

3D Modeling and 3D Space Orientation

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Recommended year	<i>8th grade primary school</i>
Time framework	<i>4 - 6 lessons</i>
Thematic block	<i>Graphic communication in technology.</i>
Objectives and development of competencies	<p><i>The project objective is mainly to make technical education more attractive, pupils learn more about the 3D modelling in a funny and interesting way.</i></p> <p><i>The project develops problem-solving competences and in some level also communicative competences.</i></p> <p><i>Pupils will develop their problem-solving competences through their individual work of creating tasks. If 3D printing is available, the competences may be developed on a higher level.</i></p> <p><i>3D models teaching can develop communication competences too. It can especially help understanding 3D models and 3D animations. 3D models may be used as a communication tool too, as a part of presentations which support understanding e.g. design of functional components.</i></p>
Interdisciplinary (cross-curricular) relations	<p><i>Information and Communication Technology</i> (Computer Science) <i>Information processing and utilization</i> – Manages working with graphic editors and using suitable applications; study materials – <i>computer graphics.</i></p> <p><i>Mathematics and its application</i> (Math) <i>Geometry in plane and space</i> – Solids, their volume and surface, a net for solid; study materials – <i>elemental formations in space.</i></p>

Theoretical Introduction

There is a lot of effort to support technical education in modern days. Technical subjects should be supported already at primary schools, which does not necessary mean that the teachers should only follow the old and proven methods.

Some schools teaching technical drawing may be an example of using older methods so the pupils are bored already imagining that they would have to open their notebooks and start drawing machine parts. A demonstration of the process how they used to draw in past would be for pupils beneficial, but it should not form the base of lessons. In such a case, pupils are motivated by their marks only and the ability of manual drawing is not that useful in a real life, because there are various specialized software applications today. Would not it be better to teach pupils something more useful?

Teaching 3D modelling may be a solution of this problem. Children get motivated already with the topic of the work. Lessons may be taken from a funny point of view without losing their effectivity. Another motivating factor may be presenting a 3D printer, where children could print their models out. Someone may argue that a 3D printer is an expensive technology, but nowadays is its price comparable with a purchase of 2 PCs.

Computer Science teaching is now necessary in our society more than ever before. Managing various types of programs and basic technological knowledge is a key to be successful in life. Apart from the basic office applications, which is considered as a computer literacy, pupils should learn proper techniques of computer graphics. Teaching computer graphics develops imagination, creativity and fine motor skills. 3D modelling is just further extension of working with graphics, it develops the skills more and adds development of the orientation in 3D space, which provides new perspectives for pupils.

When we take a look at the practical use, there is still lot of interest in people skilled in 3D modelling as they have wide application (architecture, engineering, film and game industries). Right this may persuade some pupils to choose a study at a technically focused school.

Methodical part for teachers

Objectives

- Pupils will be able to orientate themselves in the virtual 3D space and will develop their special imagination.
- Pupils will get an idea of what it is 3D graphics and what does the 3D modelling activity involve.
- Pupils will master their logic, principles and processes of making 3D models (according to the scope of the lessons).

- Pupils will learn to work with the chosen 3D modelling program (according to the scope of the lessons).

Mandatory (pupils must learn)

*Basic service and work with PC.
Orientation in graphic editors.
Basic knowledge of solids and measuring units.*

Recommended (pupils should learn)

*Principles and orientation in a rectangular projection.
Dimensioning, drawing.
English language basics.*

Expected outcomes

Expected outcomes are skills and knowledge, which should pupils have mastered after absolving the lessons.

- Pupils can create simple solids (circle, curve, ...)
- Pupils can pull and drag objects in the space.
- Pupils can create rotating objects (area rotation around the axis).
- Pupils learn basic work with scales and can design a model to the dimension.
- Pupils learn to use copy and paste of objects by proper object manipulation (move, change shape, ...).
- Pupils can create objects by pulling a curve.
- Pupils use the tools correctly and effectively (if the amount of lessons is sufficient).

Methodical recommendations for 3D modelling lesson management

Considering the age, 3D modelling should be taught at secondary schools, ideally starting in 8th grade. The content of 3D modelling is actually an extension of teaching graphics in graphic editors.

Lesson should start with a brief explanation how the 3D models are used in the practice. Then should follow the introduction of a 3D modelling software. A teacher should show the work with a camera and objects. He should not forget to explain and show up the functions of basic tools and demonstrate the suitable ones on one or more simple tasks. To demonstrate the eject function we could use the example of Dice or House. The examples of Figure or Vase are good for a demonstration of making rotating objects. At least one jointly worked out task and creation of a solid of revolution that are the conditions for the effective continuation in teaching 3D modelling.

The next step could be an individual work on a simple task. A teacher should watch the pupils and help them. If there appears any problem, he should show its solution to all the pupils together.

The teacher should then continue in a similar way and give more complicated tasks and tasks in the next lessons. He should pick the tasks according to the amount of the lessons, considering pupils abilities and 3D print possibilities.

It is appropriate for the proper progress of 3D modelling lessons that the teacher tries out all the tasks. The tasks require a certain level of adaption to a group of pupils from the point of motivation and difficulty. Each task may be adapted to the level of skills of the specific group of pupils by adding or reducing some model details. Another necessity is that the teacher is able to support pupils with some advice in cases when a pupil does not know how to fill the task. The teacher would not be able to advise them if he does not try it first.

The tasks are designed for the program SketchUp, but they can be adapted with no bigger difficulty to other 3D modelling programs. However, then it is necessary to remember that there will be change in some working tools as well as some processes, which could be different in other programs.

Activities Plan Overview:

No material equipment

- Activity 1 – Dice (15 – 25 min)
- Activity 2 – Figure (15 – 20 min)
- Activity 3 – Vase (15 – 20 min)
- Activity 4 – Cup (20 – 30 min)
- Activity 5 – House (20 – 40 min)
- Activity 6 – Match box (20 – 30 min)

Material equipment – 3D printer

- Activity 7 – Earring/Hanger (15 – 30 min)
- Activity 8 – Key case (15 – 30 min)
- Activity 9 – Chess Figure (30 – 40 min)

Individual activities have a range of scatter in timing. The length of each activity depends on pupils, their skills and the level of individuality provided by their teacher.

Tasks – Variant with no material equipment.

The tasks are designed for schools with no material equipment. The availability of a computer classroom is in modern times something normal at primary schools. Therefore, the basic variant requires computers, a data projector and SketchUp program, which is available in its Make version for free.

Activity 1 – Dice

A dice or a cube belongs among the simplest models. It is created by ejecting (pulling) process, which means that any 2D object (surface) is pulled into the space by the dimension. That way the object gets the third dimension and forms a 3D solid. This method can be used vice versa too, when you insert, cut off, cut out, push the same way another object into the existing 3D solid.

Objectives <i>Pupils will be able to</i>	<i>create a simple model; use the function pull and drag properly; copy objects.</i>
Developed skills, abilities,	<i>Spatial imagination; soft motor skills;</i>

competences	<i>Accuracy, (problem solving, creativity).</i>		
Study content	<i>Making simple objects (cube, cylindrical hole ...); pull/drag (function Push/Pull); copy objects.</i>		
Type of work	<i>Individual; shared (instructions).</i>		
Difficulty (1-5)	<i>1</i>	Time demands	<i>15 – 25 min.</i>
Input requests, tools.	<i>Basic work with PC, PC and suitable software; projector; dice.</i>		
Evaluation	<i>Verbal evaluation.</i> <ul style="list-style-type: none"> • <i>Design and quality (shape, size and placing of the holes, accuracy).</i> 		

Task notes

The task opens possibilities to show pupils how to work with scales, copy and paste objects, snap and use auxiliary lines. Be careful to overload pupils with too much information at once. Do not create all the dice with pupils. Let them make two or four sides by themselves.

Activity 2 – Figure

Figure is a solid of revolution. When you make it, you must create a side profile of the figure which you can rotate around the central point of the out-coming object.

Objectives <i>Pupils will be able to</i>	<i>create a simple solid of revolution; solve simple mistakes done during making the 3D model.</i>		
Developed skills, abilities, competences	<i>Spatial imagination; soft motor skills; solving problems.</i>		
Study content	<i>Making simple objects (circle, curve ...); making solids of rotation – rotating the area around the axis (function Follow Me).</i>		
Type of work	<i>Individual; shared (instructions).</i>		
Difficulty (1-5)	<i>1</i>	Time demands	<i>15 - 20 min.</i>
Input requests, tools.	<i>Basic work with PC, PC and suitable software; projector.</i>		
Evaluation	<i>Verbal evaluation.</i> <ul style="list-style-type: none"> • <i>Design and quality (the model has all the parts, the right proportion).</i> • <i>Filling the task.</i> 		

Activity 3 – Vase

Vase is a solid of revolution. When you make it, you must create a side profile of the vase first which you can rotate around the central point of the to-be-vase.

Objectives <i>Pupils will be able to</i>	<i>create a simple solid of revolution; solve simple mistakes done during making the 3D model.</i>		
Developed skills, abilities, competences	<i>Spatial imagination; soft motor skills; creativity; solving problems.</i>		
Study content	<i>Making simple objects; making solids of rotation – rotating the area around the axis (function Follow Me); work with 2D objects (function Offset).</i>		
Type of work	<i>Shared (Instructions); Individual.</i>		
Difficulty (1-5)	<i>2</i>	Time demands	<i>15 - 20 min.</i>

Input requests, tools.	<i>Basic work with PC, PC and suitable software; projector.</i>
Evaluation	<i>Verbal evaluation.</i> <ul style="list-style-type: none"> • <i>Design, functionality of the form (if the model can be used as a real vase).</i> • <i>Quality (vase has got all its parts, no missing e.g. bottom, and there is nothing that should not be on the vase).</i>

Task notes

Whether the pupils work individually or in teams, they should get the opportunity to design their own vase shape.

Activity 4 – Cup

Cup is a solid of revolution. When you make it, you must create a side profile of the vase first which you can rotate around the central point of the to-be cup. Then make a handle and connect it to the cup.

Objectives <i>Pupils will be able to</i>	<i>create a simple solid of revolution; suitably use the function pull by the curve; solve simple mistakes done during making the 3D.</i>		
Developed skills, abilities, competences	<i>Spatial imagination; soft motor skills; creativity; problems solving.</i>		
Study content	<i>Making solids of rotation – rotating the area around the axis (function Follow Me); work with 2D objects (function Offset). Pulling by a curve (function Move).</i>		
Type of work	<i>Individual; shared (instructions).</i>		
Difficulty (1-5)	3	Time demands	20 - 30 min.
Input requests, tools.	<i>Basic work with PC, PC and suitable software; projector.</i>		
Evaluation	<i>Verbal evaluation.</i> <ul style="list-style-type: none"> • <i>Design, functionality of the form (if the model can be used as a real cup).</i> • <i>Quality (the cup has got all its parts, no missing e.g. bottom, and there is nothing that should not be on the cup).</i> 		

Activity 5 – House

House is a simple model. It is formed by pushing or ejecting (see the example of *Dice*).

Objectives <i>Pupils will be able to</i>	<i>create a simple model; use the function pull and drag properly.</i>		
Developed skills, abilities, competences	<i>Spatial imagination; soft motor skills; creativity; problems solving.</i>		
Study content	<i>Making simple objects (cube, rectangle, cylinder...); pull/drag (function Push/Pull),</i>		
Type of work	<i>Individual; shared (instructions).</i>		
Difficulty (1-5)	2	Time demands	20 - 40 min.

Input requests, tools.	<i>Basic work with PC; task Dice (recommended); PC and suitable SW; projector;</i>
Evaluation	<i>Verbal evaluation.</i> <ul style="list-style-type: none"> • <i>Design and quality (model has all its parts, suitable proportions).</i> • <i>Creativity, own idea, sense for detail.</i>

Task notes

The lecturer can provide pupils with advice in case that they are not sure and choose from the following:

roof hatch; chimney roof; round window;
entrance into cellar; door steps; horseshoe above door;
door sill and rag.

Activity 6 – Match box

Match box is a simple model. It is made of two parts – the inner part of the box and the packaging, where you insert the inner part. On top of that, we create the model so that the inner part is in its half in the outer part. That makes our work more difficult. There are more functioning processes.

Objectives <i>Pupils will be able to</i>	<i>create a simple model;</i> <i>use the function pull and drag properly;</i> <i>use the scale to make the exact models.</i>		
Developed skills, abilities, competences	<i>Spatial imagination; soft motor skills; accuracy; problems solving.</i>		
Study content	<i>Making simple objects (cube, rectangle, ...);</i> <i>pull/drag (function Push/Pull); scale.</i>		
Type of work	<i>Individual; shared (instructions).</i>		
Difficulty (1-5)	<i>3</i>	Time demands	<i>15 - 25 min.</i>
Input requests, tools.	<i>Basic work with PC; PC and suitable SW; projector; match box.</i>		
Evaluation	<i>Verbal evaluation.</i> <ul style="list-style-type: none"> • <i>Filling the task.</i> • <i>Accuracy and quality.</i> 		

Tasks for 3D printer – Variant with material equipment

Compared to the others, this topic is very specific, because it considers 3D model making with the use of a computer. It is impossible to choose another material for its substitution or other tools to create it. Therefore we decided to find something extra to involve in material equipment. In this case we decided to use a 3D printer. There are schools where they possess and use this equipment nowadays. That shows the modern approach to education, which is very popular in these days and as well as the topic, it develops the interest in technical education. On top of that, the possibility to print out their models really motivates pupils.

On the contrary from the previous part, the worksheets do not include the instructions because they focus more on the creativity. While using a 3D printer, it is better that everyone makes his own product.

Some recommendations for printing 3D models

Model size: Some pupils may not follow the teacher's instructions and will not fit in the recommended model dimensions. Help them to change the dimensions of the model by using the Scale function.

Using the scale: To create high quality models for 3D printing, pupils need to learn how to use the scale. They should not use it only passively (read the figures), but actively (by putting the accurate dimensions).

Model optimization: The created model usually includes invisible mistakes which may not allow its high quality printing. That is the reason to use the proper software to correct each model, e.g. <https://netfabb.azurewebsites.net/> (free, registration required).

Print in the air: The printer reaches its maximal angle 45° with no support. A larger angle or printing in the air is possible only if the printer has two jets and prints the supports from another material. Alternatively, you can try to rotate the model and change its angles, or divide it into more parts which you glue together then.

Activity 7 – Hanger/Earring

It is a simple idea to create the own hanger or earring. Pupils should use their own creativity skills to make their original products.

Objectives <i>Pupils will be able to</i>	<i>create a simple model; use the function pull and drag properly; use the scale to make the exact models.</i>		
Developed skills, abilities, competences	<i>Spatial imagination; soft motor skills; accuracy; creativity, problems solving.</i>		
Study content	<i>Making simple objects (cube, rectangle, arc...); pull/drag (function Push/Pull); scale.</i>		
Type of work	<i>Individual.</i>		
Difficulty (1-5)	2	Time demands	15 - 30 min.
Input requests, tools.	<i>Basic work with PC; PC and suitable SW; projector; 3D printer.</i>		
Evaluation	<i>Verbal evaluation.</i> <ul style="list-style-type: none"> • <i>Design and quality (the model has all the parts, the right proportion).</i> • <i>Creativity, own idea, sense for the detail.</i> 		

Activity 8 – Key case

The shape of the key case is completely up to children. They are limited only by the given dimensions. They place their names on the key ring, using the 3D letters.

Objectives <i>Pupils will be able to</i>	<i>create a simple model;</i> <i>use the function pull and drag properly;</i> <i>use the scale to make the exact models.</i>		
Developed skills, abilities, competences	<i>Spatial imagination; soft motor skills; creativity, problems solving.</i>		
Study content	<i>Making simple objects (cube, rectangle, arc...);</i> <i>pull/drag (function Push/Pull); scale.</i>		
Type of work	<i>Individual.</i>		
Difficulty (1-5)	2	Time demands	15 - 30 min.
Input requests, tools.	<i>Basic work with PC; PC and suitable SW; projector; 3D printer.</i>		
Evaluation	<i>Verbal evaluation.</i> <ul style="list-style-type: none"> • <i>Design and quality (the model has all the parts, the right proportion).</i> • <i>Creativity, own idea, sense for the detail.</i> 		

Activity 9 – Chess figures

The task is aimed to make chess for the class. The pupils are divided into groups and they should make a 3D model of one chess figure for the game. After that, the best models are compared and printed out on a 3D printer to complete all the figures. The teach specifies the basic dimensions of figures, especially the stand-sectional size of the figure and its approximate height, so the figures would match together.

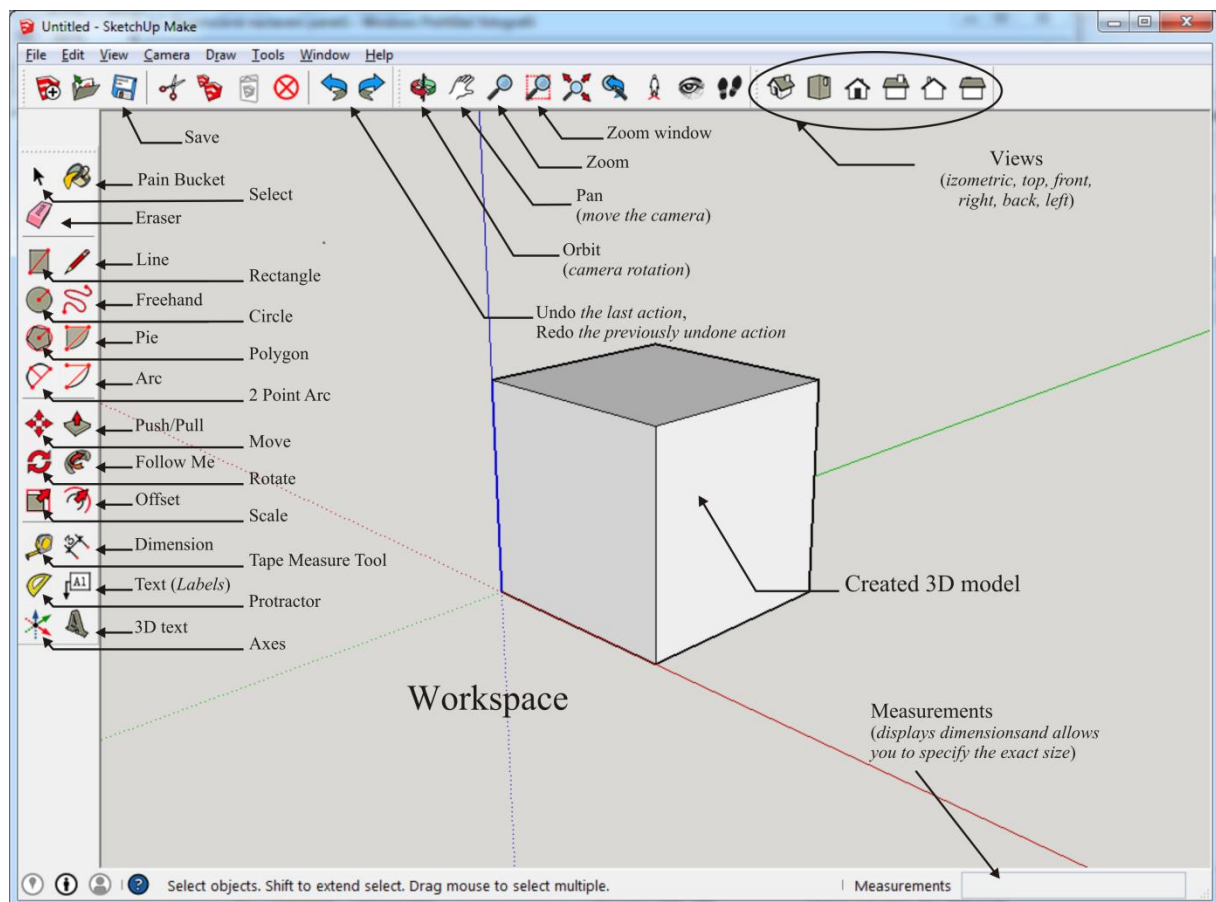
Objectives <i>Pupils will be able to</i>	<i>create a simple solid of rotation;</i> <i>use the scale to make the exact models;</i> <i>solve simple mistakes done during making the 3D model.</i>		
Developed skills, abilities, competences	<i>Spatial imagination; soft motor skills; accuracy; creativity, problems solving; communication.</i>		
Study content	<i>Making simple objects (circle, curve ...).</i> <i>Making solids of rotation – rotating the area around the axis</i> <i>(function Follow Me).</i>		
Type of work	<i>Individual.</i>		
Difficulty (1-5)	2-3	Time demands	30 - 40 min.
Input requests, tools.	<i>Basic work with PC; the task Chess figure recommended; PC and suitable SW; projector; 3D printer.</i>		
Evaluation	<i>Verbal evaluation.</i> <ul style="list-style-type: none"> • <i>Design and quality (the model has all the parts, the right proportion).</i> • <i>Creativity, own idea, sense for the detail.</i> 		

Task notes

Making the knight will differ from other chess figures a lot. That would be more suitable for really skilful pupils. Divide the model into two parts, the figure stand and the body. It is easier to make the body by using the eject function. The stand is created in the same way like other figures. Ideally, pupils should think out and find the way to connect both of the parts (without glue).

You can support pupils while making the chess figure and provide them the instructions how to create a peg of the game “Člověče, nezlob se” (similar to Sorry!).

SketchUp program description and recommended panel setting



Detail description of the selected functions

You can cancel the ongoing drawing with the selected function by pressing the key ESC.

Paint bucket – Apply color, material or external textures to model.

Line – Lines to each other automatically follow.

Freehand – Draw freehand lines.

Polygon – Draw N-sided from center point to radius. After selecting the tool, can be specify number of sides through measurements.

Offset – Offset selected edges in a plane.

Protractor – Measure angles and create guides.

Axes – Move or reorient the drawing axes.

Worksheets – *variant with no material equipment.*

DICE

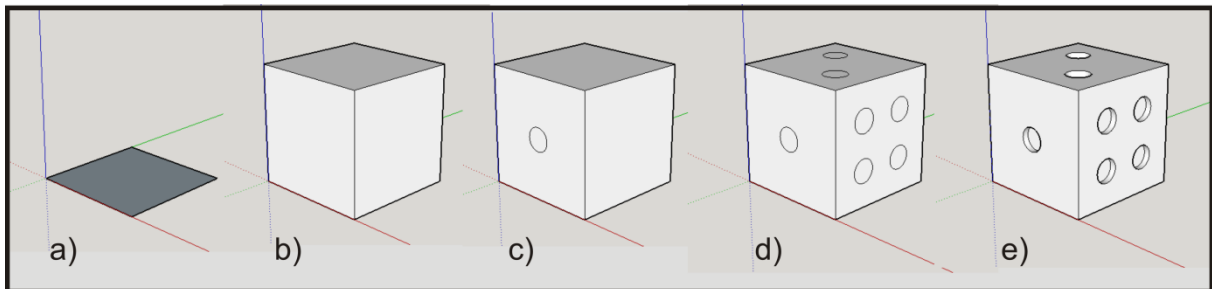
Task

Create a 3D model of a dice in the SketchUp program.

- Dice will be in the shape of cube.
- All the holes will be the same size.
- The holes of the dice will have approximately the same depth.

Instructions

- Make the stand for dice (function **Line or Rectangle**). You can estimate the dimensions or use a scale (bottom right corner).
- By pushing the stand, create a cube (function **Push/Pull**).
- Make a circle.
- Make new circles by copying the original one (key shortcut Ctrl + c, Ctrl + v) and place them properly (function **Move**).
- Make holes into the cube (function **Push/Pull**).



FIGURE

Task

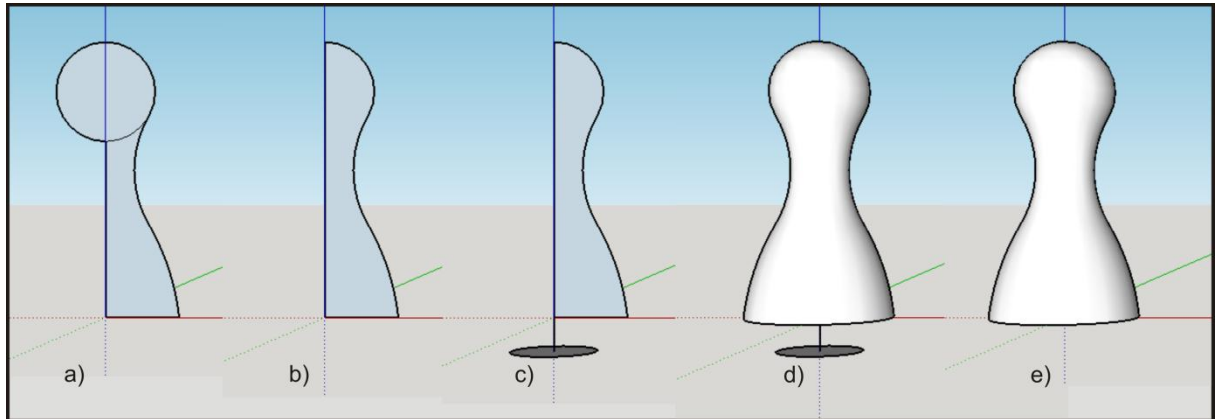
Use the SketchUp program to make a 3D model of a peg from the game “Člověče, nezlob se” (Sorry!).

- The peg should be the similar shape to the real figure.
- The model dimensions do not need to be the similar to the real figure.

Instructions

- Make the shape (profile) of the figure (functions **Line, Circle, 2 Point Arc, Freehand**).
- Erase unnecessary lines and parts of the object.
- Make a supporting circle (function **Circle**) in the axe of the future figure (cannot touch the area of the figure)
- Use the function **Follow Me** to drag the figure profile along the supporting circle.

e) Erase the supporting lines and objects.



VASE

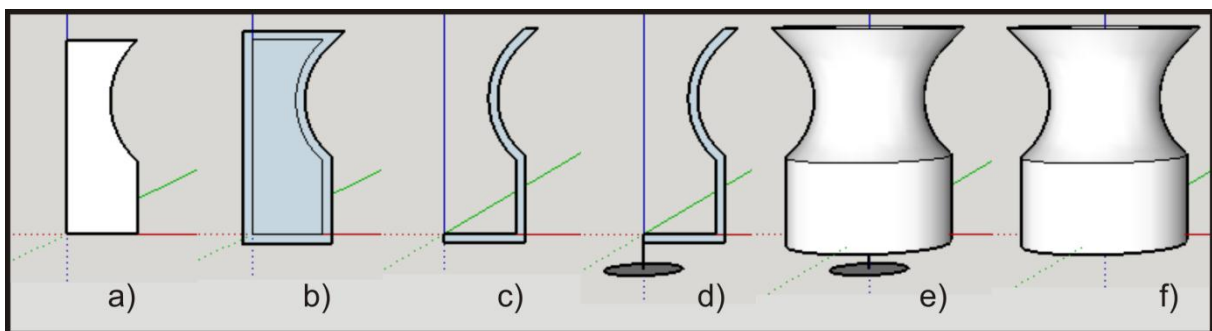
Task

Use the SketchUp program to make a 3D model of a vase.

- The vase shape will be partially rounded and partially squared, but has to serve like a vase.

Instructions

- Make a shape of the vase walls (functions *Line*, *2 Point Arc*, *Freehand*).
- Use the function *Offset* to create a vase wall.
- Erase the unnecessary lines and parts of the object.
- Make a supporting circle (function *Circle*) in the axe of the future vase (cannot touch the area of the vase).
- Use the function *Follow Me* to drag the vase wall along the supporting circle.
- Erase the supporting lines and objects.



CUP

Task

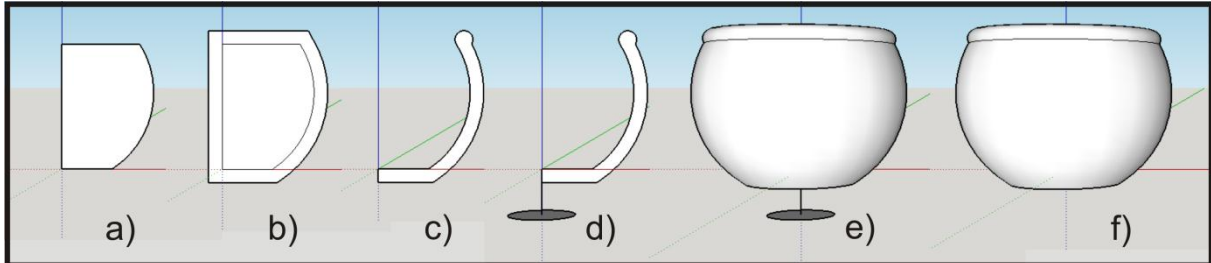
Use the SketchUp program to make a 3D model of a tea cup.

- The cup will be rounded, but it must be possible to drink out of it.
- The cup will have an ear to hold it.

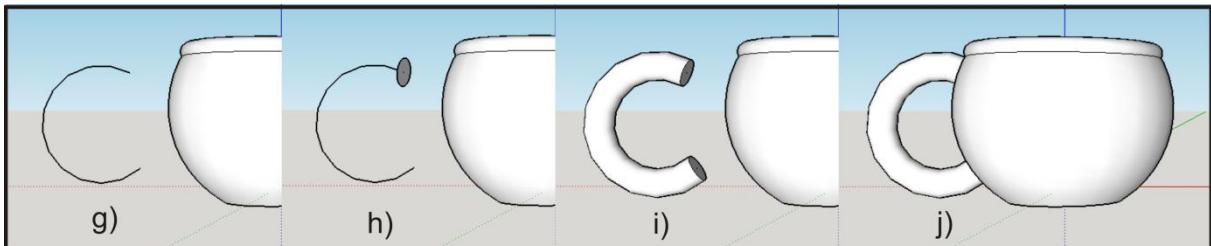
Instructions

- Make a shape of a cup wall (function *Line*, *2 Point Arc*).
- Use the function *Offset* to create a cup wall.
- Erase the unnecessary lines and parts of the object.

- d) Make a supporting circle (function **Circle**) in the axe of the future cup (cannot touch the area of the object).
- e) Use the function **Follow Me** to drag the vase wall along the supporting circle.
- f) Erase the supporting lines and objects.



- g) Make a curve to form the ear shape (function **Line**, **2 Point Arc**, **Freehand**).
- h) Create a 2D object connected to the ear curve which will design the cross-sectional shape of the ear (function **Circle**, **Line**, **2 Point Arc**).
- i) Use the function **Follow Me** to drag the 2D object along the ear curve.
- j) Connect the finish ear to the cup (function **Move**).



HOUSE

Task

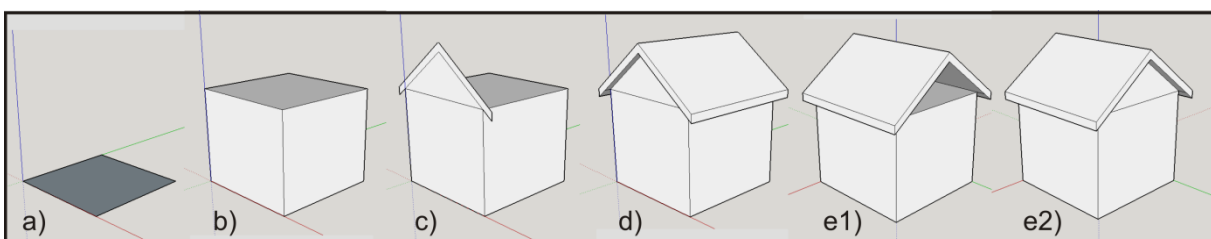
Use the SketchUp program to make a 3D model of a family house.

- The house will have all its parts, which are usual for a family house, like windows, doors, a chimney, a roof and two other parts as you wish.

Instruction

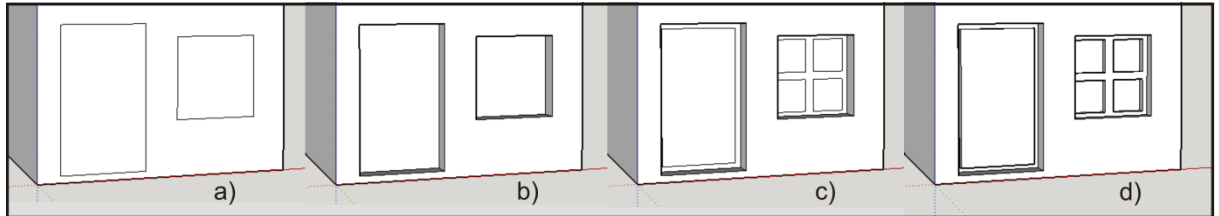
Body of the house

- a) Make a plan view of the house (function **Line** or **Rectangle**). Estimate its dimensions or use a scale (bottom right corner).
- b) Drag the view to create the main body of the house (functions **Push/Pull**).
- c) Make a roof profile (function **Line**).
- d) Eject the profile to create the house roof (function **Push/Pull**).
- e) Close the attic area under the roof from the back by using the (**Line**).



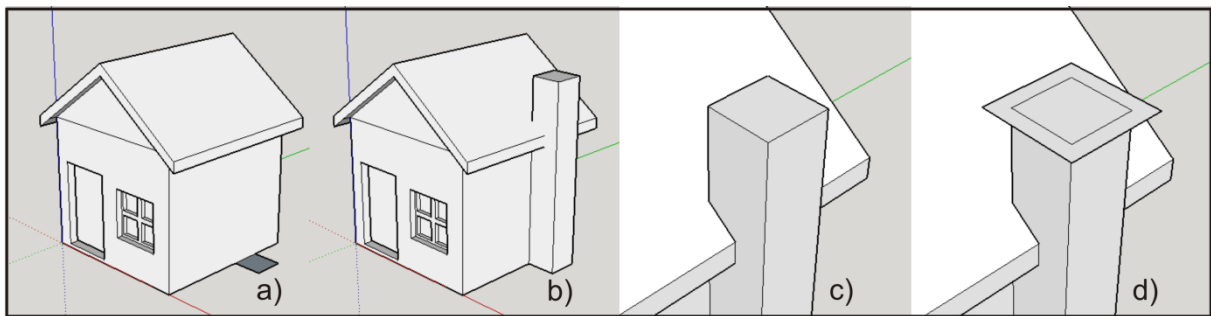
Door and windows

- Create a compartment proposal (holes in the wall) to insert windows and door (function *Line* or *Rectangle*).
- Push to form the window and door space (function *Push/Pull*).
- Draw a frame for windows and the door into the formed space.
- Pull the frames of windows and the door.

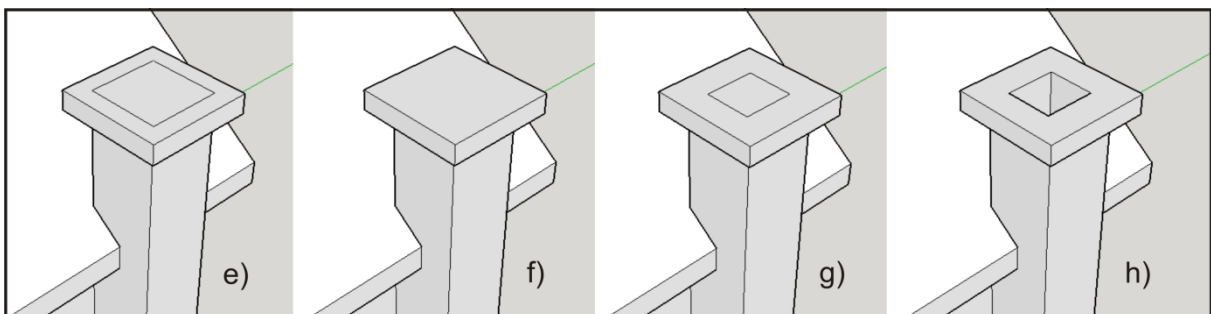


Chimney

- Make a chimney plan on a suitable place (by the wall) (function *Line* or *Rectangle*).
- Eject the chimney plan through the roof (function *Push/Pull*).
- Mark the intersection of the roof and the chimney (function *Line*).
- Draw an extension of the chimney on the top of the roof (function *Line* or *Rectangle*).



- Pull the extension (function *Push/Pull*).
- Erase the unnecessary lines.
- Draw a chimney flue (functions *Line* or *Rectangle*).
- Push the flue to finalize the chimney (function *Push/Pull*).



MATCH BOX

Task

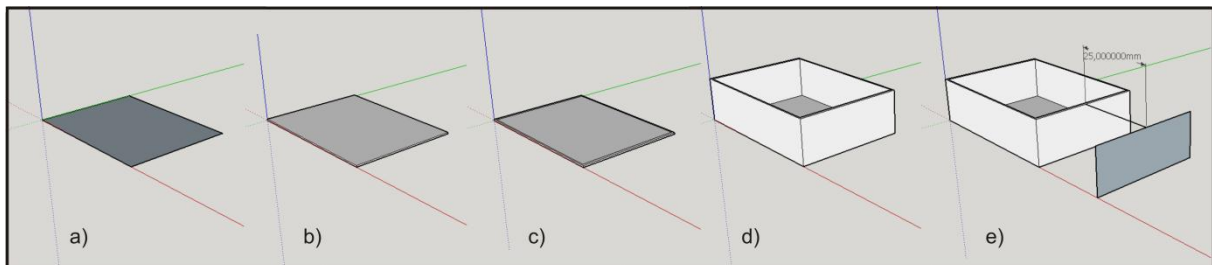
Use the SketchUp program to make a 3D model of a match box.

- Make the model exactly according to the given:
 - the inner part of the box 14 x 34 x 50 (mm);
 - the outer part of the box (package) 15 x 35 x 50 (mm);

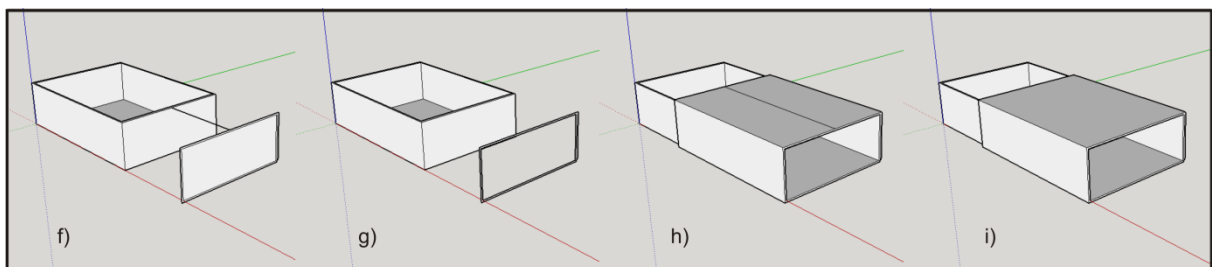
- depth of walls 0,5 (mm).
- Place the half of the inner part into the package.
- Bonus task: Review the match box model and alter it so that it is more similar to a real match box.

Instructions

- Create a stand for the inner part (function **Line**, **Offset** or **Rectangle**). Use a scale to insert the dimensions (record: 34;50).
- Eject the stand to form the bottom of the box (function **Push/Pull**).
- Design the box walls on the plan view of the box (function **Line**, **Rectangle**, **Offset**).
- Eject the walls view (function **Push/Pull**) to finish the inner box.
- Create a rectangle with the dimension according to the shorter sides of the inner box (function **Line**, **Rectangle**, **Offset**) moved by 25 mm from the box wall (in the direction of the longer side of the box).



- Create the profile (cross section) of the inner and outer walls (function **Line**, **Offset** or **Rectangle**).
- Erase the unnecessary lines and the inner area of the outer box part.
- Eject the profile of the outer part of the box - packaging (function **Push/Pull**).
- Erase the unnecessary lines.



Worksheets – variant with material equipment

Remember While making models, which will be printed in a 3D printer, it is important to follow certain rules:

Model complexity

A model can be formed from more parts, but these parts need to fit together tightly. Even a small space on a wrong place may cause huge issues.

Watch out the sizes

Every printer has limitations for printing out models. Make sure you create a model to fit into the printer.

Respect the resolution

A model with many details could look really nice, but it is probable that the 3D printer will not manage its printing. If you wish to print your models out, avoid designing of small details (1-2 mm).

Printing in the air is not possible

Most of printers cannot print anything what is too steep (e.g. stretched arms of a figure, a tree branch etc.) If you need to create something like that, rather ask your teacher for advice how to proceed.

HANGER/EARRING

Task

Use the SketchUp program to make a 3D model of your own hanger or earring.

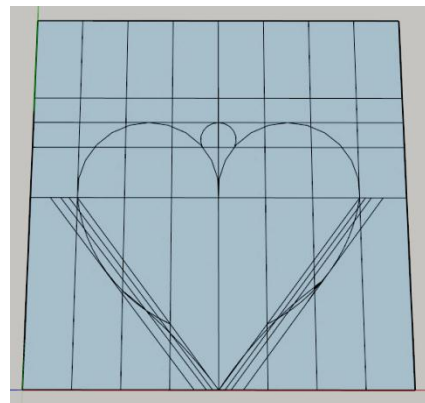
- A hanger or earrings can have a form of any “flat” shape, which comes into your mind. E.g. a star, a heart, a moon, a coat of arms, ...
- Do not forget a loop to hang it.
- Make an accurate model:
 - The individual model parts must run consecutively;
 - Use a scale to set up the individual dimensions;
 - *The model dimensions: max length 50 (mm), width 50 (mm) and thickness 25 (mm).*
- You can paint a printed product by model paints, glue flitters on it or decorate it differently.

Suggestion



Solution tip

It is complicated and time demanding to make more interesting shapes, therefore you can create a supporting network first. Use the auto snap in the middle, at the end and in the intersections of lines to prepare the network.



KEY CASE

Task

Use the SketchUp program to make a 3D model of your own key case.

- The key case would carry your name, use 3D letters.
- Do not forget “a loop” for hanging it.

- Make an accurate model:
 - The individual model parts must run consecutively;
 - Use a scale to set up the individual dimensions;
 - *The model dimensions: max length 70 (mm), width 20 (mm) and thickness 25 (mm).*
- Bonus task: you can improve your key case by designing your own symbol to it.

Suggestion



CHESS FIGURES

Task

Use the SketchUp program to make a 3D model of a chess figure. Print the best designed figures out. Keep the chess set for the class.

- Keep the figure in the similar shape like a real figure.
- The model dimensions should be more or less the same like a real figure.

Suggestion



Solution tips

Remember how you designed a peg for the “Člověče, nezlob se” (Sorry!) game. Creation of chess figures is very similar to that.

