

Should this be in the Guinness Book of Records?

Secondary: (ages 11 – 14)

Mathematics

Students become acquainted with artistic works made of unusual materials and take on the role of experts that evaluate entries for the Guinness Book of Records. They explore how artists work on their projects, and what parameters experts use to decide whether an unusual work of art should be included in the Guinness Book of Records.

Time allocation About 3 lesson periods

Subject content Problem solving
Arithmetic and forming and solving operations

Creative and critical thinking This unit has a **creativity** and **critical thinking** focus:

- Make connections between maths concepts
- Generate and play with unusual ideas to envision how to solve a maths problem meaningfully
- Reflect on strengths and weaknesses and chosen approach relative to possible alternatives

Other skills Communication, Collaboration, Persistence/Perseverance

Key words arithmetic; division; multiplication; area; experts; art; material; quantities

Products and processes to assess

Students need to propose and answer mathematical operations in order to solve a series of problems about how experts evaluate works for the Guinness Book of Records. In addition to producing correct calculations, at the highest levels of achievement, they are willing to explore and challenge a number of ideas and see connections between maths concepts and apply them well. They justify their position with good evidence and show a good understanding of the strength and limitations of chosen positions. They are open to the ideas, critiques, or feedback of others when relevant.

Teaching and Learning plan

This plan suggests potential steps for implementing the activity. Teachers can introduce as many modifications as they see fit to adapt the activity to their teaching context.

Step	Duration	Teacher and student roles	Subject content	Creativity and critical thinking
1	Lesson period 1	Teacher explains that students will first get acquainted with some artistic works made of unusual materials. Imagine that you are participating as an expert in the selection of works for the Guinness Book of Records. Today during the math lesson you'll get acquainted with how artists work on their projects, and what parameters experts use to decide whether a piece of unusual work can be included the Guinness Book of Records.	Introduction to activity	
2		<p>Students divide themselves into groups of 4-5 and get acquainted with the information resources. They then need to:</p> <ul style="list-style-type: none"> • Search for information to answer the question in task 1.1. Students will look for the required data using the internet. • Fill the gaps in the group worksheet (3 - 5 min). <p>Teacher observes the work and keeps track in "the Observation sheet" of students' actions, organization and progress in work.</p> <p>After each stage of work, the teacher may decide to facilitate a reflective discussion on what the students have done, and how they had to use creative and critical thought to help them achieve this.</p>	Creating and solving calculations	<p>Making connections between different concepts</p> <p>Generating and playing with unusual and radical ideas when approaching a maths problem</p> <p>Reflecting on steps taken to pose and solve a maths problem</p>
3		<p>Students complete 2nd stage – define the average area size of one bean used in painting in square millimeters and the average weight of one bean in milligrams.</p> <p>They again need to fill the group worksheet (5 minutes) whilst teacher observes and keeps track of progress in "the observation sheet"</p> <p>Teacher tells students if you carried out calculations of the average size of one bean in square millimeters and average weight of one bean in milligrams, go on to the 4th stage. If you want to correct what you wrote, please cross it out and write again in the free space.</p>	Creating and solving calculations	<p>Posing and envisioning how to solve meaningfully a maths problem in a personally novel way</p> <p>Reflecting on steps taken</p>
4	This may extend into a second	Students do a 3 rd stage, carrying out calculations on how many times more material did Arkady Kim use than the Albanian artist. They fill in the group worksheet and can then start 4 th stage.	Creating and solving calculations	As above

lesson period			
5	<p>Students do 4th stage, working out recommendations that will simplify the evaluation of artistic works made of unusual materials and fill in the group worksheet.</p> <p>While going through this stage, students face a problem: to give recommendations they need to imagine that they are experts and plan a procedure of receiving necessary information concerning the painting. They have to take into account the data received from mathematical calculations from 1st and 2nd stages. Students fill in the group worksheet whilst teacher observes and supports as necessary.</p>	Creating and solving calculations	As above
6	Final lesson period Students present their results. Every group receives the opportunity to explain their work, way of measuring, results, recommendations and the strengths and limitations of those recommendations. Then the class chooses the most clear and logical recommendations that they think will simplify the evaluation of artistic works made of unusual materials.	Presenting their calculations and reasoning	<p>Explaining both strengths and limitations of different ways of posing and solving a maths problem</p> <p>Considering alternative perspectives and reflecting on chosen maths approach relative to alternatives</p>

Resources and examples for inspiration

Web and print

- Reference materials (information about the expert's work, photos)
- White paper (A3)

Other

- Grains or beans
- Projector, board, colored pens, paper, glue

Creativity and critical thinking rubric for mathematics

• Mapping of the different steps of the lesson plan against the OECD rubric to identify the creative and/or critical thinking skills the different parts of the lesson aim to develop

	CREATIVITY Coming up with new ideas and solutions	Steps	CRITICAL THINKING Questioning and evaluating ideas and solutions	Steps
INQUIRING	Make connections to other maths concepts or to ideas from other disciplines	2-6	Identify and question assumptions and generally accepted ways to pose or solve a maths problem	6
IMAGINING	Generate and play with several approaches to pose or solve a maths problem	2,5	Consider several perspectives on approaching a maths problem	2-6
DOING	Pose and envision how to solve meaningfully a maths problem in a personally novel way	3,4,5	Explain both strengths and limitations of different ways of posing or solving a math problem based on logical and possibly other criteria	6
REFLECTING	Reflect on steps taken to pose and solve a maths problem	6	Reflect on the chosen maths approach and solution relative to possible alternatives	6

TASK

The Guinness Book of Records tells us about interesting projects. Let's look at how we can use mathematics to understand the way famous masterpieces were created.

Task 1.1. The biggest painting made of coffee beans

On June 26, 2012 a new record for Guinness Book of Records was registered at Gorky Park in Russia – the biggest painting made of coffee beans by artist Arkady Kim.

Total area was 30 square meters.

Total number of coffee beans was about 10^6 .

The painting was measured by the chief editor of Russian Guinness Book of Records, Alexey Svistunov. The record is not for maximum area, but for the total weight and total number of coffee beans.

Define:

- a) The average area of one bean in square millimeters
- b) The average weight of one bean from the painting in milligrams

Task 1.2.

The previous record-holder of Guinness Book of Records was a citizen of Albania. The total weight of the beans in the painting was 309 pounds. The size of the painting was 25 square meters.

How many times more beans did Arkady use than the previous record-holder? (If we agree that both artists used beans with similar average size and weight).

Task 1.3.

The measurement of the different parameters of Arkady Kim's painting took 10 days. Imagine that you know the average size and weight of beans. How can we count the number of beans and weight of painting without it taking 10 days? Describe the way the expert will accomplish this task.

Task 1.4.¹

Try to make a small picture (A4) out of a material of your choice (e.g. rice, oats, buckwheat). This will help you understand how these contest works are made.

Reference materials



¹ The teacher can suggest students continue the creative task after the end of the lesson, as homework.

Stages of work

- 1) Search for information required to answer the questions in task 1.1.
- 2) Define the average area size of one bean used in the painting in square millimeters and average weight of one bean in milligrams.
- 3) Calculate: how many times more material did Arkady Kim use than the Albanian artist?
- 4) Make recommendations on how to use mathematics while examining artistic works made of unusual material.
- 5) Make a presentation of the project – fill the tables, distribute roles for presentation:
 - Who presents the project?
 - Who answers the questions about the project?
 - Who shows the calculations of required size and argues why they were done that way?
 - Who presents the results of the work?

General recommendations

- 1) Don't prepare students for the task. They shouldn't know in advance what they will do in the first and other stages.
- 2) Don't give instructions on how to do the task. Suggest deciding collaboratively in a group.
- 3) You may have to cheer students up and encourage them to persevere.

Sample structure of a group work

1. *Preparation* (while teacher is preparing for the lesson)
 - Set the goal,
 - Define the objectives of group work,
 - State general requirements on how to perform the task and present the results,
 - Divide the students into groups.
2. *Organization of group work in a class*
 - State the task and make sure that every student understands it
 - Give general instructions
 - Give examples of what material could be used
3. *Organization of group work*
 - Ensure you have a role in your group

- Realize that this particular part of work is yours
- Individual statement by every student that a particular part of the common task is his or hers (I have to do...)
- Individual work on the research part of the task
- Collaborative construction of problem-solving through solving different tasks
- Collaborative choice of the best way to present the solution (text, presentation, model of a situation)

4. *Presentation of results*

- Collaborative choice of a student who will present a solution
- Comments on the task
- Collaborative choice of a student who will prepare answers to the audience's questions while discussing the results

5. *Self-evaluation of individual and common solutions.*

6. *Results*

- Conclusions about mastering the main mathematical skills
- Conclusions about collaborative skills

Group worksheet

_____ (Names)

Stages 1 - 2

1. Read task 1. Use the internet or a reference book and find the data needed to count the average area size of one bean that was used in Arkady Kim's painting in square millimeters and average weight of one bean in milligrams.

Write down the required data: _____

2. Investigate the resulting size of the painting. Do the calculations.

Stage 3

1. Read task 2. Compare how many times more materials did Arkady Kim use than the Albanian artist.

Stage 4

