1. Unit title	The Robotic Hand
2. Target group	8-11 years old
3. Duration	4 lessons of 40 minutes each
4. STEAM Skills/ 21st Century Skills	Problem Solving Communication Collaboration 
5. Expected learning outcomes	By the end of this unit, students will be able to: ● design a bionic hand ● understand biological mechanisms of the human hand ● investigate how a hand can grab and hold ● examine how blood flows in blood vessels ● demonstrate how fingers move thanks to muscles ● understand the connection between orthopaedic disorders and technology
6. Subjects and topics covered	Subjects: Biology, Maths, Technology, Arts Topic: Human Body The human body and in particular the arms and hands will be analysed from a biological but also from an artistic point of view. Pupils will learn about the representation of the skeletal and muscular structure of the limbs. They will hear of orthopaedic disorders and will investigate how technology can provide support. In this sense, the topic will be analysed from a variety of STE(A)M angles.
7. Methodologies	Design Thinking
8. Integration of ART	Figurative Arts are integrated in the activity, especially through drawing, painting and creating parts of the human body, but also interpreting images and representations of the human body
9. Learning Environment	Classroom, laboratory
10. Required resources	Materials: ● Red color straw x 3 ● A4 size paper x1 ● Rope (100cm) ● Scissors ● Tape ● Ruler ● Pencil
11. Prior knowledge **a. teacher** **b. students**	In order to deliver this unit, the teacher will need to have a good understanding of the Design Thinking methodology. It would also be useful to refresh the knowledge around the human anatomy in general, and the anatomy of the human hand in particular. In order to be able to participate and contribute to this lesson, the pupils will have already acquired a basic knowledge of human anatomy.
12. Detailed description of the step-by-step	Introduction

sequences of the unit, incl. specific activities to support the learning experience	Explain that you are going to explore how a human hand works, and how technology can copy the human anatomy to create a device that can grab and hold items. Once they have analysed and understood how a hand works, they will create a device that copies the movements of the hand. The pupils will collaborate in groups of 2 or 3 throughout this activity and share back to the class at the end of it. STEP 1: Discover Building on the knowledge previously acquired, review the function of a human hand and compare it with existing technological devices which copy the movements of the hand (from an excavator to a bionic hand, and many other examples in between). Ask pupils to work in their groups to find 12 amazing facts about the human hand (e.g. Why is the little finger important? Why is the thumb separate from the rest of the fingers? How many bones are there in a human hand? Which animals have hands similar to humans? etc.) STEP 2: Interpret Hand out scientific drawings of the human hand (e.g. from Grey's Anatomy, the Vitruvian Man, etc.). While looking at the drawings as a reference point, ask the pupils to identify the bones and muscles on their hands. Ask them probing questions, e.g. Which parts do you move when you do the 'thumbs up' sign? Why is it difficult to lift only the index and the ring finger at the same time? What part of the hand anatomy surprises them most? Which parts do they find particularly complicated? Which parts do they think are particularly fragile? STEP 3: Ideate Introduce the basic concept of a bionic hand and explain when a bionic hand may be useful. Use illustrations and video clips as appropriate. Ask pupils to come up with an idea of how to create a new type of bionic hand. Based on the age of the target group, a derivative ideation process is to be preferred (i.e. given an existing device, pupils are asked to improve it or to adapt it based on their own goals and desire). For instance, the teacher could show images or models of early mechanical hands, and ask pupils to come up with ideas to make them more refined, more aesthetic, etc. Let the pupils start with a brainstorming session, and explain that anything that comes to mind on the topic is a valid contribution. Ask them to build on and develop the thought of the contributions they find more interesting. To close the brainstorming session, ask them to choose one proposal and to develop it further. STEP 4: Prototype Using the scientific illustrations of the hand distributed earlier as a model, ask the pupils to draw the proposal developed from the brainstorming session. Ask the pupils to present the finished drawings to the whole class and to explain what they are hoping to achieve. Pupils who are not presenting are encouraged to either provide positive reinforcement (e.g. "I like your idea!") or to offer constructive feedback (e.g. "Have you thought about adding an extra finger?"). By creating a positive and supportive atmosphere, pupils will be encouraged to bounce ideas off each other – this is an important aspect of the ideation process. Ask the students to start working on a prototype, i.e. to transform the drawings into a 3D object. The prototype does not need to be functional at this stage, it merely has to physically represent the idea. It can be in scale or

	in 1:1 size. It can be made of any material available to the school (e.g. paper, cardboard, strings, wood, etc.) It is not always possible to ask pupils to create a prototype of their drawings (e.g. if their idea is too complicated, too abstract, etc.). To make sure that everyone has the opportunity take actively part in this step, the teacher can hand each group a set of the material mentioned above under "Required resources", together with the following instructions: 1. Place your hand on the paper and draw a template of your hand using a pen. 2. Cut this hand template carefully with the scissors. Give the fingers the following names: f1, f2, f3, f4 and f5. 3. Cut the rope in to 5 pieces of 20 cm each. Name each rope r1, r2, r3, r4 and r5. 4. Tape each rope to each fingertip on the hand template. 5. Cut the straw into 1 cm pieces. 6. Leave some space between the straw pieces and tape 3 pieces onto each finger. 7. Tape one straw in the middle of the hand. Name it sm. 8. Pass each rope though the straws on the fingers. (r1 must pass trough the straw piece on f1 etc.) 9. Pass all ropes trough sm and start to pull each rope. STEP 5: Test Ask pupils to test their prototype, to identify potential faults and weak points and to address any issues. Ask them to write down what they like most and what they like least about their prototype (i.e. what they would need to work on if they were to move from prototype to a fully functioning solution). Explain that the analysis of the prototype is an important part of the early production process, where many mistakes can be eliminated. To conclude the unit, the pupils will present their prototype to the whole class. This can be seen as part of the Test, as the presentation will also gauge the potential interest of their peers (in marketing terms, they are testing the 'buying intention' of potential customers). Explain that the presentation can be as important as the prototype itself, in order to attract interest. They should be encouraged to used colours and other means to create an interesting display. Depending on availability and age, a stretch activity could be to include multimedia support.
13. Gender-inclusive strategies and activities planned	This activity is meant to be very gender neutral. Do not refer to gender stereotypes when explaining how humans used their hands (e.g. men driving lorries, women cooking and sewing, etc.). Ensure that boys and girls are evenly distributed across the groups, so that the final results are not categorised into 'boys' and 'girls' prototypes. When observing the group work, make sure every group member contributes equally (this is also a personality aspect, gender may or may not play a role).
14. Assessment & Evaluation	For Steps 1 and 2 above, ask probing questions to check for understanding. At the end of Step 3, each group will have provided a written proposal which can be formally assessed against a variety of standards (e.g. language skills, understanding of topic, etc.). Step 4 will provide tangible results such as a drawing and a 3D object. Step 5 will also provide tangible results in the form of a display. When pupils present the prototype to each other, you can ask them to vote based on categories (e.g. best-looking solution, best technical innovation, etc.). For each category, you can give each pupil three stickers,

	or three post-it notes; they can then attach one, two or three stickers to a prototype of their choosing, or they can distribute the stickers across two or three prototypes, as they wish. You can also ask pupils to write a short justification for their vote on the post-it note. An important aspect of evaluation will be observation throughout the unit. In particular, it will be important to ensure pupils remain on task and are engaged; offer support whenever you feel they are stuck. If there are specific problematic aspects of a topic that keep arising, make a note to review them in a follow-up lesson.