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“INNOMATH - Innovative enriching education processes for Mathematically Gifted Students in Europe”

Project Number: 2019-1-DE03-KA201- 059604

Title of Content: Module 2 – Inquiry Based Learning

Presenter: Christian Mercat (University Claude Bernard Lyon 1)

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Inquiry Based Learning

Topic

Derivation of volume growth with respect to enlargement

Target group

Students at grade 7

Topic

Ratio and continued fractions

Target group

Students at grade 9

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Inquiry Based Learning

Content requirement

Basic measurement, the concepts of length, area, volume, capacity

Steps and contents

STEP 0: Introduction

STEP 1: Simple volumes growth

STEP 2: Modelling of any volume growth

STEP 3: Finding a formula for the tetrahedron

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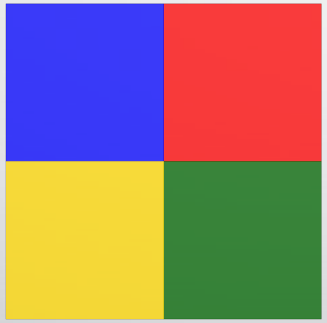
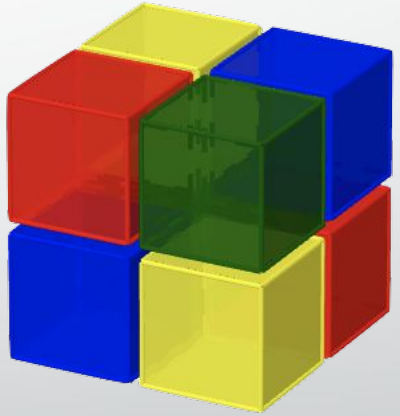
Inquiry Based Learning

STEP 0: Introduction





Area

Cuboid Volume

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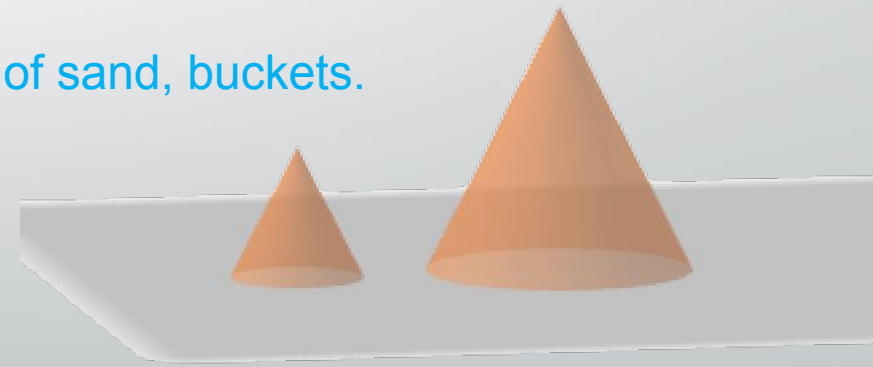
Inquiry Based Learning

STEP 1: Simple volume growth

- Objective: Students discover that the volume increases by a factor 8 when the size of a volume is doubled. Then they infer that the enlargement by a factor λ of a simple volume (cuboid, cone, pyramid, cylinder) leads to its growth by a factor $\lambda \times \lambda \times \lambda = \lambda^3$.

- Materials: - worksheet page 1
  - strong paper (cardboard), scissors and tape, 3 liters of sand, buckets.
- Processing time: approx. 75 min



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Inquiry Based Learning

STEP 2: Volume growth of any shape

- Objective: Students try out their hypothesis on other shapes, especially the sphere.
- Materials: - worksheet page 2
  - Digital camera (smartphone) or projection screen
  - Inflatable balloons, water, buckets.

- Processing time: approx. 30 min

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Inquiry Based Learning

STEP 3: The volume of the tetrahedron

- Objective: Students construct an origami model of tetrahedra and octahedra. Solve a little 3D puzzle for doubling the tetrahedron with these pieces. Infer that a certain cube, of size $\sqrt{2}$ a contains 24 tetrahedra of size a, infer the volume of a tetrahedron: $(\sqrt{2}\ a)^3/24$.

- Materials: - worksheet page 3
  - geogebra book
  - paper

- Processing time: approx. 75 min

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Inquiry Based Learning

REFLECTION

Summary for modelling the growth of a volume

TASK: Describe in your own words what you have learned from this learning module.

CONTRIBUTION:

- written form as text
- auditorily as a voice message
- visually as a graphic
- audio-visually as a video

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Inquiry Based Learning

Content requirement

Ratio and continued fractions

Steps and contents

STEP 0: Introduction

STEP 1: The A4 paper

STEP 2: Continued fraction of square roots

STEP 3: Finding a formula for the volume of the tetrahedron

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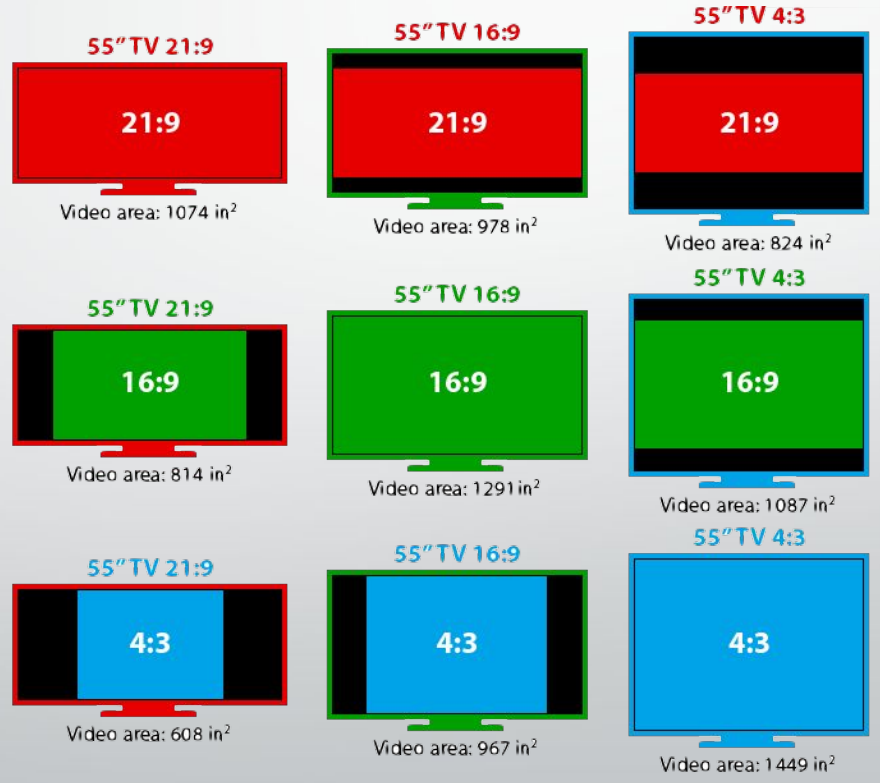
Inquiry Based Learning

STEP 0: Introduction



Ratio

Format

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Inquiry Based Learning

STEP 1: The A4 paper

- Objective: Students discover what is the ratio of the A4 paper: Two A4 papers side by side make an A3 paper of the same format. The scaling factor *and* the ratio is $\sqrt{2}$.

- Materials: - worksheet page 1
  - A4 paper.
- Processing time: approx. 30 min

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Inquiry Based Learning

STEP 2: Square roots of integers and continued fractions

- Objective: Students fold paper to understand the continued fractions algorithm and what it means for square roots of integers.
- Materials: - worksheet page 2
  - A4 paper
  - Geogebra applet 1 and geogebra applet 2

- Processing time: approx. 75 min

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Inquiry Based Learning

STEP 3: The volume of the tetrahedron

- Objective: Students construct an origami model of tetrahedra and octahedra with the help of the √3 paper format. Solve a little 3D puzzle for doubling the tetrahedron with these pieces. Infer that a certain cube, of size √2 a contains 24 tetrahedra of size a, infer the volume of a tetrahedron: $(\sqrt{2}\,a)^3/24$.

- Materials: - worksheet page 3
  - geogebra applet
  - paper

- Processing time: approx. 75 min

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Inquiry Based Learning

REFLECTION

Summary for modelling the growth of a volume

TASK: Describe in your own words what you have learned from this learning module.

CONTRIBUTION:

- written form as text
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INNOMATH Consortium

Volkshochschule Schrobenhausen

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