
Image courtesy of Pawel Rymsza

TWINMOTION:
DESIGNING A TINY HOUSE

LESSON PLAN

DESIGN

GRADES 9–11

TWO 75-MINUTE BLOCKS OR FOUR 40-MINUTE CLASS PERIODS

SIMPLICITY IS THE ULTIMATE SOPHISTICATION

Embracing simplicity, freedom, and sustainability, the Tiny House Movement is about finding housing to fit your lifestyle. It's not only about decluttering your home and space, but also decluttering your obligations, your social life, and your stress.

When you live in a tiny house, you live in such a small space that you have to get out in the world to do your living in places other than your home!

Environment and Landscaping study by Black Pixel 3D Modelling and Visualisation

Students will design a tiny house using a 3D CAD software of choice and Twinmotion. In the process, students will:

- Learn about design sketching to develop original designs
- Incorporate 2D & 3D CAD modeling to formalize final designs
- Use Twinmotion to transform 3D CAD models into a *walkthrough animation*
- Demonstrate an understanding of architectural design, drafting, and drawing principles
- Develop and test hypotheses while engaging in the iterative design process.

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Courtesy of Arch. Reynaldo Acevedo
(RAS Arquitectura)

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LESSON INFORMATION

Lesson Title: Designing a Tiny House
Content/Grade: Architecture, Art or Computer Graphics/Grade 12
Lesson Timeframe: 3–4 weeks (75-minute class period daily)

AUTHOR CONTACT

Author, Organization/Role: Mike Santolupo, John Paul II Secondary School/Teacher
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DESCRIPTION OF CLASS/LEARNING ENVIRONMENT

Architectural Design—This class is designed as a project-based and student-centered learning environment that empowers students to gain knowledge and skills by exploring, investigating, and responding to the challenge at hand. Classrooms are equipped with workstations and computers for every student.

LESSON OVERVIEW

Why Join the Tiny House Movement?

To those who haven't tried tiny-house living, it may seem daunting. Why would someone choose to live in a small space? "Bigger is better," right?

It turns out there are many merits to the tiny-home movement and the tiny-life philosophy. Of course, people may join the movement for any number of reasons, but the most popular reasons include environmental concerns, financial concerns, and the desire for more time and freedom. Students will design a tiny house using a 3D CAD software of choice and Twinmotion. In the process, students will:

- Learn about architectural sketching to develop original designs
- Incorporate 2D & 3D CAD modelling to formalize final designs
- UseTwinmotion to transform CAD models into a walkthrough animation
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DESIRED RESULTS

ESSENTIAL QUESTIONS/BIG IDEAS

- How did the Tiny-House Movement begin?
- What are the environmental benefits of living in a tiny home?
- Why is the layout of the floor plan so important?
- How does Twinmotion enhance the final design?

LEARNING OUTCOMES/OBJECTIVES

The student will be able to:

- Identify and apply the steps in the design process
- Gather and apply information pertinent to design planning
- Plan and organize the project
- Create concept and scaled sketches of floor plan ideas
- Use appropriate design tools to create CAD drawings
- Produce an architectural walkthrough with Twinmotion
- Report and reflect on their experience with the design process using a suitable oral and/or written format

LESSON PLAN

DESIGN PROCESS

Inspiration	Identify a problem or opportunity.
Research	Analyze the problem or opportunity, and gain an understanding of the requirements and constraints.
Concept	Generate ideas that may solve the problem. Choose the best solution to develop further.
Development	Search for formal characteristics.
Formalization	Create models and prototypes, and an architectural walkthrough. Improve and refine these through multiple iterations.

PROJECT DESIGN BRIEF

Objective: Design a Tiny House

Your tiny house design must include the follow criteria:

INTERIOR FEATURES	SPECIFICATIONS
Size	300 square feet (maximum)
Kitchen	Stove top, sink, refrigerator, table for two
Seating area	For two (minimum)
Bathroom	Toilet, sink, shower (tub is optional)
Storage	Indoor & outdoor
Bedroom	One (maximum) Loft is optional
EXTERIOR FEATURES	
Decking/patio	
Green roof	
Solar panels	

CONCEPT SKETCHES

- You should have a minimum of 10–15 sketches of possible designs.
    - These can be completed in pencil or marker (not pen).
- Color the sketch that is chosen for your final design.
    - The colors in the sketch should reflect the final design as much as possible, including the actual materials, such as Wood/Plastics/Metals.
    - Use markers or pencil crayons.
- Concept sketches are not drawn to scale.
- Include any notes of functions or features not evident by the sketch.
- Concept sketches are drawn freehand.

SCALED FLOOR PLAN SKETCHES

- All scaled floor plan sketches are to be completed on graph paper (supplied).
- Each scaled sketch will be drawn at ¼ in. = 1 ft. scale.
- Scale, set square, circle/ellipse templates, French curve and compass should be used to produce an accurate and precise floor plan sketch.
- The sketches should also include the overall dimensions.
- Scaled sketches are produced in pencil only.

2D/3D CAD

Working from their scaled sketches, students will generate a floor plan using CAD software. They will use the floor plan to create a fully 3d CAD Drawing.

The 3D CAD model will be imported into Twinmotion. From here, students will select background (environment), and materials for the specific components of the model. Prior to creating the walk-through, the students will be able to make adjustments to lighting and shadowing. To determine and create the path of the walkthrough, students can move the camera and select image clips.

CREATING A WALKTHROUGH WITH TWINMOTION

Definition

A 3D architectural walkthrough is superior to static 3D rendering when it comes to presenting projects. Animation in general opens a lot of possibilities for selling ideas, and the better toolset you have to work with to impress clients, the more impact your project will have.

Walkthrough Objectives

In general, a walkthrough has one or two broad objectives: to familiarize the viewer with your overall design, and to gain feedback regarding any of your design elements. Your walkthrough, which will begin with the exterior, then transition into the interior, must consider the following:

Exterior Features

- Begin with a perspective of the exterior of your tiny-house design.
- Create a path that leads the viewer around the exterior of the design.
- Consider highlighting exterior features particular to your design.
- Consider a means of entering into the house, such as a front door.

Interior Features

- Continue with a perspective of the interior of your tiny-house design.
- Create a path that leads the viewer around the interior of the design.
- Consider highlighting the designated areas and features of your interior layout.
- Consider a means of exiting the house to complete the walkthrough.

Twinmotion Learning Resources

https://www.unrealengine.com/en-US/blog/twinmotion-community-free-training-on-real-time-rendering-for-archviz

https://www.youtube.com/watch?v=8r8uvKPeM4o

https://www.youtube.com/watch?v=ZGg7Xsdh4xo

FINAL REPORT

Students are required to write a final report on their project work. The report will focus on the design process as experienced by each student.

The report is to be written in proper sentence and paragraph format, and written in third person. Because of the technical nature of this report, use proper terminology.

List and explain all the major steps required to design a tiny home, produce CAD drawings, and create a series of rendered images. In your report, be sure to address the following:

- Architectural concept sketches
- Floor plan sketches
- 2D CAD floor plan
- 3D CAD drawing
- Twinmotion walkthrough animation

Include images of your drawings in your report to help illustrate the process. Prepare a title page that includes the following information:

- Project
- Submitted by
- Submitted to
- Course and Course Code
- Date

Respond to the following reflection questions at the end of your report:

- Are there aspects of the tiny house that you would change or re-design?
- Predict a tiny house design of the future.
- Identify and explain the aspect of the project you enjoyed most, and the aspect you found most difficult.

EXTERNAL RESOURCES

Designing a Tiny House—15 Questions to Consider
https://www.livesmallbemore.blog/designing-a-tiny-house-15-questions-to-consider/

How to Draw a Tiny House Using SketchUp
https://www.youtube.com/watch?v=nir6Qk_sSrw

How to Draw a Tiny House from Scratch Using SketchUp
https://www.youtube.com/watch?v=_o_QqNshfSQ

18-Year-Old Designs and Builds Tiny House
https://tinyhousetalk.com/check-18-year-olds-mortgage-free-tiny-house/

ASSESSMENT

RUBRIC

Designing a Tiny House—Creating a Walkthrough

CRITERIA	LEVEL 1 (50-59%)	LEVEL 2 (60-69%)	LEVEL 3 (70-79%)	LEVEL 4 (80-100%)
Knowledge/ understanding walkthrough objectives	Demonstrates limited understanding of walkthrough objectives	Demonstrates some understanding of walkthrough objectives	Demonstrates considerable understanding of walkthrough objectives	Demonstrates high degree of understanding of walkthrough objectives
Thinking Creating a walkthrough animation that includes exterior and interior features	Uses thinking skills with limited effectiveness	Uses thinking skills with some effectiveness	Uses thinking skills with considerable effectiveness	Uses thinking skills with a high degree of effectiveness
Communication Use of materials, textures and colors to enhance walkthrough	Communicates the overall appearance with limited effectiveness	Communicates the overall appearance with some effectiveness	Communicates the overall appearance with considerable effectiveness	Communicates the overall appearance with a high degree of effectiveness
Application Use of *Twinmotion*	Demonstrates limited level of ability using *Twinmotion*. Follows a set of directions to complete walkthrough, but does not explore new ways to enhance design.	Demonstrates some level of ability using *Twinmotion*. Walkthrough is original, but mostly based off existing requirements.	Demonstrates considerable level of ability using *Twinmotion*. Walkthrough is explored and expressed in an original way.	Demonstrates a high degree of ability using *Twinmotion*. Walkthrough is clearly explored and expressed in multiple ideas and unique ways.

STANDARDS MAPPING

ISTE STANDARDS

3 Knowledge Constructor

3a Students plan and employ effective research strategies to locate information and other resources for their intellectual or creative pursuits.

4 Innovative Designer

4a Students know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts or solving authentic problems.

4b Students select and use digital tools to plan and manage a design process that considers design constraints and calculated risks.

6 Creative Communicator

6c Students communicate complex ideas clearly and effectively by creating or using a variety of digital objects such as visualizations, models or simulations.

ONTARIO CURRICULUM, GRADE 12 TECHNOLOGICAL EDUCATION

A3 Demonstrate an understanding of drafting standards, drawing types, conventions, and guidelines used when representing design ideas graphically.

B4 Use a variety of formats and tools to create and present reports summarizing and evaluating design process, to analyse decisions made during the process, and to advocate the final design.

D2 Compare a variety of careers related to technological design, as well as the training and educational requirements for them, and maintain a portfolio of their work as evidence of their qualifications for future education and employment.

INTERDISCIPLINARY AND 21ST CENTURY CONNECTIONS

This lesson covers areas related to engineering, science, and multimedia design. This lesson integrates all areas of STEM / STEAM.
21st Century Connections:

1. Critical thinking
2. Creativity
3. Collaboration
4. Communication
5. Technology literacy
6. Flexibility
7. Leadership
8. Initiative
9. Social skills

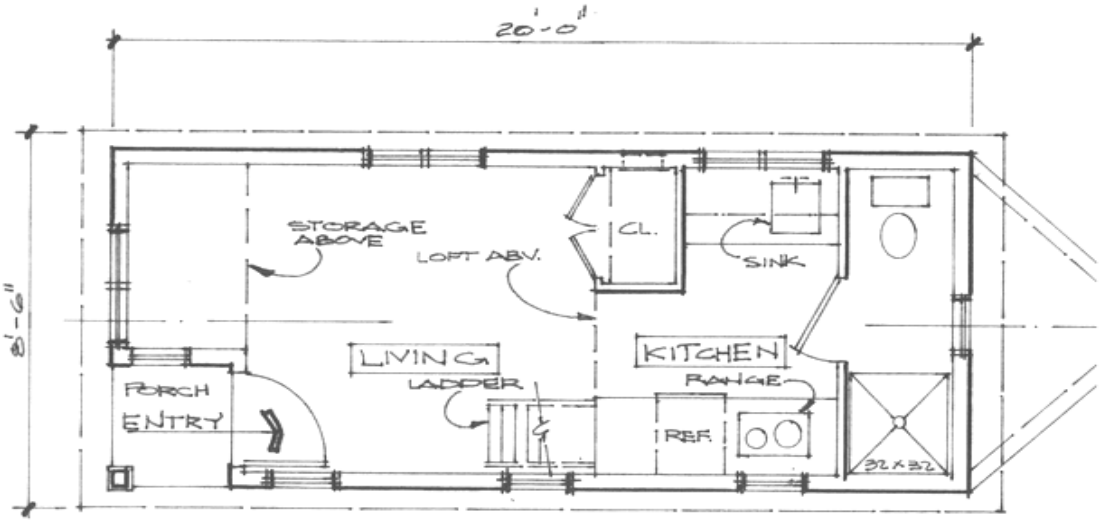
MODIFICATIONS AND ACCOMMODATIONS

Accommodations do not change the content of the learning expectations, but they should take into account the student's preferred learning modality and areas of strength and need, and should provide students with appropriate opportunities to demonstrate their learning. Some accommodations may include modifying the project requirements, replacing the computer design component with pencil drawings, providing a quiet work space, having a tutor or a teacher assistant facilitate project work, and scribing and recording the student's verbatim responses should be considered.

Additional Teaching Materials

Include other teaching materials as separate documents (handouts, and so on).

Handout One: Tiny House Floor Plan Example



Handout Two: Twinmotion Shortcuts

Twinmotion®
Shortcuts

MOVES		
Move forward	W	W
Move backward	S	S
Move left	A	A
Move right	D	D
Elevation up	Q	Q
Elevation down	E	E
Sprint	alt + Mvmt	⇧ + Mvmt
Slow	ctrl + Mvmt	alt + Mvmt

SPEED		
Walk speed	1	1
Bicycle speed	2	2
Drive speed	3	3

TOOLS		
Translate	4	
Rotate	5	
Scale	6	
Next transform	→|	
Zoom to selection	F	
Show/Hide helper	G	
Material picker	T	
Hide/Unhide	H	

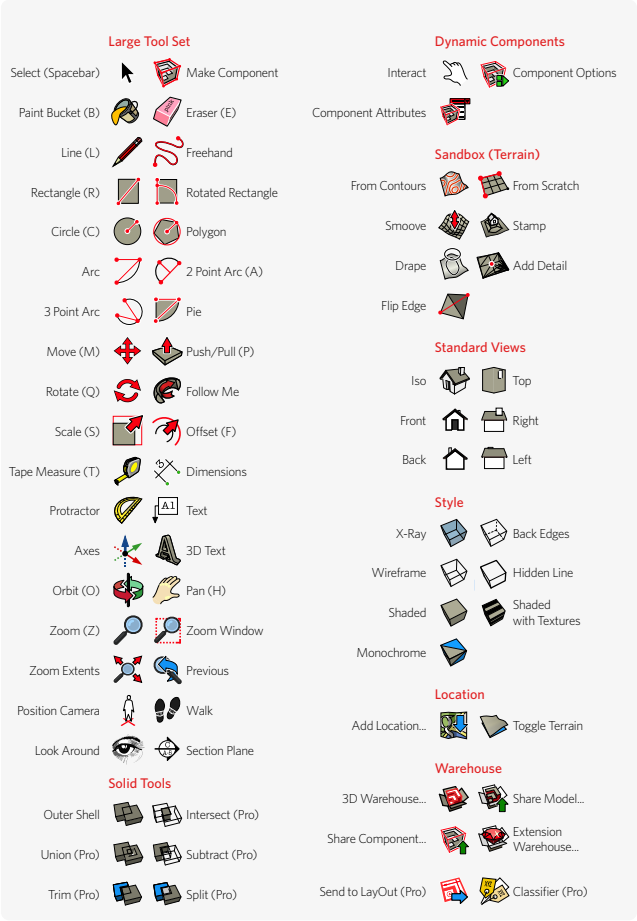
OTHERS		
Screenshot	F9	F9
BIMmotion VR	F10	F10
Full screen	ctrl + ⌘ + F	F11
BIMmotion	F12	F12
Pedestrian mode	M	M

FILE		
New project	⌘ + N	ctrl + N
Select all	⌘ + A	ctrl + A
Undo	⌘ + Z	ctrl + Z
Redo	⌘ + Y	ctrl + Y
Save	⌘ + S	ctrl + S
Save as	⌘ + ⇧ + S	ctrl + ⇧ + S
Duplicate	⇧ + move object	⇧ + move object
Copy	⌘ + C	ctrl + C
Paste	⌘ + V	ctrl + V
Delete	⌘ + ←	delete
Open	⌘ + O	ctrl + O
Merge	⌘ + M	ctrl + M
Rename		F2
Preferences	⌘ + P	ctrl + P
Import	⌘ + I	ctrl + I
File menu	B	B

Handout 3: 2020 SketchUp Reference Card

SketchUp Pro Quick Reference Card | Windows

SketchUp 2020



Middle Button (Wheel)

Scroll	Zoom
Click-Drag	Orbit
Shift+Click-Drag	Pan
Double-Click	re-center view

Tool	Operation	Instructions
2 Point Arc (A)	Bulge	specify bulge amount by typing a number and Enter
	Radius	specify radius by typing a number, the R key, and Enter
	Segments	specify number of segments by typing a number, the S key, and Enter
Circle (C)	Shift	lock current inferences
	Radius	specify radius by typing a number and Enter
	Segments	specify number of segments by typing a number, the S key, and Enter
Eraser (E)	Ctrl	soften/smooth (use on edges to make adjacent faces appear curved)
	Shift	hide
	Ctrl+Shift	unsoften/unsmooth
Follow Me	Alt	use face perimeter as extrusion path
	Expert Tip!	first Select path, then choose the Follow Me tool, then click on the face to extrude
Line (L)	Shift	lock in current inference direction
	Arrows	lock direction; up = blue, right = red, left = green, and down = parallel/perpendicular
	Length	specify length by typing a number and Enter
Look Around	Eye Height	specify eye height by typing a number and Enter
Move (M)	Ctrl	move a copy
	Shift	hold down to lock in current inference direction
	Alt	auto-fold (allow move even if it means adding extra edges and faces)
	Arrows	lock direction; up = blue, right = red, left = green, and down = parallel/perpendicular
	Distance	specify move distance by typing a number and Enter
	External Copy Array	n copies in a row: move first copy, type a number, the X key, and Enter
	Internal Copy Array	n copies in between: move first copy, type a number, the / key, and Enter
Offset (F)	Alt	allow results to overlap
	Distance	specify an offset distance by typing a number and Enter
Orbit (O)	Ctrl	hold down to disable "gravity-weighted" orbiting
	Shift	hold down to activate Pan tool
Paint Bucket (B)	Ctrl	fill material – paint all matching adjacent faces
	Shift	replace material – paint all matching faces in the model
	Ctrl+Shift	replace material on object - paint all matching faces on the same object
	Alt	hold down to sample material
Push/Pull (P)	Ctrl	push/pull a copy of the face (leaving the original face in place)
	Double-Click	apply last push/pull amount to this face
	Distance	specify a push/pull amount by typing a number and Enter
Rectangle (R)	Ctrl	start drawing from center
	Dimensions	specify dimensions by typing length, width and Enter ie. `20,40`
Rotated Rectangle	Shift	lock in current direction/plane
	Alt	lock drawing plane for first edge (after first click)
	Dimensions, Angle	click to place first two corners, then type width, angle and Enter ie. `90,20`
Rotate (Q)	Ctrl	rotate a copy
	Angle	specify an angle by typing a number and Enter
	Slope	specify an angle as a slope by typing a rise, a colon (:), a run, and Enter ie. `3:12`
Scale (S)	Ctrl	hold down to scale about center
	Shift	hold down to scale uniformly (don't distort)
	Amount	specify a scale factor by typing a number and Enter ie. `1.5` = 150%
	Length	specify a scale length by typing a number, a unit type, and Enter ie. `10m`
Select (Spacebar)	Ctrl	add to selection
	Shift	add/subtract from selection
	Ctrl+Shift	subtract from selection
Tape Measure (T)	Ctrl	toggle create guide or measure only
	Arrows	lock direction; up = blue, right = red, left = green, and down = parallel/perpendicular
	Resize	resize model: measure a distance, type intended size, and Enter
Zoom (Z)	Shift	hold down and click-drag mouse to change Field of View

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