



Lesson Plan

Module:	Filling vessels		
Teaching Hours:	60-90 minutes		
Grade Level/Age Range:	Grade 6-8		
Brief Description:	<p>In this module, students use real experiments and the GeoGebra applet "Filling Vessels" to investigate how the filling process differs in the graph for different vessels. Students investigate questions such as "Investigate why the water level in different vessels rises at different rates! How is the filling level related to the shape of the vessel?".</p> <p>The module is suitable for an introduction to functions. With the situation "Filling vessels" students learn about functional relationships of different quantities (filling quantity/ filling height) in a dynamic situation (filling process).</p> <p>The focus is on developing and promoting a qualitative understanding of functional relationships.</p> <p>There are two shortened versions (Version B & C) available. These include only real or only digital experiments. These versions should only be used if version A is not feasible.</p>		
Design Principles:	Inquiry		
	Situatedness		
	Digital tools		
	Embodiment		
Functional Thinking:	Input – Output		
	Covariation		
	Correspondence		
	Object		
Learning Goals:	See description		

Content:

- teacher guide
- PowerPoint presentation (PPP)
- Student handout (research booklet)

This material is provided by the [FunThink Team](#), responsible institution: Ludwigsburg University of Education.



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Useful information:

- Link GeoGebra "Filling vessels" (Version A): <https://www.geogebra.org/m/gbgazf5s>
- Link GeoGebra "Filling vessels" (Version C): <https://www.geogebra.org/m/urffdzd2>
- QR codes can be found in the PPP and in the researcher booklet. By scanning/photographing the QR code, students can access the corresponding GeoGebra application.
- Researcher's notebook: The memory box (research finding) can be glued on to the bottom of the first page.
- Materials needed for real experiments (version A & B):
 - o Various vessels
 - o Measuring rods
 - o Measuring cup (20ml)
 - o Water (colored with food coloring)
 - o Funnel
 - o Towels or paper towels

Lesson outline for the “Filling vessels” module

Section	Teacher	Students	Didactic-methodical comment	Material
<p>Introduction (10-15min)</p>	<p>On the table are three different vessels and three cups, each cup with an equal amount of water in it. Each vessel is filled with the water from the cup.</p> <p>Why are there differences in the water level? Isn't there the same amount of water in all vessels? How could the filling level and the filling quantity be related? How can you display the connection?</p> <p>Slide with 3 vessels and multiple graphs. Which vessel belongs to which graph? → Collect ideas, solution at the end of the lesson</p>	<p>Students observe</p> <p>Students express their thoughts.</p>	<p>Whole class</p> <p>Confrontation with the phenomenon "filling level of vessels".</p> <p>First exploration of vessel shape, filling quantity & filling level of different vessels.</p>	<p>3 different vessels, cups, water</p> <p>PPP(2)</p>
<p>Introduction exploration / research assignment (5 min)</p>	<p>Teacher explains research assignment: "Today we are going to investigate how the filling quantity and the filling level are related and how we can represent the relationship with a graph".</p> <p>At the end, you can use your knowledge to answer the questions we just had a look at.</p> <p>Teacher hands out the researcher's booklet and asks the students to look at it briefly.</p>	<p>Students ask questions if necessary</p> <p>Students familiarize themselves with the researcher assignments.</p>	<p>Whole class</p> <p>Clarification of the research assignment</p> <p>Working methods in research (quiet,</p>	<p>Researcher's booklet (version A, B or C)</p>

	Finally, L briefly discusses working methods in research.		concentrated, accurate work, assume-observe-justify results)	
Exploration / research phase (Time variable, depending on the variant used)	Teacher explains: "Now you have XX minutes to complete these research assignments. Pay attention to the time!" Teacher observes and provides assistance during experimentation (e.g., pointing out funnel when pouring water from vessel back into bottle).	Students work on the research assignments	Group or partner work Real experiment & simulation Time required varies depending on the version used: Version A: 50 min Version B: 30 min Version C: 20 min	Materials for experiment, tablets QR code Variant A: PPP(3) QR code variant C: PPP(4) Note Research booklet Variant A: Research assignment 4 is optional.
Structuring & organizing knowledge (15-20 min)	Teacher discusses the findings and supports them up with the help of the "filling vessels" memory box. You have used the research assignments to explore the relationship between the filling quantity and the filling level for different containers. Now let's take another look at the containers from the beginning of the lesson. Which graph belongs to which vessel? If we now want to know in which vessel (at the same filling level) there is the most water, how can we see this in the graph?	Students complete the memory box "Filling vessels" (and glue it on the first page of the research booklet).	Whole class Structuring and securing research findings	PPP (5-6) Memory box Filling vessels PPP(7)
Checking (5 min)	L shows 2 items for interpreting graphs.	Students solve the tasks	Whole class	PPP (8-9)

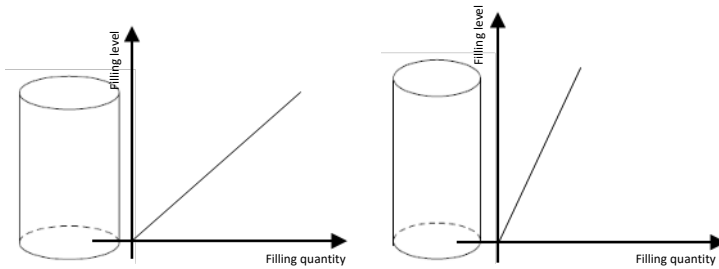
Memory box:

Research finding "Filling vessels"

If I pour a certain amount of water (first size) into a vessel, the water has a corresponding filling level (second size). If the first size changes, the second size also changes.

The filling level varies depending on the filling quantity and the shape of the vessel:

Vessels and corresponding graphs

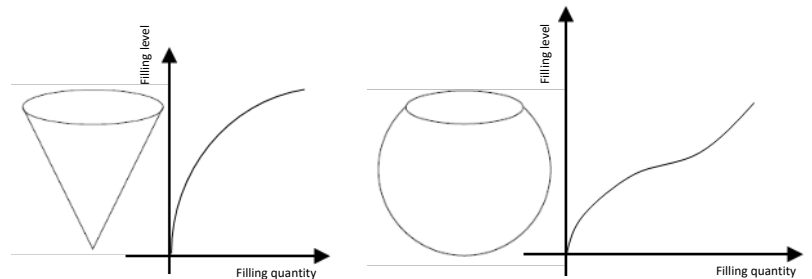


With increasing width of the vessel, the vessel fills slower and the corresponding graph is flatter.

If the shape of the vessel changes, the graph also changes.

The faster the filling level changes, the narrower the vessel is in this area.

The corresponding graph runs steeper.

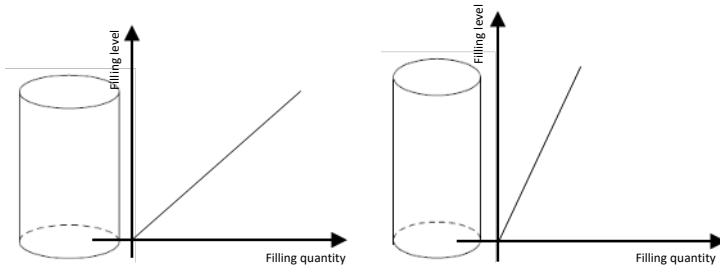


Research finding "Filling vessels"

If I pour a certain amount of water (first size) into a vessel, the water has a corresponding filling level (second size). If the first size changes, the second size also changes.

The filling level varies depending on the filling quantity and the shape of the vessel:

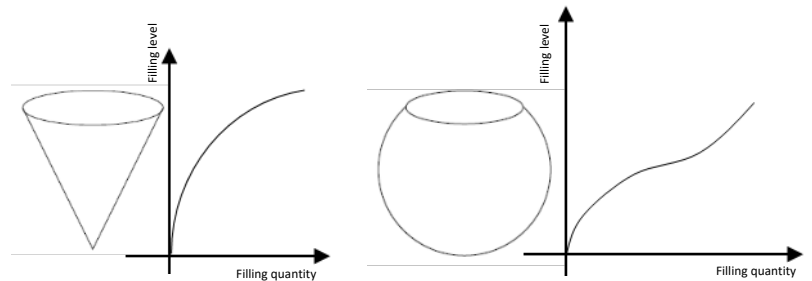
Vessels and corresponding graphs



With increasing width of the vessel, the vessel fills _____ and the corresponding graph is _____.

If the shape of the vessel changes, the graph also changes.

The faster the filling level changes, the - _____ the vessel is in this area. The corresponding graph runs _____.

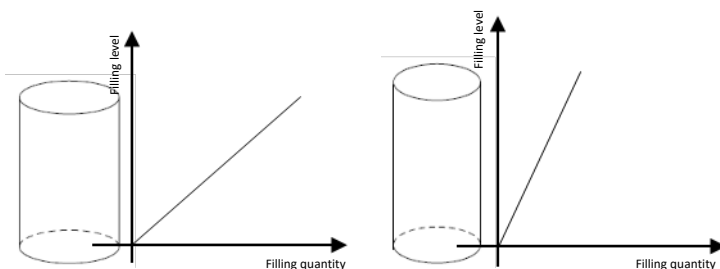


Research finding "Filling vessels"

If I pour a certain amount of water (first size) into a vessel, the water has a corresponding filling level (second size). If the first size changes, the second size also changes.

The filling level varies depending on the filling quantity and the shape of the vessel:

Vessels and corresponding graphs



With increasing width of the vessel, the vessel fills _____ and the corresponding graph is _____.

If the shape of the vessel changes, the graph also changes.

The faster the filling level changes, the - _____ the vessel is in this area. The corresponding graph runs _____.

