ONTARIO COUNCIL FOR TECHNOLOGY EDUCATION

Technology and Skilled Trades

Grade 9/TAS1O or TCJ1O or TDJ1O

July 2024

Students will design and build a shelf to hold personal items.

takeTECH

Table of Contents

Introduction

Course Code: TAS1O / TCJ1O / TDJ1O
Destination: Open
Grade Level: 9

BBT(s) Covered in the Activity: Technology and Skilled Trades, Construction and/or Design Technology

This hands-on course enables students to further explore the engineering design process and develop other technological knowledge and skills introduced in earlier grades. Students will design and safely create prototypes, products, and/or services, working with tools and technologies from various industries. As students develop their projects to address real-life problems, they will apply technological concepts such as precision measurement, as well as health and safety standards. Students will begin to explore job skills programs and education and training pathways, including skilled trades, that can lead to a variety of careers.

Project Outline

- This project highlights the construction sector by introducing machines and tools in the shop. It could also be used to focus on technological design.
- Students will be given a scenario to incorporate three different designs on their shelf gables using two types of cuts and wood-burning
- Students will participate in an ideation session with the teacher so the teacher can guide students in the correct direction.
- Students will then spend time on a computer or with pencil and paper finding or creating their designs.
- A comparison/reflection form will then be completed by students.

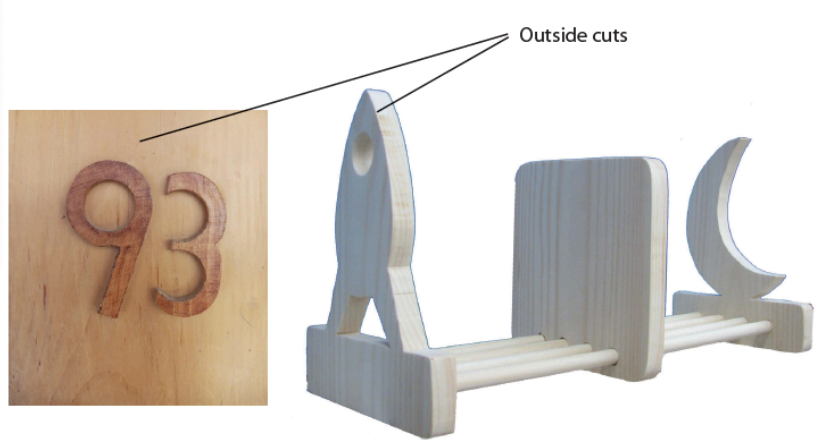
Prior Knowledge

- Students should have a basic understanding of both Metric and Imperial systems.
- Students will be trained on any required software or machinery (e.g., jig saw, scroll saw, band saw, wood burner).

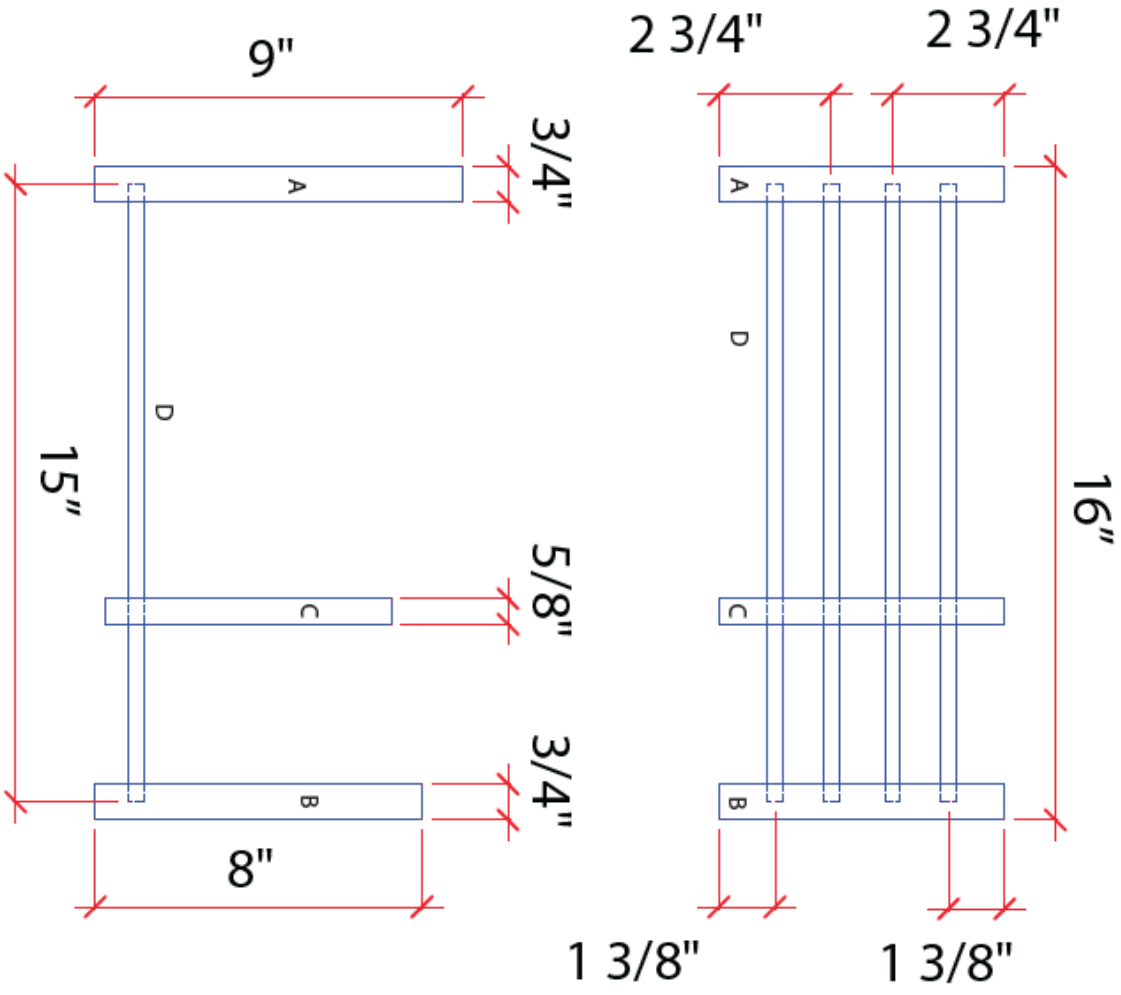
Student Activities

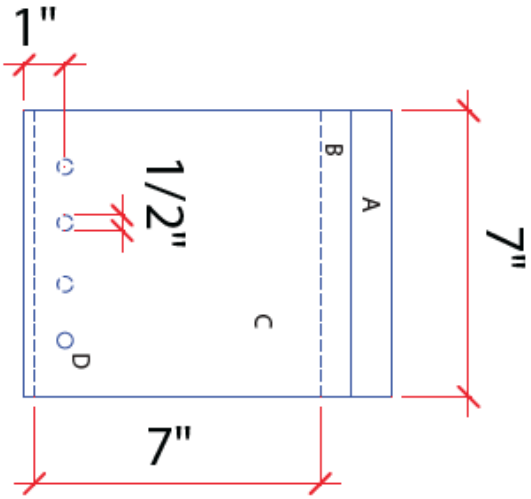
1. Beginning scenario and ideation session
2. Researching and/or designing letters or symbols
3. Confirm the suitability of image(s) with the teacher
4. Using blueprints, students will complete a bill of materials to determine the price of the project
5. Safety training
6. Creating components of the project using machines
7. Transferring images onto the shelf and completing an interior cut (jig or scroll saw), completing an exterior cut (bandsaw) and word burning their final design
8. Calculations, reporting and reflection
9. Extension Activity: Using Technology

Illustrations of Cuts



Orthographic Drawing - Use to complete Bill of Materials





Dowel Shelf Plan

Not to Scale

Fabrication and Testing

1. Now is the time to begin construction of your shelf
2. Be sure to be signed off on all safety requirements for the machines and have parental permission.
3. Rough-cut a piece of 4/4 pine to 30”
4. Joint one face and one edge.
5. Plane to ¾”.
6. Using the mitre saw, cut three gables as per the measurements on the plan.
7. Mark a layout for dowel holes on the gables
8. Using a drill press, drill ½” holes at a ⅜” depth on sides 1 and 2.
9. Using a drill press, drill 9/16” holes in the middle piece
10. Find offcuts and, using the bandsaw with a fence, rip 4 pieces ⅝” x ⅝” x 18”
11. Using the dowel cutter, create ½” dowels with the above pieces.
12. Using the mitre saw, cut them to a finished length
13. Trace backs of printed designs and carbon copy onto sides 1 and 2
14. Use a cordless drill, jigsaw and file to cut the interior design out.
15. Use a bandsaw to cut the exterior design out.
16. Finish sanding all pieces with an orbital sander and break edges with loose sandpaper
17. Transfer middle design on.
18. Practice on scrap pieces and then wood burn the final design.

Calculations, Reporting and Reflection of Learning

Upon the conclusion of these lessons, activities, assignments, and projects, the teacher is encouraged to reflect with their learners about:

- What did you feel was most successful?
- What areas could be improved?
- At what stage were you most engaged?
- How could this assignment be enhanced?
- What advice would you give to someone before starting this work?
- Provide one example of something that you learned.
- The students will be expected to complete an Order of Operations, journaling their work and reflecting on it upon completion.

Resources

This document includes handouts, examples, appendices, pictures, and step-by-step instructions. Students will use whatever resources are available to them, whether in a conventional classroom, Design Tech room, or Construction shop.

Planning Notes

- Teachers should consult with students throughout the activities.
- If required, permission forms should be created and signed by parents/guardians.
- Safety lessons will be required depending in which direction the teacher wishes the project to go.
- A review on Imperial/Metric measurements may help.

Overall and Specific Expectations Covered

Overall Expectations

A1. Initiating and Planning - demonstrate an understanding of fundamental technological concepts and related skills by initiating and planning projects

A2. Designing and Performing - develop projects that involve creating products and/or services, using a variety of resources and techniques, and record the development of their projects

A3. Analyzing and Refining - evaluate and refine processes, products, and/or services

A4. Following Health and Safety Practices - apply an understanding of health and safety practices and procedures when using materials, tools, and equipment.

B3. Careers and Pathways in Technology and the Skilled Trades - explore and describe careers in technological fields and the skilled trades, and pathways for entering them

Specific Expectations

A1.1 investigate and describe fundamental technological concepts, and explain how they are relevant to developing products and/or services in a variety of broad-based technology areas.

A1.2 apply an understanding of fundamental technological concepts, design considerations, and science, technology, engineering, and mathematics (STEM) concepts as appropriate in developing projects involving the creation of products and/or services.

A1.4 communicate design ideas for various purposes and audiences, using appropriate industry terminology.

A2.2 identify factors that could impact the development of their projects and apply appropriate strategies to increase the probability of a positive outcome.

A2.4 select, use, and maintain tools and equipment appropriately as part of creating products and/or delivering services.

A2.6 create products and/or deliver services, documenting their development process using appropriate industry terminology

A2.7 select appropriate units of measure and tools to make accurate measurements using relevant measurement systems, such as the metric and imperial systems

A3.1 identify challenges they encounter in the process of developing their projects and apply critical thinking skills to address these challenges.

A3.3 identify potential refinements to the design of products and/or services based on an analysis of data collected throughout the development process.
A3.4 communicate project-related challenges, performance analyses, and proposals for refinements for a specific audience, using appropriate formats and terminology.
A4.1 describe relevant health and safety regulations for the classroom and workplace, including mandated roles and responsibilities
A4.3 use tools and equipment safely, including using personal protective equipment and safety devices as appropriate
A4.4 follow practices that support physical and mental health and well-being
A4.6 demonstrate a safety mindset by making safety a priority at all times and by engaging in industry-specific safety procedures
B3.1 explore a variety of roles, responsibilities, and opportunities related to current and emerging careers in technological fields, including a variety of broad-based technology areas, and the skilled trades
B3.2 research and identify programs, including in-school job skills programs and community-based programs, related to pathways and careers in technological fields and the skilled trades

Engineering Design Process

The engineering design process will allow students to demonstrate their learning through a design process connected to the broad based technology classes.

This engineering design process has been modified from the Ministry of Educations model and as part of the expectations this step-by-step guide was developed to help the educator meet those expectations This engineering design process is to use as the basis of the activity below.

Students will go through the process of Initiating and Planning, Designing and Performing, and Analysing and Refining a project based on a real world problem.

Any engineering design process can be used. Connect with your board to implement the engineering design process that is currently being used in your district.

Fundamental Technological Concepts

The fundamental technological concepts covered in this assignment include, but are not limited to:

- The act or process of assembling components and/or materials and resources to fabricate/build/create a product or service.
- The use for which a product, process, or service is developed.
- Original and creative thinking results in the effective design of a product or service.
- Any substance or item used in the creation of a product or delivery of a service.

- A system of connected parts that allows a product to work or function.
- The essential physical or conceptual parts of a product, process, or service, including the way in which the parts are constructed or organized.
- The combinations of interrelated parts that make up a whole and that may be connected with other systems.

Universal Design for Learning

The personalized project aligns with the Universal Design for Learning (UDL) framework by offering multiple means of engagement, representation, and action and expression. Students choose their objects to measure, ensuring relevance and motivation while collaborating and receiving peer feedback. This project provides diverse resources in various formats, supporting different learning preferences. Key concepts are explained through multiple representations to aid understanding. Students demonstrate their knowledge through varied methods, with scaffolded support and progressive skill development. Additionally, the project ensures accessibility and encourages cultural inclusivity, making it suitable for all students.

Teachers are encouraged to visit The UDL Guidelines for more information.

Instructional Strategies

- Independent, guided research
- Open-ended problem solving
- Supervision and feedback
- In-person discussions
- Ideation session

Motivational Strategies

- Students are allowed to customize this project to their own tastes and interests
- They get to use a significant number of machines in the construction shape to create them
- This project could be done in partners or groups
- Students are integral to the design and build process

Learning Goals and Success Criteria

By the end of this project, students will be able to:

- Demonstrate an understanding of the safe use of tools and equipment.
- Demonstrate the ability to complete scale drawings.
- Demonstrate the ability to communicate ideas and information through technical sketches and presentation software.
- Will be able to fabricate a product using simple or more advanced machines
- Will use keywords in an internet search.
- Will demonstrate learning skills that include Responsibility, Organization, Independent Work, Initiative, and Self-Regulation

Differentiation of the Project / Activity

There are a number of ways in which this project can be differentiated for instruction. They include:

- The project can be completed using construction tools, Google SketchUp, AutoCAD or with the help of automation
- The presentation technique may change to video or live video discussion.
- Teachers may give a student a specific design to try.
- Extension activities may be used to enhance projects or substitute parts of projects.
- Teachers may allow students to work with partners.

Indigenous ways of knowing, doing and learning:

- Teachers can direct students to research symbols associated with their own personal heritage and look into symbols associated with Indigenous people in the area where the school is located or where they live. These symbols/shapes can be incorporated into the project.

The author has suggested an activity that honours the place from where it was written.

Please consult your school board First Nation, Metis and Inuit curriculum and / or cultural support team to inform content or activities relevant to communities in your area.

Potential For Community Partnership

- Take a field trip to a woodworking facility/business to discuss how these tasks are performed and the technology used for accurate layout and measurements
- Invite people from the construction field to critique the student's projects and finishing standards.

Innovation and Emerging Technologies

Investigate whether your school or classroom has a 3D printer or CNC technology. Students could use these to build the models in sections or add intricate details to their projects. Students could also look into ways to take their home “off the grid”. This could involve investigating solar technology (shingles), reusing rain water, compostable toilets, etc.

Skilled Trade, Apprenticeship and Career Opportunities

- Architect
- Cabinetmaker
- CAD Designer

- Construction Craft Worker
- Construction Engineering Technician
- General Carpenter

For additional skilled trade, apprenticeship, and career opportunity resources, visit the Ontario Council for Technology Education website or contact your school's guidance department.

Assessment and Evaluation

- As part of assessment for learning, teachers provide students with descriptive feedback and coaching for improvement. Teachers engage in assessment as learning by helping all students develop their capacity to be independent, autonomous learners who are able to set individual goals, monitor their own progress, determine next steps, and reflect on their thinking and learning.
- Multiple rubrics and checklists have been woven throughout this resource to allow students to track their own progress throughout the assignments and for teachers to give constructive feedback that will allow students to re-submit assignments to improve their learning and marks.
- There is also a chart detailing the Overall and Specific Expectations of the unit that both teachers and students can use to track their learning and progress

Experiential learning

This project makes use of experiential learning by immersing students in the hands-on process of designing and building their shelf. Students actively engage in the design process, from conceptualizing their ideas to executing them using a variety of building and planning techniques. They experience real-world applications of design principles, receive immediate feedback from peers and instructors, and iterate on their work to improve their skills.
Health and Safety Considerations

- If required, permission forms should be created and signed by parents/guardians.
- Depending on the class or shop used, extensive safety training will need to be administered
- Reflect on your experiences and relate the learning to the real world

Applicable SAFEDocs and ToolSAFE Videos

- Exploring Technologies SAFEDocs (OCTE), 2013
- Construction Technology SAFEDocs (OCTE), 2013
- Technological Design SAFEDocs (OCTE), 2013
- ToolSAFE TDJ Modelling Tools, (OCTE), 2015
- ToolSAFE TDJ Hot Glue Gun (OCTE), 2015

Appendix

Appendix A - Dowel Shelf Checklist and Rubric

Application	
Accuracy	
	Large gable is built to correct dimensions
	Medium gable is built to correct dimensions
	Small gable is built to correct dimensions
	Dowels have been cut to correct dimensions
Fit and Finish	
	The Dowel Shelf Assignment package was submitted
	Dowel holes are aligned
	Student has done a good job with glue clean-up
	Wood joints fit tight
	All surfaces have been finish sanded
	All edges of components have been “broken” with sandpaper
Gable Design	
	Student has completed an outside cut on Side A
	Student has completed an inside cut on Side B
	Student has painted or wood-burned a design on the Middle Gable
/30	Sub-Total
10	• that the student demonstrated great understanding to achieve a truly exceptional result
8	• that the student demonstrated above-average understanding to achieve a very good result
6	• that the student demonstrated average understanding to achieve a moderate result
4	• that the student demonstrated below-average understanding to achieve a mediocre result
2	• that the student demonstrated weak understanding to achieve a poor result
/10	Sub-Total
/40	Total
Thinking	
	The Bill of Materials has been completed properly
/10	Total

Appendix B - Dowel Shelf Rubric

Categories	Level 1	Level 2	Level 3	Level 4
Knowledge and Understanding				
Knowledge of content Student demonstrates knowledge of math concepts, internet research and presentation software.	demonstrates limited knowledge of the content	demonstrate some knowledge of the content	demonstrates considerable knowledge of the content	demonstrates thorough knowledge of the content
Understanding of content Student understands Imperial and Metric Systems. Student understands the Pythagorean Theorem and how to calculate a hypotenuse.	demonstrates a limited understanding of the content	demonstrates some understanding of the content	demonstrates a considerable understanding of the content	demonstrates a thorough understanding of the content
Thinking				
Use of planning skills Student follows a logical order of events to complete the assignment	uses planning skills with limited effectiveness	uses planning skills with some effectiveness	uses planning skills with considerable effectiveness	uses planning skills with a high degree of effectiveness
Use of processing skills Student develops 2 measurement devices that are highly effective.	uses processing skills with limited effectiveness	uses processing skills with some effectiveness	uses processing skills with considerable effectiveness	uses processing skills with a high degree of effectiveness
Use of critical/creative thinking processes Student is able to self-evaluate his/her product, reflect on the process and suggest positive changes.	uses critical/ creative thinking processes with limited effectiveness	uses critical/ creative thinking processes with some effectiveness	uses critical/ creative thinking processes with considerable effectiveness	uses critical/ creative thinking processes with a high degree of effectiveness

Communication				
Expression and organization of ideas and information in oral, non-verbal, visual, and/or written forms, including digital and media forms Slide show is well organized. Information is delivered effectively.	expresses and organizes ideas and information with limited effectiveness	expresses and organizes ideas and information with some effectiveness	expresses and organizes ideas and information with considerable effectiveness	expresses and organizes ideas and information with a high degree of effectiveness
Communication for different audiences and purposes in oral, non-verbal, visual, and/or written forms, including digital and media forms Student communicated effectively with the teacher. The visuals on the slide show are relevant and clear.	communicates for different audiences and purposes with limited effectiveness	communicates for different audiences and purposes with some effectiveness	communicates for different audiences and purposes with considerable effectiveness	communicates for different audiences and purposes with a high degree of effectiveness
Use of conventions, industry-related vocabulary, and terminology of the discipline in oral, non-verbal, visual, and/or written forms, including digital and media forms Student produced well-drawn and clear sketches. Dimensions in slide show have correct designations.	uses conventions, vocabulary, and terminology of the discipline with limited effectiveness	uses conventions, vocabulary, and terminology of the discipline with some effectiveness	uses conventions, vocabulary, and terminology of the discipline with considerable effectiveness	uses conventions, vocabulary, and terminology of the discipline with a high degree of effectiveness

Application				
Application of knowledge and skills in familiar contexts Student was able to take previously learned math concepts and use them to solve a practical problem.	applies knowledge and skills in familiar contexts with limited effectiveness	applies knowledge and skills in familiar contexts with some effectiveness	applies knowledge and skills in familiar contexts with considerable effectiveness	applies knowledge and skills in familiar contexts with a high degree of effectiveness
Transfer of knowledge and skills to new contexts Student was able to take basic household items and create a measuring device.	transfers knowledge and skills to new contexts with limited effectiveness	transfers knowledge and skills to new contexts with some effectiveness	transfers knowledge and skills to new contexts with considerable effectiveness	transfers knowledge and skills to new contexts with a high degree of effectiveness
Making connections within and between various contexts Student makes the connection between angle inclination and height.	makes connections within and between various contexts with limited effectiveness	makes connections within and between various contexts with some effectiveness	makes connections within and between various contexts with considerable effectiveness	makes connections within and between various contexts with a high degree of effectiveness

Appendix C - Order of Operations and Reflection

Order of Operations

While laying out and constructing your project, keep a detailed account of each taken step during the process and which tools were used (ie. Step #1 - Milled lumber to finished thickness using the Jointer and the Planer). This can be done in sentence or point form on the lines below. After this, spend a few moments reflecting and then make notes on things you would do differently and discuss problems that arose that you had to overcome.

Task Description	Resource, website, machine, or tool used
Reflection Space	

Appendix D - Bill of Materials Template

Board Foot Calculation Formula = $\frac{\text{Number of pieces x Length" x Width" x Thickness"}}{144}$

Bill of Materials Template

Finished Material Measurements					
Letter	Part Name	Quantity	Thickness	Length	Width
A	Side 1				
B	Side 2				
C	Middle				
D	Dowels				

Rough Material Measurements (add 1/2" to the finished width and 1" to the finished length)							
Letter	Part Name	Quantity	Thickness	Length	Width	Lumber Description	Board Feet
A	Side 1						
B	Side 2						
C	Middle						
D	Dowels						
Pine Total BF:		Round-Up:		x $ =		(BF Price)	$
Grand Total							$

DECIMAL EQUIVALENTS OF FRACTIONS OF AN INCH			
1/32 = .03125	9/32 = 0.28125	17/32 = 0.53125	5 25/32 = 0.78125
1/16 = .0625	5/16 = 0.3125	9/16 = 0.5625	13/16 = 0.8125
3/32 = .09375	11/32 = 0.34375	19/32 = 0.59375	27/32 = 0.84375
1/8 = 0.125	3/8 = 0.375	5/8 = 0.625	7/8 = 0.875
5/32 = 0.15625	13/32 = 0.40625	21/32 = 0.65625	29/32 = 0.90625
3/16 = 0.1875	7/16 = 0.4375	11/16 = 0.6875	15/16 = 0.9375
7/32 = 0.21875	15/32 = 0.46875	23/32 = 0.71875	31/32 = 0.96875
1/4 = 0.25	1/2 = 0.5	3/4 = 0.75	1 = 1.000

References

Clipart (courtesy of Vecteezy), 2020

Construction Technology SAFEDocs (OCTE), 2013

Construction Training and Apprenticeship Ontario (CTAO)

Exploring Technologies SAFEDocs (OCTE), 2013

Growing Success: Assessment, Evaluation, and Reporting in Ontario Schools, 2010

Indigenous Knowledge and Our Connection to the Land

Learning for All – A Guide to Effective Assessment and Instruction for All Students, Kindergarten to Grade 12, 2013

Technological Design SAFEDocs (OCTE), 2013

The Ontario Curriculum, Grades 9 and 10: Technology and the Skilled Trades, 2024

The Ontario Curriculum, Grades 11 and 12: Technological Education, 2009 (revised)

ToolSAFE TDJ Hot Glue Gun (OCTE), 2015

ToolSAFE TDJ Modelling Tools, (OCTE), 2015