**Grow**

**SUMMARY**

Age group: 9-12 years old

Number of hours: 10-12 hours (maths science, technology and arts) Maths topics: Proportionality, scaling, measuring, geometry

Short description of activity: Students measure different body parts. They explore the differences in proportion between the body of children and adults. They design and create a costume for different age groups.

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?

Problem(s) 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.

Goals

*Skills:*

* Decide which lengths are needed in a 3D model and perform them
* Use ratios and proportions in a meaningful context
* Interpret data from a measurement table
* 2D design (on paper) and scale to real size
* Optimise the use of a resource (cloth, glue, paper, etc.) in order to stay within a certain

budget or available stock.

* Schedule the tasks, the time and the resources

*Knowledge:*

* Length, circumference, perimeter and its relationship to diameter/radius and pi number, ratios and scales
* Read and interpret data from tables
* Organisation of living beings Growth, development and health
* Characteristics of living beings according to their interaction function, evolution and adaptation to the environment
* Design, plan and execute a project with a certain budget
* Schedule resources, people and time to complete a task
* Optimise the use of materials

*National curriculum:*

* Mathematics: Block 2: Numbers; Block 3: Measurement; Block 4: Geometry
* Experimental science: Block 1: introduction to scientific activity; Block 2: Human beings and health; Block 3: Living beings

Methodology

*Chronological overview:*

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| Part | Description | Timing |
| 1 | **Teacher’s introduction to the problem: group discussion***The teacher introduces the real-world motivation of the activity in context: life cycle, human body, vital functions, growth, development or health.*Children are invited to think about the part of the body that needs to bemeasured. | 20’ |
| 2 | **Draw a model of your body: group work***The teacher introduces the problem of creating 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.*Children should take measurements of a classmate: height, arm length, leglength, trunk length, head perimeter, arm length and arm perimeter, etc. | 20’ |
| 3 | **Make estimations by scaling all the previous measurements for a grown-up taking height as the scaling factor: group work**Children should make estimations for the teacher or an average-height adult (i.e. 1.80 metres) and do the same computations for a 6-month old baby (i.e.0.70 metres) or a toddler at the school (i.e. 1 metre tall).[Optionally, children draw these two models] | 20’ |
| 4 | **Compare estimations and real measurements: group work**Children should take real measurements of an adult and a baby (or look for them in the anthropometric tables) and compare with their estimations. | 20’ |

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| 5 | **Conclude: group work***Teacher helps children to think with 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?*Children draw conclusions from the comparison between their estimation andthe tables. | 20’ |
| 6 | **Reflection: group discussion***Teacher helps children to think with 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 | **Calculate the proportions for the different parts of the body, for a baby, child, and adult: group work***Teacher helps children to reflect on the large size of our head when we are born compared to our short arms and legs.*Children look at pictures of newborn babies and/or their clothes. | 30’ |
| 8 | **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? Diseases that 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 theprojection. | 20’ |
| 9 | **Presentation of conclusions: group discussion**Children create a document, a poster or a presentation with group work conclusions. | 50’ |

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| 10 | **Create (or, at least, plan how to create) a costume for different sizes: group work**Different groups of children create a costume with real cloth or large paper for one of 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.First step: 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:Cut and sew (or glue) the costume | 60’ |

*Printables:*

* Tables with standard measurements (‘anthropometric tables’). Full reference data –only for the use by the teacher-- can be found at https[://w](http://www.cdc.gov/nchs/data/series/sr_11/sr11_252.pdf)ww[.c](http://www.cdc.gov/nchs/data/series/sr_11/sr11_252.pdf)d[c.gov/nchs/data/series/sr\_11/sr11\_252.pdf](http://www.cdc.gov/nchs/data/series/sr_11/sr11_252.pdf) (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: https[://w](http://www.aepap.org/sites/default/files/curvas_oms.pdf)ww[.aep](http://www.aepap.org/sites/default/files/curvas_oms.pdf)a[p.org/sites/default/files/curvas\_oms.pdf](http://www.aepap.org/sites/default/files/curvas_oms.pdf)
* Template for writing data with measurements and proportions Organisation

*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.).

*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 (abilities of age group, within the group, etc.):*

* 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. interpret 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 your learn about the human body?
* How would you evaluate the group work?

Tips & tricks

* Let children reflect on how the measurements have being taken.
* Encourage children to think about what body parts should be measured and how to scale in a 2D or 3D model.
* Make sure that children can enjoy the craftwork (costume) for a while.



#  How do

**we grow?**

Name:

…………………………………………………

Class:

…………………………………………………

School:

…………………………………………………

Date:

…………………………………………………

Universidad de Valladolid

|  |  |
| --- | --- |
|  | Engage |

Make a list of the parts of the body that **you** think should be measured to design a costume. When you are done, discuss it with a classmate (in **pairs**) and agree on a new list. Discuss the list with your **team** and agree on a final list.

(Remember that we are not deciding on whose list to use, but on a brand new list where important measures are kept and redundant or non-important ones are discarded.)

|  |  |
| --- | --- |
|  | Investigate |

Make a table like the one below in your notebook or spreadsheet. Start by listing all the parts of the body that your team is going to measure and then perform the real measurements together. Each student should take notes of those measurements.

|  |  |
| --- | --- |
| Part of the body | Real Measurement |
| Head’s circumference |  |
| … |  |
|  |  |

Draw a simple model (it can be as simple as a stick man) where each mm in your drawing represents a cm in your table, that is, with a scale of 1:10.

Make a table like the one below in your notebook or spreadsheet. Use additional paper or a calculator (if you are allowed to) to calculate your estimations using height as the scaling factor. Share and discuss your estimations with your team and agree on a **new** table that will be shared by the whole group.

|  |  |  |
| --- | --- | --- |
| Part of the body | Estimate for grown-ups | Estimate for toddlers |
| Head’s circumference |  |  |
| … |  |  |
|  |  |  |

**[OPTIONAL]** Using the data in those columns, draw simple models of a grown-up and a toddler using a scale of 1:10 (you are allowed to glue two or more pages together if your model is too big for your paper). Do this with your team.

Make a table like the one below in your notebook or spreadsheet. (Use the internet or the

anthropometric tables if you don’t have a real grown-up or toddler that you can measure).

|  |  |  |
| --- | --- | --- |
| Part of the body | Real for grown-ups | Real for toddlers |
| Head’s circumference |  |  |
| … |  |  |
|  |  |  |

**[OPTIONAL]** Using the data in those columns, draw simple models of a grown-up and a toddler using a scale of 1:10 (you are allowed to glue two or more pages together if your model is too big for your paper). Do this with your team.

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| --- | --- |
|  | Conclude |

Compare the last two tables (and the drawings, if you have them) and discuss why some measurements are not even close to your estimations. Then, make two tables like the ones below in your notebook or spreadsheet, comparing the proportions of your body and a grown-up’s body and the proportions of your body and a toddler’s body.

|  |  |  |
| --- | --- | --- |
| Part of the body | Real for grown-up/Real measurement for child (as afraction) | Real for grown-up/Real measurement for child (decimalnumber) |
| Head’s circumference |  |  |
| … |  |  |
|  |  |  |

|  |  |  |
| --- | --- | --- |
| Part of the body | Real for toddler/Real measurementfor child (as a fraction) | Real for toddler /Real measurement for child (decimalnumber) |
| Head’s circumference |  |  |
| … |  |  |
|  |  |  |

Share your findings with the other teams (oral presentation, poster, document, etc).

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| --- | --- |
|  | Plan |

Plan how to create the costumes that will fit the REAL measurements that you have on the tables by drawing one for your size and scaling appropriately for the others. You can test your ideas using 1:10 models that should fit on standard sheets of paper.

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| --- | --- |
|  | Create |

Remember that you should use the material wisely, so think carefully how to place each part of the costume on the cloth/paper before asking the teacher for the cloth and, of course, before making any cuts!

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| --- | --- |
|  | Report |

Summarize what you have learned in this activity:

I already knew:

Now I also know: