Growth

Summary

Age category
9 - 12 years
Topic
Algebra
Total duration
280 minutes

Students measure different body parts. They explore the differences in proportions between the body of children and adults. They design and create a costume for different age groups.

Problems to be tackled:

In the 9-12 age group, all children are aware of the changes to their body and growth, but the fact that this growth process is not proportional is not something they are usually aware of.

Depending on the age group, students could be in any of these situations: a) They have studied the life cycle and classification of living beings, etc. b) They have studied the human body, vital functions, etc.

- Can you design a costume for Halloween, Christmas, Carnival or other event and make it in all different sizes?
- What do you need? What do you have to do?
  If smaller siblings are involved or if the school includes infant education groups, the project is even more interesting due to the different sizes that will be involved.

Real context

Real world motivation

Juan is 12 years old. He has noticed that his trousers and the sleeves of his t-shirt are now short but are wide enough for him. Last week, he visited the paediatrician for a periodical medical examination and vaccines. As usual, the nurse weighed him and measured his height, but did not measure the perimeter of his head as he has seen the nurse do with babies. He is intrigued by all of this. Why are his clothes small in some measurements only? Why doesn't the nurse take the same measures for all ages?

Throughout a schoolyear there a different opportunities to design and create costumes. These situaties, such as Halloween, Carnaval, a school event, ... can be used to set up this project. The students are challenged to create costumes for different age groups at school.

Goals

Skills

Domain-general:

- Scheduling the tasks, the time and the resources.
- Designing, planning and executing a project with a certain budget.

Mathematics:

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- Deciding which lengths are needed in a 3D model and performing them.
- Using ratios and proportions in a meaningful context.
- Interpreting data from a measurement table.
- 2D designing (on paper) and scaling to real size.

Science:

- Inquiring the growth of human beings, the growth of their body parts, ...

Technology - Engineering:

- Optimising the use of a resource (cloth, glue, paper, etc.) in order to stay within a certain budget or available stock.

Knowledge

Mathematics:

- Length, circumference, perimeter and its relationship to diameter/radius and pi number.
- Ratios, proportions and scales.

Science:

- Organisation of living beings. Growth, development and health.
- Characteristics of living beings according to their interaction, function, evolution and adaptation to the environment.

Technology - Engineering:

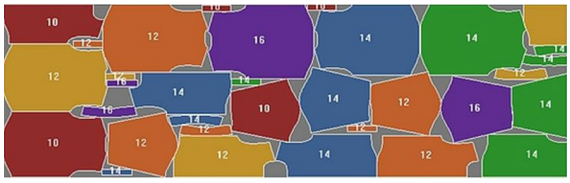
- Ways of stitching. Materials, instruments, ...

Methodology

Part	Description	Timing
1	**Introduction: group discussion** The teacher discusses the context with the students. The students discuss the parts of the body that need to be measured.	10'
2	**Drawing a model of the body: group work** The students are challenged to create a model of the human body. Ages 9-10 can focus on a 2D 1:10 model with lines, rectangles or circumferences (stick-man style), while ages 11-12 might even try some 3D modelling with paper, wooden or plastic blocks. The students take measurements of a classmate: height, arm length, leg length, trunk length, head perimeter, arm length and arm perimeter, etc.	30'
3	**Calculating estimations: group work** The students make estimations for the height of the teacher or an average adult (i.e. 1.80 metres) and do the same computations for a 6 months-old baby (i.e. 0.70 metres) or a toddler at the school (i.e. 1 metre tall). Optionally, the students draw these two models.	20'

4	**Comparing estimations and real measurements: group work** The students measure one or more adults. They measure also one or more young children (babies, toddlers, ...). They calculate the average body sizes for each age group. They can also search for these body sizes in anthropometric tables. The students compare the measurements with their estimations (see 3).	20'
5	**Drawing conclusions: group work** The students draw conclusions from the comparison between their estimation and the tables, based on questions like: How do the different parts of our body grow? Do we grow the same in all directions? Do our body-parts grow at the same ratio? Why? ...	20'
6	**Reflection: group discussion** The students reflect on the way they have tried to obtain the body sizes of the different age groups, based on questions like: Is it sufficient to apply the same scale to all measurements? And to all ages? What should the scale be based on? Is height or weight a better scaling factor? ...	20'
7	**Calculating proportions: group work** The students calculate the proportions for the different parts of the body, for baby, child, and adult (see worksheet). They reflect on the large size of our head when we are born compared to our short arms and legs. They look at pictures of newborn babies and/or their clothes.	30'

8	**2 options ...** **Option A** **Do all mammals have the same body proportions as humans?** The teacher uses this option when the context is the study on living beings, interaction function, evolution and adaptation to the environment: The teacher reflects with children on human evolution and how we are born with large heads when compared to our short arms and legs. Children have to answer the question looking at pictures of newborn herbivores (such as horses, red-deer, etc.), discussing the proportions of their bodies (small head related to long legs) and, afterwards, children compare with the conclusions obtained after analysing the human body. **Option B** **Make a projection: What size will you be when you are 17 years old?** The teacher uses this option when the context is growth, health and development. The teacher obtains a percentiles chart from the National Health System and speaks about controlling healthy growth, periodic medical (paediatric) examination and asks children: What measurements are taken in the examination? What are percentiles charts? Which diseases could prevent the growth? Children must add their current measurements obtained in previous tasks to the percentiles chart, and then extract information from graphs/charts and make the projection.	20'
9	**Presentation of conclusions: group work - class discussion** The students create a document, a poster or a presentation with group work conclusions. They present their conclusions in class.	50'

10	**Creating (or, at least, planning how to create) a costume for different sizes: group work** Different groups of students create a costume with real cloth or large paper for one of the children in the group, for a toddler (for the youngest children at school or siblings) and for an adult. They may optimise the use of the materials. The students make a pattern on paper for each size, scaling appropriately for different sizes. Pay attention! Different holes should be made in the patterns (for arm opening and for the head). The measurements include head circumference perimeter and arm width, also as a perimeter. From those measurements, students should calculate the diameter of the holes using pi and the perimeter. Using the width of your material for making the real costume (cloth/paper/plastic waste bags), plan where you should place each part of the different patterns in order to use the smallest amount of material as shown in the following picture:  The students cut and sew (or glue) the costumes. The costumes can be presented during a fashion show, school party, ...	60'

Organization

Materials

- Measuring tapes or sewing meters (one for each group)
- Large thin sheets of paper to draw the real-scale patterns for the costumes
- Cloth for, at least, all children's costumes and one adult per group
- Something to join the cloth (sewing thread and needles or staples, cloth glue, etc.).

Printables

- Tables with standard measurements ("anthropometric tables"). Full reference data -only for the use by the teacher- can be found here (additional measurements can be found as explained on page 40 of the document). Children's summary can be found at the end of this document and should not be distributed before children have reflected on the body parts that should be measured.
- Photographs of breeding and adults of different species.
- Percentile charts from each National Health System. For example: click here.
- Template for writing data with measurements and proportions.
- Worksheet Growth

Grouping

- Groups consist of four or five students.
- Attitudes needed in a group:
  - Creativity
  - Fine motor skills

- Planning
- Accuracy
- Spatial vision, spatial orientation

Coaching

Useful questions

- What are the normal proportions of the human body?
- How do humans grow after they are born?
- What is healthy eating and why is it important when growing?
- How do other animals grow?
- Is the trunk/leg ratio the same among children? Among grown-ups? And between both groups?
- How do L and XXL t-shirts/trousers/etc. compare? Are these sizes the same in different countries?
- Are any measurements the same or nearly the same for both children and grown-ups?
- Given the circumference perimeter how can we obtain the diameter or radius?
- General reflection questions, such as:
  - What are you doing? Why?
  - What is the problem?
  - What can you do differently?
  - What did you do? What went well/wrong? Why?
  - What would you do differently next time?
  - …

Adaptations

- For ages 9-10, scales focus only on lengths (1D) and we should aim at making ghost costumes (or, in general, any costume that will be made using three rectangles).
- Ages 10-11 can already work in 2D and reflect on how, for a 2D-shape scale, different proportions can be used for each dimension.
- Older children (ages 11-12 or older) might even study weight and/or reflect on relative volumes. If Tinker CAD, Sketch-up or another 3D-design tool has already been introduced to children, simple cylinder models can be studied, generated or even 3D-printed using additional ICT hours.
- The suggested way of grouping according to the skills and abilities required in each group should accommodate all types of learner. Even though it is interesting for all students to participate in all parts of the project, students with disabilities and gifted children should be given some freedom to emphasise or skip the areas where they feel more/less confident or motivated to work.

Assessment

Teacher's assessment:

Assessment takes place in a formative way, especially regarding:

- Problem solving (e.g. performing length measurements on a 3D model)
- Planning (e.g. planning the setting of the different patterns in order to use the smallest amount of material)
- Analysing & interpreting data (e.g. interpreting data from a table)
- Reflecting (e.g. human's growth and other animals' growth in relation to functional characteristics)
- Understanding (e.g. proportions as ratios, fractions or decimal numbers)

Student's assessment:

At the end of the activity:

- What did you did?
- If you would start over, what would you do differently?
- Did you use mathematics? When? Examples?
- What did you learn about human body?
- How would you evaluate the group work?