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Lesson plan:
Bears, Foxes, Penguins: surface area/volume ratio in zoology

School	<input type="radio"/> Primary	<input type="radio"/> Middle	<input type="radio"/> High
Year / Class	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3
Subject :	Topic: geometry - biology		
CLIL language	English		

Teacher / Teaching team profile	Teacher's role:	<input type="radio"/> Main Teacher <input type="radio"/> Co-teacher <input type="radio"/> Other: _____	Subject taught: Math and Natural Science
	Teacher's role:	<input type="radio"/> Main Teacher <input type="radio"/> Co-teacher <input type="radio"/> Other: _____	Subject taught: _____

Student group profile (general)	CEFR Level:	<input type="radio"/> A1 <input type="radio"/> B1	<input type="radio"/> A2 <input type="radio"/> B2	<input type="radio"/> C1 <input type="radio"/> C2
	<input type="radio"/> Experiences of CLIL (German) <input type="radio"/> English native speakers <input type="radio"/> Other native speakers			

☐ **Migrant background**
☐ **Special Educational Needs**

Timetable fit	○ Module ○ Lesson (2h)	Previous lessons: This lesson comes at the end of a series of geometry lessons regarding solid figures . It is the first one of a module of two lessons. It is cross-curricular: prior knowledge and skills in both <i>geometry</i> and <i>biology</i> are required, and a little about <i>geography</i> and <i>art</i> too. This lesson is not essential in the school's syllabus, but I find it interesting because it shows how mathematics affect the natural world, even living beings' morphology. Previous lessons focused on: <ol style="list-style-type: none">1. What are polyhedra?2. Which are regular polyhedra's features? How many regular polyhedra is possible to build and which are they?3. What's a parallelepiped? What's a cube? What's a prism?4. How can we build a paper 3D prism?5. What is a develop area and how can we draw it?6. How can we calculate a solid surface area?7. How can we measure volumes? Relationship between volume and capacity measurement units.8. What are equivalent solids?9. How can we find a formula to calculate parallelepiped volume? Can we adapt this formula for cube and prisms?10. Problem solving activities about solid figures.
		Future lesson: In the next lesson, the last one, homework will be checked, sketches will go through a peer evaluation, a whole class recap will be done before beginning a new task: an extension of the surface/volume ratio problem. We'll apply our reasoning to other different contexts, in particular to environmental problems: <div>Packaging questions and waste limitation</div> <div>Heat radiation and energy saving in buildings</div> Summative assessment is planned at the end of the module.
Resources & tools	Worksheets prepared by the teacher. Images Preview: sketch by the author http://www.arkive.org/fennec-fox/vulpes-zerda/image-G26725.html http://www.arkive.org/giant-panda/ailuropoda-melanoleuca/image-G3989.html http://www.arkive.org/red-fox/vulpes-vulpes/ http://www.arkive.org/little-penguin/eudyptula-minor/image-G68913.html http://cdn1.arkive.org/media/43/43030D5E-3AF5-47A3-BCF5-28CD989FBDF2/Presentation.Large/Adult-emperor-penguin-	

[tobogganing.jpg](#)

<http://www.arkive.org/magellanic-penguin/spheniscus-magellanicus/image-G38528.html>

<http://www.arkive.org/polar-bear/ursus-maritimus/image-G8915.html>

<http://www.arkive.org/brown-bear/ursus-arctos/image-G56054.html>

Videos

<http://www.arkive.org/fennec-fox/vulpes-zerda/video-09.html>

"Polar bear mum and cubs. National Geographic":

<https://www.youtube.com/watch?v=vZjFVb0jdbc>

(modified by the teacher through Edpuzzle <https://edpuzzle.com>)

Texts

About the fennec fox:

<http://www.nationalgeographic.com/animals/mammals/f/fennec-fox/>

About the polar bear:

<http://polarbearsinternational.org/polar-bears/characteristics/>

Other open source digital tools

Quizlet

<https://quizlet.com/203086862/fox-and-bear-flash-cards/>

Books

“Le petit Prince“ by A. de Saint-Exupéry

Avec des aquarelles de l'auteur

Editions Gallimard, 1999

	Subject	Language
<p>Students' prior knowledge, skills, competencies</p>	<p>Students know: <u>Mathematics:</u> GEOMETRY what volume and surface area are; how to calculate them for cube, parallelepiped, prism; the measurement units for volume and surface area; what equivalent solids are; what similarity means in geometry and what similar shapes are; ARITHMETICS what ratio is and how to express it mathematically: as a division, as a fraction, as a percentage; what proportional quantities are; how to use a Venn's diagram <u>Biology:</u> the use of Linnean binomial nomenclature; Vertebrates' classification; how vertebrates thermoregulation works; what adaptation to the environment means and how evolution works in living beings <u>Geography</u> climate zones Most students are able to: work on geometry models; follow instructions to carry out a procedure; use formulas to calculate cube volume and surface area; carry out divisions by using a calculator and approximate results as required; recognize related quantities and proportionality functions; use a table to organize results and compare them; make simple pencil sketches</p>	<p>Specific vocabulary: <u>Mathematic</u> Volume, surface area, shape, divide, to measure, to calculate; direct proportionality and mathematical function <u>Biology</u> adaptation, environment, evolution, fit, birds <u>Geography</u> Climate zone Structure: present tenses, past tenses, future tenses, imperative form; conditional form; comparative and superlative; negative form, interrogative form; modal verbs Function: giving instructions, describing facts and results, comparing and contrasting data, asking and answering questions, agreeing and disagreeing, making hypotheses, giving opinions, analyzing and drawing conclusions</p>
<p>Learning Outcomes expected for this lesson</p>	<p>CONTENT To understand the meaning of “surface area/volume ratio” and be able to calculate it in different contexts To be aware that mathematical laws are always present in nature, even in complex systems such as living organisms where regularity seems hard to find.</p>	

To recognize how simple mathematical laws can affect species' features and determine their survival in the environment or extinction.

To be aware that all species' traits are an outcome of natural selection, which allows the fittest to survive.

To consolidate the use of binomial nomenclature according to the international scientific community; to be aware of its importance to avoid misunderstanding in describing large amounts of species, many of them very similar to each other.

To know how to convert an English measurement unit into another in the metric system.

COGNITION

Recalling information (when learners use mathematical formulas; when they have to refer to the evolution process; when they have to use information about geography and climate)

Describing (when they outline animal features)

Organizing ideas and facts (when they use table organizers)

Comparing (when they have to find analogies and differences between species)

Applying rules (when they have to decide which mathematical rules are to be used to work out the question of animal size)

Determining and selecting factors (when they have to choose which traits are related to climate adaptation)

Formulating hypotheses (when they have to tell the reason why an animal has certain size and shape)

Predicting (when they have to say where certain animals live, according to their features and the climate)

Inventing and designing (when they have to create a drawing of an imaginary animal whose features are related to a determined climate)

Evaluating, giving opinions, justifying (when they have to discuss other group's work in plenary; when they have to assess their mates' drawings)

COMMUNICATION

To know and be able to use the key vocabulary, the structures and the language functions that follow:

Key vocabulary/chunks:

Mathematics

Volume, surface area, figure, shape, cube, cube-let, parallelepiped, ratio, to measure, to calculate, measurement unit; direct proportionality and mathematical function

Biology

adaptation, environment, evolution, fit, mammals, birds, temperature, thermoregulation, warm-blooded/cold-blooded, body heat, survive, survival, extinction, fur, fat, release, omnivore, carnivore, fennec fox, red fox, polar bear, brown bear, panda, penguins

Geography

Climate zone, warm, hot, cold, ice, desert, Arcti

Structure and related function:

- present tenses (for describing)

	<ul style="list-style-type: none"> • past tenses (for recounting what has been done) • imperative form (to understand and give instructions) • conditional form (for making hypotheses and conclusions) • comparative and superlative (to compare and contrast) • negative form (to express disagreement) • interrogative form (to ask questions, ask for help) • modal verbs (to express possibility, necessity) <p>CULTURE</p> <ol style="list-style-type: none"> 1. To be able to see a worldwide best-seller children novel (<i>"The little Prince"</i>) under a new light, discovering that the author put in it something really happened in his life (the meeting with a fennec fox in the Sahara, after an emergency landing). 2. To realize how important Linnaeus' binomial nomenclature and classification are in the international scientific community (we would use these same Latin names both in an Italian or English lesson, actually) 3. To be aware that different measurement units are used in UK, USA and other former Commonwealth countries.
Methodology	<ol style="list-style-type: none"> 1. At the beginning of the lesson, the teacher makes a quick presentation of the purposes of the activities and the main steps in order to clarify the road-map (especially to visualize a frame for less skilled learners); she starts with an image to switch on curiosity and motivate learners. 2. Students will: describe an animal's main traits to the whole class, they need to record their knowledge by themselves, discuss in pairs or in groups in order to find, for example, new relevant features reading a text or watching a video. Visual organizers, word banks, sentence starters, and images are provided by the teacher in order to support understanding and scaffolding learners output; the teacher gives necessary wait time when asking questions, and uses a "correcting echo" strategy when learners make production mistakes, without interrupting them (TTT shouldn't be too much). 3. At the end of the main phases, teacher gives oral feedback about learners' outputs. 4. A whole class plenary at the end of both the activities and the whole lesson is done to check, recap and assess both contents and language acquisition. 5. When speaking, the teacher must always remember to do it slowly and clearly, stopping and repeating every now and then, to make sure that most learners can comprehend the message. Gestures can also be helpful for less skilled learners. It's also necessary for learners to come across new vocabulary many times in different forms and contexts (repetition). <p><i>This lesson's assessment is both formative and self assessment.</i></p>
Assessment	<p><i>Summative assessment is planned at the end of the entire module.</i> Teacher monitors:</p> <ul style="list-style-type: none"> groups' activities learners' interaction in pair work learners' participation in whole class activities. <p>Learners monitor their own work quality, both individually and in group, by filling their self-evaluation form at the end of the lesson.</p>

INDIVIDUAL SELF-ASSESSMENT (GROUPWORK)

I can...: (NameDate.....)	1	2	3	4	5
Participate in group discussion					
Help keep the group on task					
Share useful ideas					
Listen to mates					
Help solving problems					
Take responsibility in the group					
Ask for help or extra explanation when I'm not sure					

(Use scale from 1= needs improvement, to 5 =very well)

GROUP SELF- EVALUATION

We finished our task in time	Yes	No
We did a good work	Yes	No
We helped each other	Yes	No
We used quiet voice in communicating	Yes	No
We shared our ideas and listened to others'	Yes	No
We did best at.....		
We have to improve....		

TEACHER FORMATIVE ASSESSMENT FOR GROUPWORK

Name	Lessons 1 and 2				
<i>INTERACTION - Learner can:</i>	1	2	3	4	5
1. Take responsibility in the group					
2. Carry out his own task in the group					
3. Share ideas and opinions with mates					
4. Use evidence to defend his point of view					
5. Allow mates to speak their mind, even if he doesn't agree with them					
6. Ask for help if he needs it					
<i>COMMUNICATION – Learner can:</i>					
1. Understand what he listens to (with scaffolding)					
2. Understand the texts provided by teacher (with scaffolding)					
3. Use new key vocabulary					
4. Use the negative form					
5. Ask and answer questions					
6. Use correctly verbal forms:: present and simple past					
7. Use more advanced verbal forms: future, conditional, present perfect					
8. Use modal verbs					

(Scale from 1= needs improvement, to 5 =very well)

Activity	Activity aims	Activity Procedure	Language	Interaction	Materials (please cite all sources)	Timing	Assessment
0	Preview: explain today's activity	Teacher shows a sketch about the activity road-map to help learners visualizing the purposes and main steps of their future work	Function: Describing Structure: Future form	Whole class	road-map sketch	2'	
1	Introduction: warm up and motivate learners; activate possible prior knowledge	The teacher shows a the picture of a fox taken from Saint-Exupéry's " <i>The little Prince</i> " and asks learners if they notice something strange in the animal's features: is it a bad sketch or does the animal really look like that?	Function: Questioning and debating; giving opinions Use of " <i>It could.... I think that...</i> " as sentence starters	Whole class	book: "Le petit Prince" by A. de Saint-Exupéry <i>Avec des aquarelles de l'auteur</i> <i>Editions Gallimard, 1999</i>	3'	
2	Observe and select relevant Features	The teacher plays the video and asks learners to observe very carefully the main features of the fennec	Structure: imperative form	Whole class	<u>video</u> (without audio) about the fennec fox (see: Resources and tools)	2'	

3	Reworking of video informations	The teacher asks the learners to describe on their book the fennec main traits; then, they share their observations with the whole class. The teacher writes what learners say on the blackboard and learners complete their own list; the teacher asks questions to recap and summarise, and, if needed, helps with language (e.g. sentence starters, vocabulary) to ensure understanding and output	<p>Function: Describing, writing a list, summarising main elements</p> <p>Key vocabulary: <i>tail, ears, tip, fur</i></p> <p>Sentence starters: <i>"It has/is...."</i></p>	Whole class Pair work	science exercise book	10'+5'	
4	Reading comprehension Read a text to find information	In groups, learners read a text, underlining important information to complete what they wrote and to find out if something new comes up. To help learners understand clearly the text, the teacher hands out a list of new words, defining them in L2 and having learner writing translation in L1 on their sheets. More skilled and quick learners read a second text about another animal, the polar bear	<p>Key vocabulary: <i>sandy, to release, shovel, to dig, to prevent, seal, layer, average, cub, den, paw, to slip, paddle</i></p>	Group work	<p><u>text</u> about fennec fox (adaptation by the teacher)</p> <p><u>text</u> about polar bear (adaptation by the teacher)</p> <p>key vocabulary to be completed for scaffolding</p>	15'	

	Organize , select and share information; Compare differences and relevant features	Groups who worked on polar bear communicate their new discoveries; teacher writes them on the blackboard. Learners work on a sheet filling a Venn diagram to compare the features of the fennec and the bear to list analogies and differences. Then, they produce a short text selecting analogies and differences in climate adaptation for each animal.	Function: Describing, comparing: “It has/is....” “They both have/are”	Whole class Individual work	blackboard comprehension worksheet with Venn diagram exercise book	15'	
6	Homework: recap and consolidate new vocabulary	Learners work on the Quizlet	Function: Asking and answering, defining	Individual work	Quizlet		Quizlet (self-assessment)
7	Watch and listen to a short video to consolidate new information	Learners watch and listen to a short video about polar bears, then the teacher replays it stopping in main points; the third time, she plays the same video with added questions and learners try to answer them; if needed, the teacher helps comprehension by repeating slowly and clearly the words/sentences	Function: Asking and answering, describing	Whole class	videos about polar bears in Svalbard Islands (edited through Edpuzzle); first one just resized, second one with questions	15'	

8	Search for a larger amount of elements to make a more reliable comparison and find regularities; formulate hypotheses	Groups receive from the teacher a little piece of paper with the scientific name of an animal written on it: by surfing on the web, they have to find out what animal it is, plus some information about it (size, weight, area, climate) . They write the information on their worksheets and on the WB's table prepared by teacher; then, they paste a note with their animal's name and image on a world map. If nobody notices it, the teacher asks if learners can see connections among animals' characteristics; and if both animal's size and shape are possibly related with climate.	Key vocabulary: <i>weight, length, climate, zone common name, scientific name</i> Function: Describing, asking and answering	Group work Whole class	Internet worksheet with grid provided by teacher world map animals' images to be glued on the world map	15'	
9	Task organisation	Teacher assigns one task to half the groups and another task to the second half, explaining what they have to do.	Structure: Imperative form	Group work		5'	

10a	Lab activity 1 : work on a geometric model to formulate a mathematical law	Using polystyrene cubes learners build cubes of different size (l=1, l=2, l=3,...) Then they use formulas to calculate each surface area and volume. They write down their results on a grid. Then the teacher asks if the two quantities change at the same rate (is there direct proportionality?) To verify this, learners calculate each surface area/volume ratio and write it down on the grid in the last column (approximation to 0,1 is required)	Key vocabulary: <i>cube, solid, shape, side, surface area, volume, direct proportionality, ratio, approximate, increase, diminish</i>	Group work whole class	polystyrene cubelets worksheet with grid calculator	15'	
10b	Lab activity 2 : work on a geometric model to formulate a mathematical law	Learners build different solid shapes using the same number of polystyrene cubes (8). Then they use formulas to calculate each surface area and volume. They write down their results on a grid and draw the shapes. Eventually, the teacher asks if same volumes have same surface, and if ratio consequently changes. To verify this, learners calculate each surface area/volume ratio and write it down on the grid in the last column (approximation to 0,1 is required)					

11	Sharing information, giving opinions, reasoning, justifying, synthesising to eventually draw general conclusions	Groups share their results and try to draw conclusions: what happens to S/V when shape remains constant and volume changes what happens to S/V when volumes remains constant and shape changes They write results on their exercise book.	Function: recounting Sentences starters “I think that...In my opinion...I'm sure that... If.., then” Form: present, conditional	Whole class	exercise book	10'	
12	Evaluating work	Learners assess their own and group work, discussing and finding an agreement upon what was good and what could be improved	Function debating; giving opinions	Individual work Group work	self-assessment forms, both individual and for groupwork	10'	<i>Group self assessment</i> <i>Self evaluation</i>
13	Homework: applying what's been discovered to create and design something completely new, letting imagination free	To be created: teacher asks learners to design an imaginary Animal, with the adequate characteristics To adapt to a warm/cold climate	Form: Imperative form Modal verbs (<i>It should/ has to/must</i>)	Individual work	white sheets, colour pencils		<i>Homework assessment in the next lesson (both peer assessment and evaluation by the teacher)</i>