrangements as necessary during the activity to assist students who are experiencing difficulties in completing the activity.
4. The teacher conducts short theoretical sessions at predetermined points in the activity to address the purposes of the major engine components, and four-stroke/cycle engine terms and operating theory. These points can be reinforced with individual students as they work on their engines.
5. Students research engine specifications using technical manuals (printed or computerized) and note them on their procedural worksheets. They then remove cylinder heads and oil pans. The heads are set aside and are not disassembled until the short block is completed.
6. Piston and connecting rod assemblies are removed and labeled. The students then remove the crankshaft. The teacher conducts a brief classroom session demonstrating the use of these tools before students use them. The teacher assists students who encounter difficulties using the tools on their engines.
7. Students disassemble the cylinder head once the short block is completely assembled and the crankshaft turns correctly. The teacher performs a demonstration of correct procedures (including safety precautions) for using valve spring compressors before students perform this task. Valves are removed and all components are placed in a fixture to maintain correct order for reassembly.
8. Students will use extreme care during the cleaning of their engine components.

Minds On (Engaging Prior Knowledge)

Activity 2 Prior Knowledge	Connections
Knowledge of key engine components Knowledge of the four stroke engine cycle Group Skills: ● skills in co-operative learning techniques (effective interpersonal skills) and an understanding of personal responsibilities and commitment required for group activities; ● respect for the rights, responsibilities and contributions of self and others; Knowledge of the basic operating procedures of the technical facility Awareness of acceptable personal conduct standards General housekeeping skills Knowledge of safety rules and Safety Passport (See Appendix G – Sample of Safety Passport.) Awareness of Ontario Skills Passport (OSP)	**Differentiated Instructions (DI):** become familiar with the learner's strengths and needs (readiness, interests, and leaner preferences. **SEF** Component 1 Assessment for, as and of Learning Connections Indicator 1.1 Assessment is connected to the curriculum, collaboratively developed by educators and used to inform next steps in learning and instruction.
Activity 2 Planning Notes	**Connections**
Prior to beginning this activity, ask students to define some key terms for review. Terms may include engine components, engine terminology, etc. Review all activities and prepare all resources (handouts, and materials) necessary for the delivery of content. Use of a projector will be useful for PowerPoint presentations The classroom requires sturdy benches suitable for laying out large and heavy engine components, shelves for short term storage of removed components and variety of posters displaying safe working procedures. A class set of safety glasses must be provided. Use of models or cut-out engines is necessary. Required basic hand tools and speciality tools including valve spring compressor Materials required for this activity include: -one engine (preferably a simple 4-cylinder model) per group, mounted on approved engine stands; -service manuals or other means of researching procedures and specifications -containers such as large tin cans for storage of small parts or components A WHMIS approved parts cleaner must be used for the cleaning of the components.	**The Ontario Curriculum, Grade 11-12, Revised 2009** Overall Expectations: A1, A4 Specific Expectations: A1.2, A4.1, A4.3 **Growing Success:** Share learning goals and success criteria with students at the outset of learning to ensure students and teachers and have a common and shared understanding of these goals and criteria as learning progresses. **STEM** **SEF** Component School and Classroom Leadership Indicator 2.2: Processes and practices are designed to deepen understanding of the curriculum and refine instruction to improve student learning and achievement. **Ontario Skills Passport** Literacy skills in reading, writing, oral communications, document and computer use.

Action (Introduce or Extend Learning)

Activity 2 Instructional Strategies	Connections
Teacher: Revisit learning goals through this activity so students have a clear understanding Review key engine terms, components, and the four stroke cycle engine Students are to work in groups of 2-3 to disassemble an engine. Teacher may choose or modify teams accordingly to student strengths and weaknesses Discuss the need of organization of fasteners and components Discuss proper usage of hand tools Emphasize the importance of shop safety Introduce the proper steps to dismantle engine Using the provided lab sheet (Appendix D). Students will use this as a guide for this activity. This lab sheet will include questions pertaining to: - four different cycle identification -engine components. -engine timing. -a diagram of the different internal components. - Purpose of certain internal engine components. Discuss and demonstrate key terms such as Top Dead Centre, Bottom Dead Centre, Stroke, Bore, Engine Displacement, Engine Configuration Teacher demonstrates proper procedures prior to each student group as they progress through the activity. Be attentive to each group's needs as issues arise. Orally question students of their knowledge. This will allow teacher to gain an insight of student learning. Encourage each student to participate equally in this group activity Invite a guest speaker to speak with the class about the career opportunities in automotive engine rebuilding and race engine design. **Student:** -listen actively and critically to understand and learn; - demonstrate organizational skills -identify engine components and demonstrate proper procedures - disassemble engine removing all components - disassemble cylinder head by removing all valves -participate in collaborative/cooperative learning through group activity -record their experiences through a daily log where they can describe their learning experiences.	**The Ontario Curriculum, Grade 11-12, Revised 2009** Overall Expectations: A1 Specific Expectations A1.3 **Think Literacy** Oral Communications-Whole Class Discussion-Discussion Etiquette Small group discussion strategies can also apply here. **SEF** Component School and Classroom Leadership Indicator 2.3: Organizational structures are coherent, flexible and respond to the needs of students. **SEF** Component Student Engagement Indicator 3.4: Students demonstrate a wide range of transferable skills, such as teamwork, advocacy, leadership and global citizenship. **Ontario Skills Passport** Literacy skills in reading, writing, oral communications, document and computer use. **Differentiated Instruction (DI):** provide choice, respectful tasks, a shared responsibility for learning and flexible learning groups
Activity 2 Assessment and Evaluation	**Connections**

Daily observation of student progress is noted. Daily student entries in a log book provide information used to assist the teacher in evaluating individual accomplishment as well as contributions to group work. Lab sheets are checked for accuracy and organization. Written quizzes are given at appropriate points in the activity. **Knowledge and Understanding** To assess students on their knowledge and understanding, teachers will evaluate students' quiz and test results. **Thinking** To assess students on their thinking skills, teachers will evaluate students' on their four cycle charts, engine component descriptions, and engine lab sheet. **Application:** Students are assessed, through observation, on their ability to properly disassembly an engine. The assessment will be based on safety procedures and correct tool usage. **Communications** The work log report will be assessed in terms of format and content (Appendix I) **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 Tools** This activity will be evaluated using a rubric and quizzes. The purpose of this assessment is to gauge the student's ability in applying their skills individual and within a group atmosphere.	**Growing Success:** Have a choice of ways to learn and/or ways to demonstrate their learning on an ongoing basis. **Growing Success:** Use assessment to inform instruction, guide next steps, and help students monitor their progress towards achieving their learning goals. **Differentiated Instructions (DI):** Teachers help students develop, practise and become comfortable with critically analyzing their own work with reflection **SEF** Component 1 Assessment for, as and of Learning Connections Indicator 1.2: A variety of relevant and meaningful assessment data is used by students and educators to continuously monitor learning, to inform instruction and to determine next steps. **SEF** Component 1 Assessment for, as and of Learning Connections Indicator 1.3: Students and educators build a common understanding of what students are learning by identifying, sharing and clarifying the learning goals and success criteria.
Activity 2 Accommodations	**Connections**
The teacher may provide pre-printed notes to students who are unable to keep pace with activities. Students may be assigned peer helpers. Teacher may choose or modify teams accordingly to student strengths and weaknesses. Certain procedures requiring greater accuracy and skill level may be omitted from the procedural worksheet. Oral testing can be substituted for written testing. Individual study topics may be assigned for extra credit. Students may be assigned as peer helpers to assist others. Different engines or tasks may be used according student skill sets and abilities (e.g. grinding valves, small engines repair)	**SEF** Component Curriculum, Teaching and Learning Indicator 4.5: Instruction and assessment are differentiated in response to student strengths, needs and prior learning. **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 2 Daily Work Log	Connections
Students will be asked to write a daily work log of this activity. The paper will include a summary of the activity. The purpose of this log is to allow students to practice the use of proper written language skills. It will also help students reflect on their experiences throughout this unit in preparation for the unit test. This log should include key terms discussed throughout the activity. **Appendix I:** Daily Work Log	**Think Literacy Standard 12L:** Document processes and procedures and communicate them to different audiences using appropriate oral and written techniques

Materials, Tools and Resources

Activity 2 Websites

Grade 11 Transportation Technology Curriculum Document
http://www.wikihow.com/Rebuild-an-Engine
http://www.chevydiy.com/engine-disassembly-guide-build-chevy-small-block-engines/http://smallengineinformation.com/?page_id=459
http://www.aera.org

Activity 2 Publications

Gilles, Tim , Automotive Service: Inspection, Maintenance, Repair, 4th Edition, Nelson,2012,
ISBN10: 1-111-12861-8
Halderman, James D. ,Automotive Technology: Principles, Diagnosis, and Service, 5th Edition, Pearson, 2016
ISBN13: 9780133994612
Duffy, James E., Modern Automotive Technology 8th Edition, Goodheart-Willcox, 2013
ISBN: 1619603705 / 9781619603707
Halderman, James D. , Automotive Engines: Theory and Servicing, 8/E, Pearson, 2015
ISBN-10: 0133515001 • ISBN-13: 9780133515008
Duffy, James, Auto Engine Repair, 6th Edition, Goodheart-Willcox, 2015
ISBN: 978-1-61960-667-8 9780133515008978013351500897801335161 35

Activity 2 Video Resources

Learn360
YouTube
Auto Maintenance and Light Repair Video Clip Library, Goodheart-Willcox , 2015
ISBN: 978-1-61960-912-9
Small Gas Engines DVD Series, Goodheart-Willcox , 2004, ISBN: 978-1-60525-090-8

Activity 2 Computer Software

CDX Auto
Word Processing

Activity 2 Tools and Materials

Engines
Basic Hand Tools
Valve Spring Compressor
Ridge Reamer
Containers (organization)
Plastic Bags organization)
Service Manuals

Activity 2 Human Resources

Guest speakers: local professionals, racing community, Local College Instructors
Special Education/Resource staff
Math/Science teachers

Activity 2 Other

Automotive Society of Engineers
Automotive Service Excellence
Niagara College
Local Machine Shops
Local Engine Rebuilders

Activity 2 Appendices

Appendix D: Engine Activity Lab Sheet
Appendix E: Engine Activity Rubric
Appendix F: Cylinder Head Lab Sheet
Appendix G: Safety Passport
Appendix I: Daily Work Log

Activity 3 Engine Component Inspection and Measuring

Activity Description:
After the groups of students have completely disassembled and cleaned their engines, they must use different sources of information and specifications to inspect, measure, and compare the components. A lesson on the use of micrometers will be reviewed. Students will then be introduced to the use of plastigauge and bore measuring equipment. Students will gain the ability to understand certain areas of common wear and how to properly check all of the engine components. Students will complete a lab sheet with the measurement of the major components of their engines. This lab sheet will include a list of the components that are worn beyond specification. Students will also learn the mathematical equation on cubic inch displacement.

Activity 3 Instructions
1. Students are instructed to bring proper work clothing (preferably coveralls) prior to commencing this activity. Safety shoes are also recommended. The teacher acquaints students with a basic set of hand tools and their correct usage, care, and safety concerns. The need for other safety equipment such as safety glasses and their proper usage is also discussed. 2. The teacher assists students in locating the correct service information for the engine on which they will work. Students work with the teacher to develop a sequential procedural sheet to be completed at various stages of work. Precautions and special points of interest can be noted on this lab sheet. The procedures are reviewed before commencing the activity. 3. The teacher conducts short theoretical sessions at predetermined points in the activity to address major engine components wear and its cause. Constantly refresh the student's knowledge of four-stroke/cycle engine terms and operating theory. These points can be reinforced with individual students as they work on their engines. 4. Students research engine specifications using technical manuals (printed or computerized) and note them on their procedural lab sheets. 5. The students' measure engine bore and strokes using micrometers and dial indicators and compare them to the specifications noted on their procedural lab sheets. The students use the removed crankshaft and check bearing dimensions with a micrometer. Crankshaft bearing clearance is checked using a thickness gauge (e.g., plastigauge) during reassembly.

Minds On (Engaging Prior Knowledge)

Activity 3 Prior Knowledge	Connections
Prior instruction and use of measuring equipment would be useful Research abilities and the knowledge of automotive manuals will also be useful Theory of the different components and their purpose is mandatory Group work abilities and co-operation is necessary. General housekeeping skills	**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 **Ontario Skills Passport** Numeracy skills in measurement and calculations.
Activity 3 Planning Notes	**Connections**

Review all activities and prepare all resources (handouts, and materials) necessary for the delivery of content. Use of a projector will be useful for PowerPoint presentations Various measuring tools must be accessible such as: micrometers, plastigauge, bore gauges, and tape measures. Information must be accessible through automotive manuals, and possibly a computer. Time may be affected depending on the student understanding of the measuring equipment. This activity can be linked with a Math unit on measurement, volume and displacement, and Science units on heat, energy, and pressure. Ask Manufacturing instructors' to describe their teaching perspectives on measuring tools Check all recommended resources prior to beginning lessons and activity. Be sure that all computers are in working order and that the Internet access is available. Review all activities and prepare all resources (handouts, and materials) necessary for the delivery of content. If using collaboration software, be sure that all posts are updated and ready for student interaction. Plan a field trip to a local engine rebuilder or machine shop	**Leading Math Success:** lesson purpose and objectives should target important mathematical concepts and processes. The teacher helps students make connections within mathematics and between mathematics and the world and develop lifelong learning skills. **STEM** **SEF** Component 1 Assessment for, as and of Learning Connections Indicator 1.3: Students and educators build a common understanding of what students are learning by identifying, sharing and clarifying the learning goals and success criteria. **SEF** Component 4 Curriculum, Teaching and Learning Indicator 4.1: A culture of high expectations supports the belief that all students can learn, progress and achieve. **Differentiated Instructions (DI):** A class profile provides a teacher with a snapshot of the strengths, needs, interests and/or readiness of the students in the class.

Action (Introduce or Extend Learning)

Activity 3 Instructional Strategies	Connections
Teacher: Introduce activity and criteria. Discuss the link with proper measurement skills and engine activity. Describe what students are expected to learn and how their learning will help with the overall project. Provide students a clear vision of where this activity will lead. Discuss and demonstrate proper procedure in reading a tape measure with the use of a lab sheet (Appendix K) Discuss and demonstrate the proper procedure in reading an outside micrometer with the aid of handouts and lab sheet Discuss other types of measuring tools used in the automotive field Instruct students to record the specifications and the results of their measurements in their log, notebook, and lab sheet. **Student:**	**The Ontario Curriculum, Grade 11-12, Revised 2009** Overall Expectations: A1, A4 Specific Expectations: A1.1, A1.3, A4.2, A4.3 **Leading Math Success:** Begin by selecting one major mathematical idea (e.g. fraction) and exploring that idea with students from many different perspectives, employing a variety of manipulatives.

listen actively and critically to understand and learn; identify different types of measurement tools and interrupt to determine condition of engine component(s) Students become familiar with the tape measure and outside micrometer by applying these skills through a hands on lab sheet (Appendix K) Students complete Engine Measurement Lab Sheet (Appendix H) Students determine the condition of the component through these measurements Students apply their measurement skills to specific components related to the engine used in the previous activity	**Think Literacy Relationship Building IS29:** Understand and work within the dynamics of a group. **Writing Skills in Note Taking** **SEF** Component 4 Curriculum, Teaching and Learning Indicator 4.2: A clear emphasis on high levels of achievement in literacy and numeracy is evident throughout the school.
Activity 3 Assessment and Evaluation	**Connections**
Assessment strategies and tools in this activity will include opportunities in monitoring students' achievement levels as well as learning skills. Students are assessed on their ability to interrupt readings from various measurement tools using techniques learned. Written lab sheets and quizzes are given at appropriate points of the activity. Student-teacher conferencing occurs regularly throughout the activity to check for student understanding Assignments are collected and assessed for correctness. Student's daily classroom participation will also be an indicator of success. **Knowledge and Understanding** To assess students on their knowledge and understanding, teachers will evaluate students quiz results. **Thinking** To assess students on their thinking skills, teachers will evaluate students' on their engine component measurements and component, evaluation. **Application:** Students are assessed on their ability to properly read measurement tools. The assessment will be based on the safety procedures and correct tool usage. **Communications** The work log report will be assessed in terms of format and content (Appendix I) **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 Tools** Lab Sheet	**SEF** Component 1 Assessment for, as and of Learning Connections Indicator 2.2: Provide explicit feedback about their engagement and learning as educators and advocate for what they need as learners. **Differentiated Instructions (DI):** Teachers help students develop, practise and become comfortable with critically analyzing their own work with reflection **Growing Success:** Teachers assess and evaluate student work with reference to established criteria for four levels of achievement that are standard across the province. **Leading Math Success:** A focus on process goals is often more helpful than a focus on product goals

Quizzes Work Log Rubric	
Activity 3 Accommodations	**Connections**
The teacher may provide pre-printed notes to students who are unable to keep pace with activities. Certain procedures requiring greater accuracy and skill level may be omitted from the procedural lab sheet. Oral testing can be substituted for written testing. Individual study topics may be assigned for extra credit. Teaching Strategies for students with special needs may include: - grouping teams with varied abilities to allow for peer support. The teacher may choose or modify the teams depending on individual strengths and weaknesses; -pairing experienced students with those who are not yet familiar with the techniques; -the use of a support staff to assist students in reaching their IEP goals.	**Leading Math Success:** modify instruction on the spot, on the basis of observation of the students' body language, discussions with classmates, or questions and answers **Growing Success:** Accommodations may include individualized teaching and assessment strategies, human support, and/or individualized equipment **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 Daily Work Log	**Connections**
Students will be asked to write a daily work log of this activity. The paper will include a summary of the activity. The purpose of this log is to allow students to practice the use of proper written language skills. It will also help students reflect on their experiences throughout this unit in preparation for the unit test. This log should include key terms discussed throughout the activity. **Appendix I:** Daily Work Log	**Think Literacy Standard 12L:** Document processes and procedures and communicate them to different audiences using appropriate oral and written techniques. **SEF** Component 4 Curriculum, Teaching and Learning Indicator 4.2: A clear emphasis on high levels of achievement in literacy and numeracy is evident throughout the school.

Materials, Tools and Resources

Activity 3 Websites
Engine Rebuilders Association http://www.aera.org

http://www.linnbenton.edu/auto/day/mike/read.html

Activity 3 Publications

Peterson/deKryger , Math for the Automotive Trade, 5th Edition, 2012, Goodheart-Willcox
ISBN10: 1-111-31823-9
Gilles, Tim , Automotive Service: Inspection, Maintenance, Repair, 4th Edition, Nelson,2012,
ISBN10: 1-111-12861-8
Halderman, James D. ,Automotive Technology: Principles, Diagnosis, and Service, 5th Edition, Pearson, 2016
ISBN13: 9780133994612
Duffy, James E., Modern Automotive Technology 8th Edition, Goodheart-Willcox, 2013
ISBN: 1619603705 / 9781619603707

Activity 3 Video Resources

Learn360
YouTube
Auto Maintenance and Light Repair Video Clip Library, Goodheart-Willcox , 2015
ISBN: 978-1-61960-912-9
Small Gas Engines DVD Series, Goodheart-Willcox , 2004, ISBN: 978-1-60525-090-8

Activity 3 Computer Software

CDX Auto
Word Processing

Activity 3 Tools and Materials

Micrometers
Bore Gauge
Torque Wrench
Basic Hand Tools
Plastigauge
Cleaning Solvents
Service Manuals

Activity 3 Human Resources

Guest speakers: local professionals, racing community, Local College Instructors
Special Education/Resource staff
Math/Science/Manufacturing teachers

Activity 3 Other

Automotive Society of Engineers
Automotive Service Excellence
Niagara College
Local Machine Shops
Local Engine Rebuilders

Activity 3 Appendices

Appendix D: Engine Activity Lab Sheet
Appendix E: Engine Activity Rubric
Appendix F: Cylinder Head
Appendix G: Safety Passport
Appendix H: Measurement Lab Sheet
Appendix I: Daily Work Log
Appendix K: Measurement Worksheet

Activity 4 Engine Assembly

Activity Description:
This activity will teach the students the necessity for organization and housekeeping practices during engine re-assembly. They will also learn the appropriate procedures for engine assembly using the proper tools and equipment.

Activity 4 Instructions

1. Students are instructed to bring proper work clothing (preferably coveralls) prior to commencing this activity. Safety shoes are also recommended. The teacher acquaints students with a basic set of hand tools and their correct usage, care, and safety concerns. The need for other safety equipment such as safety glasses and their proper usage is also discussed.
2. The teacher assists students in locating the correct service information for the engine on which they will work. Students work with the teacher to develop a sequential procedural lab sheet to be completed at various stages of work. Precautions and special points of interest can be noted on this lab sheet. The procedures are reviewed before commencing the activity. The teacher assists students with all aspects of the procedures as required.
3. The teacher conducts short theoretical sessions at predetermined points in the activity to address the areas that need special care and attention as well as constantly re-freshing the student's knowledge of four-stroke/cycle engine terms and operating theory. These points can be reinforced with individual students as they work on their engines
4. Students research engine specifications using technical manuals (printed or computerized) and note them on their procedural lab sheets.
5. The teacher conducts a brief classroom session demonstrating the use of these tools before students use them. The teacher assists students who encounter difficulties using the tools on their engines.
6. Students locate the correct timing chain or belt alignment procedures and note them on their procedural lab sheet prior to installation. A classroom session describing the valve train components and operation reinforces the need for this alignment procedure.
7. The teacher constantly monitors the progress of each group and addresses all components that require a coating of engine pre-lube and addresses the need for this.
8. When is engine is completely assembled correctly the teacher will verify by rotating the crankshaft.

Minds On (Engaging Prior Knowledge)

Activity 4 Prior Knowledge	Connections
Knowledge of key engine components Knowledge of the four stroke engine cycle Group Skills: -skills in co-operative learning techniques (effective interpersonal skills) and an understanding of personal responsibilities and commitment required for group activities; -respect for the rights, responsibilities and contributions of self and others; General housekeeping skills Knowledge of the basic operating procedures of the technical facility Awareness of acceptable personal conduct standards Knowledge of safety rules and Safety Passport (See Appendix G – Sample Safety Passport.) Awareness of Ontario Skills Passport (OSP)	**Differentiated Instruction (DI):** become familiar with the learner's strengths and needs (readiness, interests, and leaner preferences. **SEF** Component 1 Assessment for, as and of Learning Connections Indicator 1.1 Assessment is connected to the curriculum, collaboratively developed by educators and used to inform next steps in learning and instruction.
Activity 4 Planning Notes	**Connections**
Prior to beginning this activity, ask students to define some key terms for review. Terms may include engine components, engine terminology, etc. Review all activities and prepare all resources (handouts, and materials) necessary for the delivery of content. Use of a projector will be useful for PowerPoint presentations The classroom requires sturdy benches suitable for laying out large and heavy engine components, shelves for short term storage of removed components and variety of posters displaying safe working procedures. A class set of safety glasses must be provided. Use of models or cut-out engines is necessary. Required basic hand tools and speciality tools including valve spring compressor, ring compressor, etc. Materials required for this activity include: -one engine (preferably a simple 4-cylinder model) per group, mounted on approved engine stands; -service manuals or other means of researching procedures and specifications -containers such as large tin cans for storage of small parts or components A WHMIS approved parts cleaner must be used for the cleaning of the components. -Teacher developed checklist of procedures and observations to be completed by students at predetermined points in the activity. A WHMIS approved parts cleaner must be used for the cleaning of the components.	**The Ontario Curriculum, Grade 11-12, Revised 2009** Overall Expectations: A1 , A4 Specific Expectations: A1.2, A4.1, A4.3 **STEM** **Differentiated Instruction (DI):** Category of Instructional Strategies: 7 Setting objectives and providing feedback Rubrics or checklists with clear learning goals and previously established assessment criteria **SEF** Component 5 Pathways Planning and Programming Indicator 5.2: Opportunities for authentic learning experiences and experiential learning exist in all classrooms, schools and community programs. **Growing Success:** Teachers can ensure that students understand the success criteria by using clear language that is meaningful to the students and by directly involving them in identifying, clarifying, and applying those criteria in their learning.

Action (Introduce or Extend Learning)

Activity 4 Instructional Strategies	Connections
Teacher: Revisit learning goals through this activity so students have a clear understanding Review key engine terms, components, and the four stroke cycle engine Students continue to work in their original groups of 2-3 to assemble an engine. Teacher may choose or modify teams accordingly to student strengths and weaknesses Discuss the need of organization of fasteners and components Discuss proper usage of hand tools Emphasize the importance of shop safety Introduce the proper steps to assemble engine Continue to use engine lab sheet which students will use as a guide (Appendix D) Discuss and demonstrate key terms such as Top Dead Centre, Bottom Dead Centre, Stroke, Bore, Engine Displacement, Engine Configuration Discuss and demonstrate proper procedure to time an engine Demonstrate proper torque sequence on specific components such as cylinder heads, crankshaft, connecting rods, etc Demonstrate proper procedure to install pistons into cylinder Demonstrate to students how to reassemble cylinder head - Teacher demonstrates proper procedures prior to each student group -Be attentive to each groups needs -Orally question students of their knowledge. This will allow teacher to gain an insight of student learning. - Promote each student to participate equally in this group activity Cross-curricular opportunities may exist in math and science **Student:** - listen actively and critically to understand and learn; - identify engine components and demonstrate proper procedures - participate in collaborative/cooperative learning through group activity - demonstrate the proper procedure to time an engine - demonstrated the correct procedures in assembling an engine - record their experiences through a daily log where they can describe their learning experiences.	**Think Literacy** Oral Communications-Whole Class Discussion-Discussion Etiquette Small group discussion strategies can also apply here. **Think Literacy Relationship Building Skills IS32:** Respect and support ideas, approaches, contributions of others **SEF** Component 3 Student Engagement 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. **SEF** Component 3 Student Engagement Indicator 3.4: Students demonstrate a wide range of transferable skills, such as teamwork, advocacy, leadership and global citizenship. **SEF** Component 5 Pathways Planning and Programming Indicator 5.4: Students build on in-school and out-of-school experiences to further explore and reflect upon their interests, strengths, skills and education and career/life aspirations.
Activity 4 Assessment and Evaluation	**Connections**
Daily observation of student progress is noted. Daily student entries in a logbook provide information used to assist the teacher in evaluating individual accomplishment as well as contributions to group work. Lab sheets are checked for accuracy and organization. All written work is to be complete, in chronological order and neatly written. All lab sheets must be completed as the activity progresses.	**Growing Success:** Have a choice of ways to learn and/or ways to demonstrate their learning on an ongoing basis.

Knowledge and Understanding Students will be evaluated on engine terms and theory **Thinking** To assess students on their thinking skills, teachers will evaluate students' on procedures taken to reassemble their given engine **Application:** Students are assessed on their ability to properly reassemble their engine including proper torqueing techniques. This assessment will also include safety procedures and correct tool usage. The purpose of this assessment is to gauge the student's ability in applying their skills individual and within a group atmosphere. **Communications** The work log report will be assessed in terms of format and content (Appendix I) **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 Tools** This activity will be evaluated using a rubric and quizzes. The purpose of this assessment is to gauge the student's ability in applying their skills individual and within a group atmosphere. A rubric will be used with the Engine Lab Sheet as an assessment tool.	**Growing Success:** Use assessment to inform instruction, guide next steps, and help students monitor their progress towards achieving their learning goals. **Differentiated Instructions (DI):** Teachers help students develop, practise and become comfortable with critically analyzing their own work with reflection **SEF** Component 1 Assessment for, as and of Learning Connections Indicator 1.1: Assessment is connected to the curriculum, collaboratively developed by educators and used to inform next steps in learning and instruction. **SEF** Component 1 Assessment for, as and of Learning Connections Indicator 1.3: Students and educators build a common understanding of what students are learning by identifying, sharing and clarifying the learning goals and success criteria. 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, within the context of the Ontario curriculum and/or Individual Education Plan (IEP).
Activity 4 Accommodations	**Connections**
The teacher may provide pre-printed notes to students who are unable to keep pace with activities. Students may be assigned peer helpers. Teacher may choose or modify teams accordingly to student strengths and weaknesses. Certain procedures requiring greater accuracy and skill level may be omitted from the procedural worksheet. Oral testing can be substituted for written testing. Individual study topics may be assigned for extra credit. Students may be assigned as peer helpers to assist others. Different engines or tasks may be used according student skill sets and abilities (e.g. grinding valves, small engines repair)	**SEF** Component Curriculum, Teaching and Learning Indicator 4.5: Instruction and assessment are differentiated in response to student strengths, needs and prior learning. **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. **Differentiated Instructions (DI):** Flexible Learning Groups

Consolidation & Connections (Provide Opportunities for Reflection)

Activity 4 Daily Work Log	Connections
Students will be asked to write a daily work log of this activity. The paper will include a summary of the activity. The purpose of this log is to allow students to practice the use of proper written language skills. It will also help students reflect on their experiences throughout this unit in preparation for the unit test. This log should include key terms discussed throughout the activity. **Appendix I:** Daily Work Log	**Think Literacy Standard 12L:** Document processes and procedures and communicate them to different audiences using appropriate oral and written techniques **SEF** Component 4 Curriculum, Teaching and Learning Indicator 4.2: A clear emphasis on high levels of achievement in literacy and numeracy is evident throughout the school.

Materials, Tools and Resources

Activity 4 Websites
Grade 11 Transportation Technology Curriculum Document http://www.wikihow.com/Rebuild-an-Engine http://www.chevydiy.com/engine-disassembly-guide-build-chevy-small-block-engines/http://smallengineinformation.com/?page_id=459 http://www.aera.org
Activity 4 Publications
Gilles, Tim , Automotive Service: Inspection, Maintenance, Repair, 4th Edition, Nelson,2012, ISBN10: 1-111-12861-8 Duffy, James E., Modern Automotive Technology 8th Edition, Goodheart-Willcox, 2013 ISBN: 1619603705 / 9781619603707 Halderman, James D. , Automotive Engines: Theory and Servicing, 8/E, Pearson, 2015 ISBN-10: 0133515001 • ISBN-13: 9780133515008 Duffy, James, Auto Engine Repair, 6th Edition, Goodheart-Willcox, 2015 ISBN: 978-1-61960-667-8 9780133515008978013351500897801335161 35
Activity 4 Video Resources

Learn360
YouTube
Auto Maintenance and Light Repair Video Clip Library, Goodheart-Willcox , 2015ISBN: 978-1-61960-912-9
Small Gas Engines DVD Series, Goodheart-Willcox , 2004, ISBN: 978-1-60525-090-8

Activity 4 Computer Software

CDX Auto
Word Processing

Activity 4 Tools and Materials

Basic Hand Tools
Torque Wrench
Valve Spring Compressor
Piston Ring Compressor
Service Manual

Activity 4 Human Resources

Guest speakers: local professionals, racing community, Local College Instructors
Special Education/Resource staff
Math/Science teachers

Activity 4 Other

Automotive Society of Engineers
Automotive Service Excellence
Niagara College
Local Machine Shops
Local Engine Rebuilders

Activity 4 Appendices

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Appendix E: Engine Activity Rubric
Appendix F: Cylinder Head
Appendix G: Safety Passport
Appendix I: Daily Work Log