Creative Design and Innovation

G11 Teacher's Guide

Term 3 2017-18

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Instructional Planner:

Week	Period	Unit/Section		Task	Page	Key skills	Assessment Focus
1	1	**Introduction to Project**	**Introduction**	• Introduce the structure of the term based around the robotics project. • Highlight that for group projects all members of group MUST complete their book. • Inform students that in weeks 3-6 they will be introduced to Autodesk Inventor software and the VEX EDR robotics kit while they make their first robot "the Clawbot". • Throughout the year they will follow the design process to design their own robot using Autodesk Inventor and VEX EDR. This design can be a completely new design to solve the brief using Autodesk Inventor and VEX EDR or it can be a **modification** to their Clawbot to solve the brief.			
1	2		**Unit 1 Artificial Intelligence (Lesson 1)**	• Teacher to write down all student learning outcomes on the board and ensure students understanding of the aim and outcomes of the lesson.	Pg. 12	• Define key words	

				• Introduce key words for lesson 1. • Teacher to assess prior knowledge of artificial intelligence with questioning. • Teacher to help define what artificial intelligence is. • Teacher should show students both videos on the two different forms of artificial intelligence. • Facilitate as student's complete Activity 1.1 - 1.3 • Get students engaged by playing the "Quick, Draw" game from Google AI experiments. • Also allow students try out the other AI technologies on the site • Facilitate students as they complete activities 1.4- 1.7 • Gain feedback from student reflections	Pg. 15 Pg. 14-17 Pg. 19 Pg. 20- 24	• Define what artificial intelligence is. • Compare narrow AI to general AI. • Experiment with machine learning	
2	1		**Unit 2 Entrepreneurship (Lesson 1)**	• Teacher to write down all student learning outcomes on the board and ensure students understanding of the aim and outcomes of the lesson. • Introduce key words for the lesson.	Pg. 28	• Define key words	

				• Teacher to assess prior knowledge of what it is to be an entrepreneur with questioning. • Teacher to define what an entrepreneur is. • Facilitate students as they complete (Activity 1.1). • Facilitate students as they complete activities (1.2- 1.4.) • Instruct students to use internet to research their findings for (Activity 1.5) • Teacher should introduce students to "the national strategy for innovation" and the idea of setting up their own robotics company.	Pg. 32 Pg. 33- 35 Pg. 37	• Define what an entrepreneur is. • Identify core attributes of an entrepreneur. • Research a successful entrepreneur and identify their cote attributes.	
	2		**Unit 2 Project (Introduction only): Innovative and creative robot design (Lesson 2)**	• Introduce the robotics project aims and learning outcomes • Introduce the robotics project design brief • Break down the brief into key words • In groups: discuss the brief and break it down into a mind map	Pg. 42 Pg. 44	• Analyse the brief	

			***Stage 1*:** **Analysis of brief**	• Ensure students understand the brief • Explain the project keywords and ensure students understand them • Inform students that each of them will come up with their own individual research and possible solutions. As a group, they will then decide on a final solution that has the most advantages and least disadvantages • The final solution can be a **modification** on the Clawbot they already worked on, **OR** a **completely new design** • Inform students they will work on research stage and possible solutions as homework over the next 3 weeks because they need to look for information online if needed. • Instruct students to complete the mind map (Activity 2.4) for homework. • Show students mind map examples from the teacher guide	LMS resources Pg. 49	• Brainstorm ideas for their robots design • Produce a mind map	
3	1	**Unit 3**	**Lesson 1: Introducing Robotics** **Clawbot design on Autodesk Inventor**	• Students will start learning robotics while still working on their project **in parallel**. They will learn how to assemble a robot virtually (using a software "Autodesk Inventor") and then practically (using VEX EDR kit) – (Activities 1.6 & 1.7). Lessons 2-4 of this unit are "self-study".	Pg. 72		

				• Teacher to start by introducing robotics to students through Lesson 1 of Unit 3 so they can carry on with their project • Teacher to write down all student learning outcomes on the board and ensure students understanding of the aim and outcomes of the lesson. • Introduce key words for the lesson. • Teacher to start the lesson facilitating Activity 1.1 • Teacher to introduce students, **briefly**, to the world of robotics and explain its importance in the 21st century • Teacher to introduce Autodesk Inventor and explain that it's used for simulating the robot and assembling it **virtually** before students physically assemble it using VEX EDR kit in the next weeks (Step I) • Students to experience assembling their Clawbot virtually using Autodesk Inventor (Activity 1.6). Teacher to follow the step by	Pg. 72 Pg. 73 Pg. 74 self-study Pg. 75-85 Pg. 86-88 Pg. 89	• Define key words	

				step guide (in the teacher guide) on how to assemble, render and animate the Clawbot. This stage is to be carried out throughout weeks 3 and 4. By the end of week 4, students should paste a picture of their Autodesk Inventor Clawbot in Page 89			
	2		**Clawbot design on Autodesk Inventor (continued)** ***Stage 2*:** **Research and Investigation**	• Work on Activity 1.6 continued **For the project:** • Set work for homework, each member of the group should carry out research and represent their findings using images/notes/sketches/mood board. • Introduce the research section explaining different sources of research and how to accumulate research on research page or mood boards.	Pg. 89 Pg. 56- 57 LMS resources	• Generate research • Recognise research types and methods	
4	1	**Unit 3**	**Clawbot design on Autodesk Inventor (continued)**	• Work on Activity 1.6 continued	Pg. 89		
	2	**Project**	***Stage 3*:** **Possible solutions**	• Work on Activity 1.6 continued **For the project:**	Pg. 89 Pg. 58-60		

				• Introduce stage 3 (possible solutions) for homework. Explain how relevant research forms possible design ideas. • At least 2 possible solutions must be produced by EACH PUPIL for week 5 (encourage more than 2 on extra paper if needed)	LMS resources	• Sketch possible solutions • Identify key aspects of possible solutions	
5	1	**Unit 3**	**Clawbot assembly**	• Now that students have created a software version of their Clawbot, they need to practically assemble it in the Robotics Lab/CDI Room through doing Step II • Teacher to introduce Activity 1.7. Students to use VEX EDR robotic Kit to assemble the Clawbot in real life. Teacher to help students follow the step by step guide (available with each kit) on how to assemble the Clawbot. Students should work in groups (Recommended: around 5 students per group) • This stage is to be carried out throughout weeks 5 and 6. By the end of week 6, students should paste a picture of their Clawbot in Page 91 • Students to organise and classify the components of the Kit • Students to follow the key stages of the guide to assemble the clawbot	Pg. 90 Pg. 91 Pg. 91		

				• Students to organise their groups to efficiently assemble the parts of the robot in the correct order • Students to check the accuracy of their assembled parts • Students to brainstorm and record how their robots could be used and further developed to be used in other fields of operation			
	2	**Project**	***Stage 4:*** **Final Solution**	• Work on Activity 1.7 continued **For the project:** • Check each student's possible solutions and give feedback. • Inform them as a group they must decide on a final solution. • When suitable solution is reached each group should sketch a final solution.	Pg. 91 Pg. 61 Pg. 62	• Generate final solution from possible solutions. • Interpret feedback • Sketch final solution	
6	1-2	**Unit 3**	**Clawbot assembly**	• Work on Activity 1.7 continued	Pg. 91		
7	1-2	**Project**	***Stage 5:*** **Design realisation/ manufacture of robot**	• Inform students that in this lesson they will begin manufacture of their chosen robot which is either a modification of the Clawbot or a completely new design. • Check each group's final solutions and give feedback.		• Develop Inventor modelling skills	

			Robot design on Inventor	• Present Inventor tips to class, level of depth here based on prior knowledge and ability of class. • Students begin to model design on Inventor when final sketch is complete. As mentioned earlier, they are free to choose between modifying their Clawbot, or come up with a totally new design • In this lesson you will facilitate students as they continue their design on Inventor • Demonstrate areas that groups are struggling with or areas new to a class • Incorporate peer teaching if some groups are more proficient in Inventor techniques than others		• Design a new robot or a modification on Inventor	
8	1-2	-	**Summative assessment task week**	• Students will carry out **a summative assessment task**			
9	1	**Project**	**Assembly**	• Introduce students to final assembly of the designed robot • After modifying their Clawbot, or designing a new robot on Autodesk Inventor, students should now use the robotic Kit to physically implement these changes		• Assemble their designed robot using VEX EDR robotics kit.	

	2		**Assembly** ***Stage 6:*** **Evaluation**	• Facilitate as students continue to Assemble their robot using the robotic Kit • Discuss the function of evaluating a project. • Break down the evaluation questions and ensure student understanding of what is being asked. • Facilitate as students complete evaluation and finalize & submit their project	Pg. 67-68	• Evaluate the Project	

Lesson Plans:

Grade 11 Unit 1: Artificial Intelligence Week 1 Lesson plan

Lesson 1: Artificial Intelligence

Aim

The aim of this lesson is to introduce students to artificial intelligence (AI), what it is, how it works and where you might apply it to your robotics project. Students must also learn the difference between narrow AI and machine learning, and the various uses of each in the real world.

Teacher learning objectives:

Learning objective refers to what you as a teacher will have taught the student by the end of the lesson. Teachers are to tick the box when the they have covered a learning objective.

Develop and understanding of what artificial intelligence is

Compare examples of narrow AI with general A

Facilitate students as they experiment with different forms of AI

Student Learning Outcomes :

SLO's refer to what the student can expect from the lesson. Teachers must share these outcomes with all students. Teachers are to tick the box when the outcome is achieved. Learning outcomes can be assessed using oral questioning and the written activities.

Teachers must share these outcomes with all students.

- ☐ Define what artificial intelligence (AI) is.
- ☐ Identify everyday problems that can be solved using AI.
- ☐ Define what machine learning is.
- ☐ Compare narrow AI to general AI.
- ☐ Experiment with different forms of AI.
- ☐ Learn what the future holds for AI.

Keywords	**What are the keywords the students must learn?** • artificial intelligence (AI) • narrow AI • general AI • machine learning • data • problem-solving • algorithm
Resources	**What resources are required?** • Textbooks • Internet access
Prior Knowledge	• Computer science • Robotics • Engineering • Computer programming

Possible Teaching Method(s) or Approach for this lesson

- ☐ Collaborative Teaching (student centred)
- ☐ Instructional / Demonstrative Teaching (teacher centred)
- ☐ Inquiry-based Teaching (student centred)
- ☐ Lecture Style Teaching (teacher centred)
- ☐ Coach Style Teaching (teacher centred)
- ☐ Facilitator Style Teaching (student centred)

Essential and non-essential Sections:

In some lessons it may not be possible to cover every section of the book due to time constraints or lesson variables. Below is a guideline to essential sections for examination and project knowledge.

Topic- Unit 2	Page	
	Essential	Non-essential/Self Study
Two forms of artificial intelligence activity 1.2	Pg. 16	
AI experiments activity 1.4	Pg. 20	

Development [Phases or chunks of learning]:	**Notes for differentiation:**	**Assessment Opportunities:**
Note: All lessons start with Phase 1, Lessons can move back and forth between phases 2 and 3 as content is covered and then students engage. All lessons must finish with phase 4 to evaluate learning	Note: All lessons can be different	Activity 1

Phase 1 of lesson (Connect) **Starter** Teacher to introduce students to the lesson aim. Teacher to place all student learning outcomes on the board and ensure student understanding of aims and outcomes of lesson. Teacher to assess prior knowledge of artificial intelligence. Have students seen examples in real life? Possible uses? Teacher and students should define what artificial intelligence is. Suggested starter activity: ***Activity 1*** **Teacher Tip:** *When explaining always relate back to everyday examples from their lives.* **Phase 2 of lesson (Activate)** Teacher should show students both videos on the two different forms of artificial intelligence. Teacher should instruct students to complete **activity 2** Good use of questioning to ensure understanding: *What are the two types of artificial intelligence?* *Give two everyday examples of narrow AI?* *What can general AI do that narrow AI cannot?* Instruct students to complete **activity 3** **Phase 3 of lesson (Engage and Demonstrate)** Get students engaged by playing the "Quick, Draw" game from Google AI experiments. Also allow students try out the other AI technologies on the site. Students should then answer the following questions on the game: *How is it showing machine learning?*	depending on ability and success of previous lesson. Place additional notes or activities to cater for differentiation where necessary through ought the lesson.	Activity 2 Activity 3 Activity 4 Activity 5-6

How did I help it improve its AI by playing the game? Instruct students to complete activities 5 and 6 after you have gone through these sections. **Teacher Tip:** *Question students throughout to ensure understanding.* **Plenary (Consolidate)** Evaluate students understanding of your lesson by getting them to complete Activity 7 which recaps on their knowledge on the difference between narrow AI and machine learning. Instruct students to complete student reflection and key skills reflection for homework.		Activity 7

Possible Teaching Method(s) or Approach for this lesson

- ☐ Collaborative Teaching (student centred)
- ☐ Instructional / Demonstrative Teaching (teacher centred)
- ☐ Inquiry-based Teaching (student centred)
- ☐ Lecture Style Teaching (teacher centred)
- ☐ Coach Style Teaching (teacher centred)
- ☐ Facilitator Style Teaching (student centred)

Answer Key/Resources

Activity 1

Write below an example of when you made an intelligent decision, why you consider it an intelligent decision and how you came to that decision?

I forgot my pencil for CDI class one day, the teacher wasn't happy and made me stay in for detention during lunch break.

The next week, I checked my bag the night before to make sure I had my pencil for CDI class.

I now do this every night before school to make sure I don't get detention again.

Activity 2

Please watch the videos above and answer the following questions:

What are the two types of artificial intelligence?

Narrow AI

General AI

Give two everyday examples of narrow AI.

Satellite navigation

Online hotel booking

What can general AI do that narrow AI cannot?

General AI can think like humans, learn like humans and make its decisions like humans. It can learn to perform a variety of tasks and learn new skills without having to be specifically programmed like narrow AI systems.

Activity 3

Give two examples of where an artificially intelligent bot may perform better than a human in the customer services industry.

Faster at providing a list of all five-star hotels in Abu Dhabi

No waiting time to speak to a representative

Give two examples of where a human may perform better than an artificially intelligent bot in the customer services industry.

Could give advice on sites to visit near a hotel

Better with dealing with complaints, can try help the person in some way

Activity 4

What did you enjoy about this game?

It was a lot of fun trying to draw the item in time while the AI bot tries to guess what you are drawing.

How is it showing machine learning?

The more people play the game the more it improves at guessing items, it starts to learn and improve by itself

How did you help it improve its AI by playing the game?

By attempting to draw the various items with my own unique sketches I was adding to the AI bots database. Now it can improve and is more likely to guess correctly.

Activity 5

Can you give three other examples of AI that are currently making the UAE's cities 'smarter'?

- Smart parking systems
- Smart gates at airports using Emirates ID
- Talabat food app

Activity 6

Identify four AI devices or systems to help the UAE in its pursuit of these goals (one for each goal). It could be an AI device or system currently available, or one you feel may come available in the future.

- Smart card payment systems
- AI space technology simulators
- Hyperloop
- AI autonomous cars

Activity 7

Can you identify which of the following examples display either narrow AI or machine learning?

 **car satellite navigation**	 **Google Quick, Draw!**	 **self-learning robotic arm**	 **IBM's Deep Blue chess-playing computer**
narrow AI	machine learning	machine learning	narrow AI

Video links

https://www.youtube.com/watch?v=qNoTjrgMUcs AI social robot Sophia

https://www.youtube.com/watch?v=7mJZLLKcvXE AI explained

https://www.youtube.com/watch?v=mJeNghZXtMo what is AI (machine learning)

https://www.youtube.com/watch?v=qgl0dJ6vRyQ Dubai driverless car

https://www.youtube.com/watch?v=4b4tztjRJkA Dubai flying taxi

https://www.youtube.com/watch?v=oy86Dx-N6SE robot learns to walk

https://www.youtube.com/watch?time_continue=59&v=X8v1GWzZYJ4 how quick draw works

https://experiments.withgoogle.com/ai Quick draw an other AI games link

https://www.youtube.com/watch?v=6P-5PkzC2ZI UAE AI strategy

https://www.youtube.com/watch?v=IBglFi6zAY8 tesla auto pilot

https://www.youtube.com/watch?v=fuoX_866UFg google deep learning robotic arm

https://www.youtube.com/watch?v=icsz6OAyW74 swarm AI

Grade 11 Unit 2: Entrepreneurship Week 2 Lesson plan

Aim

The aim of this lesson is to introduce students to the characteristics of a good entrepreneur. They will study examples of successful entrepreneurs and identify where they demonstrated creativity, determination, problem-solving, passion, risk-taking and teamwork.

Teacher learning objectives

Learning objective refers to what you as a teacher will have taught the student by the end of the lesson. Teachers are to tick the box when the they have covered a learning objective.

Highlight the attributes of an entrepreneur

Give students every day examples of entrepreneurship

Present project brief

Student Learning Outcomes

SLO's refer to what the student can expect from the lesson. Teachers must share these outcomes with all students. Teachers are to tick the box when the outcome is achieved. Learning outcomes can be assessed using oral questioning and the written activities.

- ☐ Describe the attributes of an entrepreneur.
- ☐ Evaluate the attributes of a successful entrepreneur.
- ☐ Identify and record the risks and rewards of becoming an entrepreneur.
- ☐ Research and present examples of successful entrepreneurs.
- ☐ Analyse their design brief

Keywords	**What are the keywords the students must learn?** • entrepreneurship • social entrepreneurship • teamwork • creativity • passion • determination • risk taking • project management and Leadership • the business model • the target market • client profile
Resources	**What resources are required?**

	• Textbooks
Prior Knowledge	• Cross-curricular transferable knowledge from Business Studies

Possible Teaching Method(s) or Approach for this lesson

- Collaborative Teaching (student centred)
- Instructional / Demonstrative Teaching (teacher centred)
- Inquiry-based Teaching (student centred)
- Lecture Style Teaching (teacher centred)
- Coach Style Teaching (teacher centred)
- Facilitator Style Teaching (student centred)

Essential and non-essential Sections:

In some lessons it may not be possible to cover every section of the book due to time constraints or lesson variables. Below is a guideline to essential sections for examination and project knowledge.

Topic	Page	
	Essential	Non-essential/Self Study
Analysis of brief	Pg. 46-50	Pg. 34-37

Development [Phases or chunks of learning]:	Notes for differentiation:	Assessment Opportunities:
Note: All lessons start with Phase 1, Lessons can move back and forth between phases 2 and 3 as content is covered and then students engage. All lessons must finish with phase 4 to evaluate learning Phase 1 of lesson (Connect) Starter Teacher to introduce students to the lesson aim. Teacher to place all student learning outcomes on the board and ensure student understanding of aims and outcomes of lesson. Teacher to assess prior knowledge of entrepreneurship. *What is an entrepreneur? What do they do? Do you know any examples of entrepreneurs?* Teacher and students should define what an entrepreneur is. Suggested starter activity: *Activity 1.1 core attributes of an entrepreneur* Teacher Tip:	Note: All lessons can be different depending on ability and success of previous lesson. Place additional notes or activities to cater for differentiation where necessary through ought the lesson.	Questioning Activity 1.1 Questioning

When explaining always relate back to everyday examples from their lives. Phase 2 of lesson (Activate) Once students have completed activity 1 the teacher should recap on this activity ensuring students are clear on the attributes of an entrepreneur. These attributes should be displayed on the board and referred to throughout the lesson. Teacher should now instruct students to complete activity 1.2, 1.3 and 1.4. Activity 1.5 requires internet for research teacher can instruct students to complete this in class or at home. Students should identify where their chosen entrepreneur displayed the following core entrepreneurial attributes: • creativity • problem-solving • risk-taking • passion • teamwork • determination Teacher Tip: *Posters could be made to display the core attributes of an entrepreneur throughout the classroom* Phase 3 of lesson (Engage and Demonstrate) Teacher should introduce students to "the national strategy for innovation" and the idea of setting up their own robotics company. Teacher will now divide students into their groups for the project and introduce the brief (Unit 2 Lesson 2). Use of questioning by teacher to ensure students are very clear on the design brief for their robot. Teacher can now instruct the leaders of each group to lead a brainstorm on ideas for robot design and analysis of brief (if this doesn't work in your classroom setting, teacher may lead brainstorm for all groups).		Activity 1.2, 1.3, 1.4 Activity 1.5 Questioning

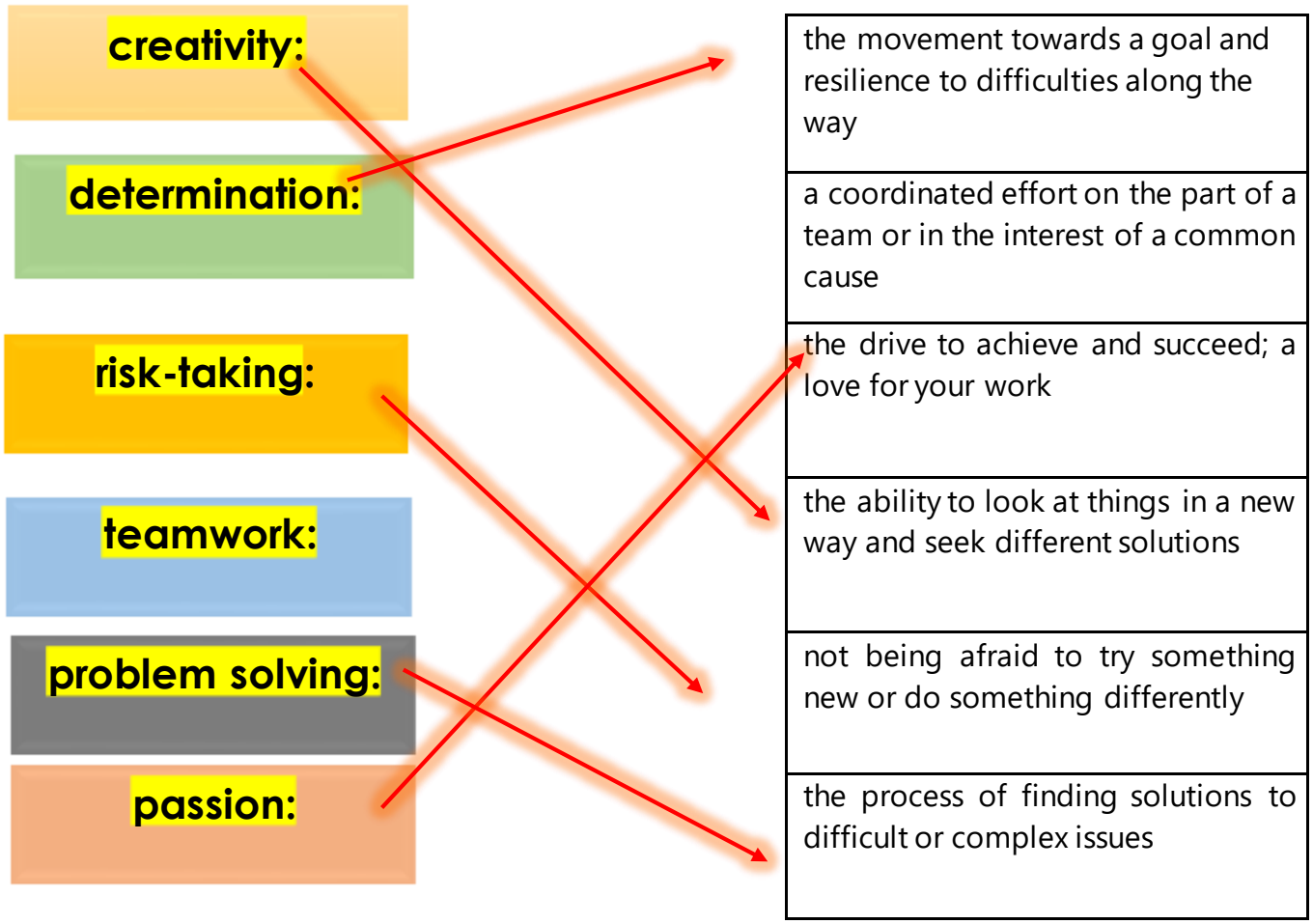
Go through brainstorming tips in guide attached in resources. Inform students that they will work as a team on final solution for robot but each member will come up with his own ideas for possible solutions to the robot design. Creativity should be encouraged. Remind students there are many places they may look for inspiration: • nature • architecture • design movements - • past and future solutions • internet and social media <u>Teacher Tip:</u> *Could photocopy the design brief for each group and get them to circle keywords.* <u>Plenary (Consolidate)</u> You will instruct students to complete activities 2.1, 2.2 and 2.3 into their individual books to ensure understanding of analysis of brief. Instruct students to complete mind map activity 2.4 for homework. You can show students the examples from guide attached in resources. Creativity should be encouraged throughout project. Remind students there are many places they may look for inspiration: • nature • architecture • design movements - • past and future solutions • internet and social media Recap on students understanding of your lesson with some questioning.		Activities 2.1, 2.2 and 2.3 Activity 2.4

What is an entrepreneur? What do they do? Do you know any examples of entrepreneurs? What are the core attributes of an entrepreneur?		

Answer Key/Resources

Activity 1

As illustrated in Sir Richard Branson's profile, he demonstrates many entrepreneurial attributes. Below is a list of **essential entrepreneurial attributes** that an entrepreneur must possess. Can you match the attributes on the left with the correct descriptions on the right using arrows? The first one has been completed for you as an example.



Activity 2

Can you name a famous entrepreneur from the UAE? Maryam Matar

Activity 3

From the list below, chose which you consider the risks and which you consider the rewards of becoming an entrepreneur. Write each of the consequences in the appropriate box.

Risks	Rewards
financial failure stress sacrifices to your personal life	self-satisfaction with your work creativity and new challenges increased income independence

Activity 4

Give one example of where you displayed some entrepreneurial attributes in your life, or how you will become entrepreneurial in the future.

I set up the school's first ever chess club

Project section: Design of robot

Stage 1 Analysis of Brief

This section should show evidence of understanding of the given brief. Areas which require solutions should be identified and problems which will be encountered should be recognized.

What is a Design Brief?
A Design brief is a written description that outlines the design or engineering problem being posed to the student. It also highlights the requirements of the student's final solution.

Design Brief:

This term, you have learned how to use Autodesk Inventor to design a robot, and you have also assembled the Clawbot. In Term 2, you designed your very own smart hand. You must now combine all these skills to design a new innovative robot that solves a problem faced in one of the seven sectors listed below.

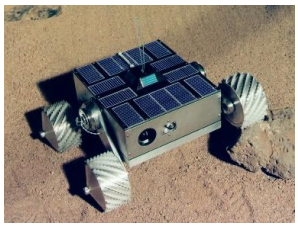


Figure **Error! No text of specified style in document.**.1 Space robot

- renewable energy
- transport
- education
- health
- technology
- water
- space.

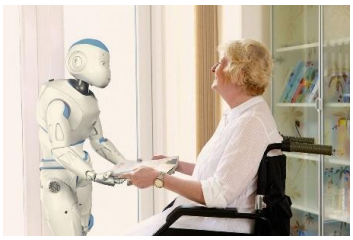


Figure **Error! No text of specified style in document.**.2 Care robot

Figure **Error! No text of specified style in document.**.3 Driverless cars

It is important that you follow the design process to research different types of robots. You must:

- produce possible solutions based on your research.
- sketch a final design based on your possible solutions.
- design and model a robot on Autodesk Inventor.
- assemble all parts to create a robot using the robotics kits provided.
- create a working model of the robot that you could present to potential investors.
- identify the target market for your robot and create a brand for your robotics company.
- display creativity, innovation and entrepreneurship throughout this project.

Where do I start?
Explore the brief carefully yourself before you introduce to your students. A good exercise to start is reading through the brief with your students and getting them to highlight what they feel are the keywords in the brief. This will help to break down the design one step at a time. The students will fill this into their books, some examples of keywords are shown below:

Activity 2.1

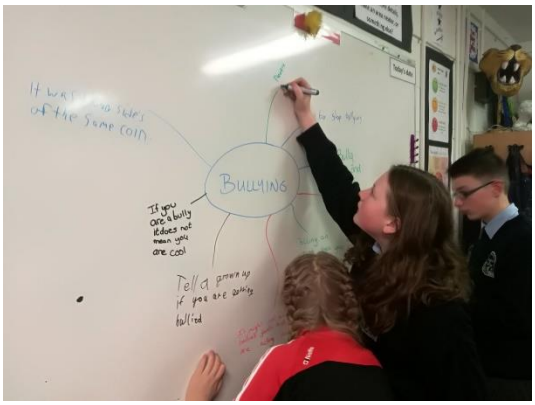
Highlight or circle keywords and phrases in the brief. This will help to break down the design one step at a time. **List five of these keywords below and describe their meaning.**

Keyword	*Meaning*
innovative	*A new idea that is creative*
entrepreneurship	*to develop, organise and manage a business venture*
creativity	
robot	*is a machine that can carry out a complex series of actions*
assemble	*to join parts together*

How will I encourage my student's creativity?

A very useful group exercise at this stage is brainstorming. Brainstorming is a group creativity technique, designed to generate a large number of ideas for solving a problem. Students or the teacher can write the discussed ideas on the board. Throughout the session you should:

- Focus on quantity.
- No criticism is allowed.
- Unusual ideas are welcome.
- There are no wrong answers at this stage.
- Combine and improve ideas



Teacher Tip: The group could be seated in a U direction to encourage discussion. The teacher will act in a facilitating role and can guide the discussion where necessary.

What will your students do next?

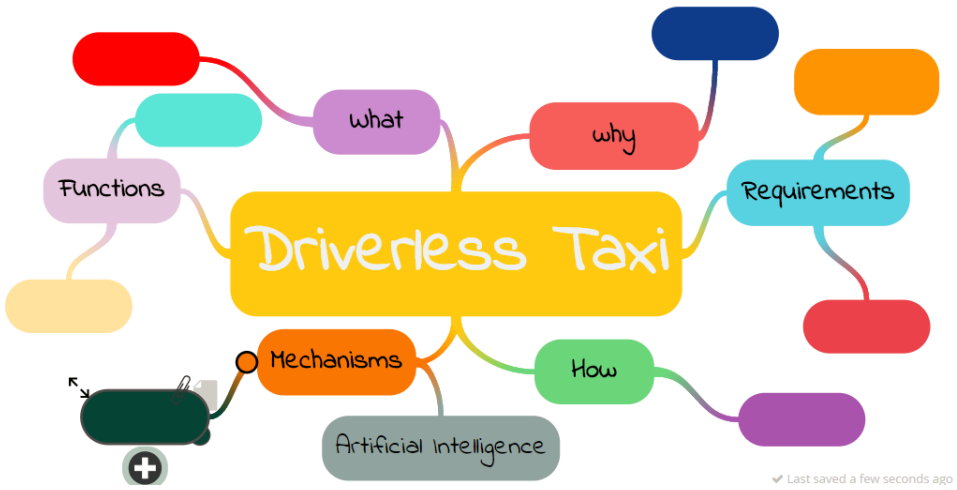
Students will now describe in their own words, what they are being asked to do in the brief. They will fill in the section below in their books.

Activity 2.4

Mind map or spidergram

Once you have decided on the sector, members then need to discuss important characteristics of their robot. **What problem will it solve, and how will it solve it?** Each student should now represent the discussion using a mind map or spidergram. Example of a mind map to get them started is shown below.

Mind map/ spidergram:



Where can I encourage my students to look for inspiration?

You could do up a powerpoint presentation addressing some of the points below or you could even ask a guest speaker to come into school to speak about design.

When designing a product, designers often look at various areas for inspiration. Some of these include:

- **nature -** The natural patterns and forms found in nature are often used as a starting point for fresh ideas. The speaker in fig xx was inspired by the natural form of a sea shell.
- **architecture -** Common shapes or forms can provide inspiration when thinking of creative ideas.
- **design movements -** Design movements such as Art Nouveau, Modernism, Bauhaus, Art Deco, etc. can provide inspiration for new innovative ideas.
- **past and future solutions -** Looking at previous designs of can really help. Most modern-day inventions or designs are an improvement on, or inspired by, an existing product. Futuristic or concept designs can really get creativity flowing.
- **internet and social media –** Google images, Pinterest, Youtube and Instagram can be great assets in gaining inspiration for a design.

Teacher Tip: Put up various images of successful designers work or quotes on your walls to help develop the interest of your students in design.

Unit 3: Introduction to robotics
Lesson 1: Introducing Robotics

Aim:

This lesson aims to introduce you to the revolutionary world of robotics. You will experience simulating then building your first robot (clawbot). You will also be introduced to programming and you will test some programs on your robot.

Student Learning Outcomes: Learning outcomes refer to what the student can expect from the lesson, Teachers must share these outcomes with all students. Teachers are to tick the box when the outcome is achieved. Learning outcomes can be assessed using oral questioning and the written activities.

Students should be able to:

- ☐ List the basic components of a robot.
- ☐ List the real-life applications of robots.
- ☐ 3D model and simulate a robotic system.
- ☐ Assemble a robotic system using a robotic kit.
- ☐ Identify the types of computer programming languages used in robotics.
- ☐ Test codes that allow a robotic system to perform the desired tasks.

Keywords	What are the keywords the students must learn? • robotics • robot • manipulators • control system • sensors • central processing unit • drivetrain • assemble • render • animate
Resources	What resources are required? • textbooks • projector • Laptop/PC • Autodesk Inventor • VEX EDR Kit • VEX EDR supplementary kit
Prior Knowledge	• Understand the basics of computer programming. • Understand the basics of 3D modelling and 3D design.

Possible Teaching Method(s) or Approach for this lesson

- ☐ Collaborative Teaching (student centred)
- ☐ Instructional / Demonstrative Teaching (teacher centred)
- ☐ Inquiry-based Teaching (student centred)
- ☐ Lecture Style Teaching (teacher centred)
- ☐ Coach Style Teaching (teacher centred)
- ☐ Facilitator Style Teaching (student centred)

Essential and non-essential Sections:

In some lessons it may not be possible to cover every section of the book due to time constraints or lesson variables. Below is a guideline to essential sections for examination and project knowledge.

Topic	Page	
	Essential	Non-essential/Self Study
History of robotics		Pg. 75-77
What is robotics?		Pg. 78-85
Your first experience	Pg. 86	
STEP 1: Autodesk Inventor - Clawbot simulation	Pg. 87-89	
STEP 2: Robotic kit - Clawbot assembly	Pg. 90-91	
Activity 1.8		Pg. 92
Robots and programming		Pg. 93-98

Notes for differentiation:

All lessons can be different depending on ability and success of previous lesson. Place additional notes or activities to cater for differentiation where necessary throughout the lesson.

Development [Phases or chunks of learning]:	Assessment Opportunities:
Note: *All lessons start with Phase 1, Lessons can move back and forth between phases 2 and 3 as content is covered and then students engage. All lessons must finish with phase 4 to evaluate learning.* **Phase 1 of lesson (Connect)** **Starter** Teacher to introduce students to the lesson aim. Teacher to place all student learning outcomes on the board and ensure student understanding of aims and outcomes. Ask students to work on the starter Activity 1.1 for 5 minutes then collectively get their answers and discuss the difference between normal machines and robots. Make sure you introduce students to the revolutionary world of robotics and let them discuss this sectors contribution to the development of the UAE. Show motivational videos / models to outline the end goal of the term. You can display examples of famous industrial/educational robots. **Teacher Tip:** *Teacher to set high expectations which inspire, motivate and challenge pupils.* **Phase 2 of lesson (Activate)** Teacher to introduce all key words, discuss meaning and ensure understanding before progressing. Teacher to introduce robotics and the different applications of robots, while students research the topic. Question students on what aspects are new to them when compared to prior knowledge discussion. Teacher to make sure students download Autodesk Inventor on their laptops or in the computer/CDI lab. All teachers and students have a 3-year license through this link: https://www.autodesk.com/education/free-software/inventor-professional Teacher to introduce Autodesk Inventor as a new modelling software for the students through step I in their book. Students are going to experience using it for the first time to assemble their first robot (Clawbot), render it and animate it. Students are expected to individually model the robot following the steps in the step by step Clawbot modelling guide so they could	**Questioning** **Questioning** **Peer teaching**

model their Clawbot in 4 lessons (weeks 3&4) as per the instructional planner. The guide will be shared during the term. Now that students have created a software version of their Clawbot, they need to practically assemble it in the Robotics Lab/CDI Room through doing Step II in their book. Teacher to introduce students to VEX EDR robotic kit as a tool for physically building their first robot. Students should classify the various components in the kit to start assembling the Clawbot. Teacher to take students to the CDI room/lab/FabLab and distribute students into groups of 5 (recommended). Teacher to provide each group with the "VEX Clawbot building guide" that comes with each Clawbot kit. Students should define the responsibility of each team member so they could assemble their Clawbot in 4 lessons (weeks 5&6) as per the instructional planner. Teacher to monitor the students' progress throughout the lesson by using the different assessment opportunities. **Teacher Tip:** *Teacher to demonstrate good subject and curriculum knowledge* **Phase 3 of lesson (Engage and Demonstrate)** Students should complete Activity 1.5 after being introduced to Autodesk Inventor interface. Students should complete Activity 1.6 and paste a picture of their final modelled Clawbot as an evidence. This step shall take 4 lessons (weeks 3&4) as per the instructional planner. Teacher to facilitate as peer teaching takes place. Students should complete Activity 1.7 and paste a picture of their final assembled Clawbot as an evidence. This step shall take 4 lessons (weeks 4&5) as per the instructional planner. Teacher to facilitate as collaborative learning takes place. **Teacher Tip:** *Use groupwork as appropriate, get to know your class and organise groups to support mixed ability's.* **Phase 4 Plenary (Consolidate)** Teacher to facilitate as students evaluate learning. Question pupils on what they have learnt. Have learning outcomes been met? Has the lesson aim been achieved?	**Group work** **Peer teaching** **Oral Assessment** **Student evaluation**

All students to show compare their modelled Clawbot with their assembled one and then complete the student evaluation/reflection. *This lesson should be conducted in eight lessons (8 periods – 45min) in 4 weeks (3-6)*	

Stage 2: Research and investigation of possible solutions

What should my students include in this section?

There are two distinct elements to this stage of the process:

1. **Market research:** Here students will research their target market and build a client profile for their robot. They will be required to design a questionnaire and hand it out to potential customers. In this section, they will also look at creating their own brand.

2. **Research and Investigation:** Students should clearly show the investigation that has been completed. The investigation should display your understanding of the brief. They can use notes, sketches, images from the web, magazine cut outs etc. Avoid having just a collection of information gathered, students should explain why this information is useful.

Teacher Tip: Possible solutions will be produced in Stage 3 not here, but students should be thinking about possible solutions when carrying out their research.

1. Market research: Here students will be required to design a questionnaire and hand it out to potential customers. In this section, they will also look at creating their own brand. This is all clearly laid out and explained in the book.

2. What methods of research and investigation should the students use?

You could start by introducing students to the two types of research- primary and secondary research.

Primary research involves the observation of associated objects in your immediate environment or locality. For example, students could photograph various robotics projects at a robotics competition.

Secondary research involves gathering information from existing sources. You should encourage students to consider the following sources.

- Libraries
- Books
- Magazines
- Catalogues
- Homecare and hardware stores
- Exhibitions
- Websites

Students should take note of any inspiration gathered at any stage of this process as this will be useful for their presentation of investigation. These images can be used in the mood board.

Teacher Tip: Encourage students to use forms of research they might enjoy like capturing and sharing images on Snapchat or Instagram.

What is required of my students in this section?
Each time they carry out research they should be posing questions about their design. Some examples of the questions they may have are listed below:

- What shape, texture and style is best for my design?
- What materials are suitable for my design?
- What size should my design be?
- What features should my design contain?
- Where did I get my inspiration from?
- How much would my design cost?

Note: Students are required to investigate **at least three** essential requirements of their chosen design. These questions will be developed from their brainstorming session and mind mapping in the analysis of brief.

How should my students present their research and investigation?

When presenting their research, they will need to condense it down and give the teacher a clear picture of the research they have carried out. This should all be presented in the Investigation section of their **books page 56-57**. You should encourage students to consider the following:

Teacher Tip: It would be a very good idea to have students get a folder to store all their work. Or have somewhere safe they can store it before its transferred to the book.

- Using images and freehand sketches is a clever way of presenting investigation.
- A mood board is a great way to represent where students got their inspiration.
- Virtually any conceivable method of presentation can be used to convey the thought process
- Images from books, catalogues and the internet are fine, but they must be accompanied by short notes describing their purpose.
- If your students have prior knowledge of any word processing/desktop publishing software they could use it here.
- Images and annotations together give a distinct representation of the research undertaken.
- Students may include extra pages to accompany their book for this section.
- **Try to be as creative and unique as possible.**

One example is shown below.

What features should my design contain? A space robot would need to face difficult terrain and various obstacles. They must have good acceleration, torque and suspension. They must also be built to withstand high/low temperatures, corrosion and dust.

Why are annotations/ notes important to accompany images and sketches throughout this project?
These annotations are where the real 'critical thinking' takes place. They should be found throughout the project. They demonstrate a good understanding for the various design features.

What are mood boards?

As mentioned above a mood board is a great way to represent where students got their inspiration. A mood board is an arrangement of images, materials or text which is used for inspiration for a new design concept. Designers often use mood boards as inspiration for creativity, a good starting point for their design.

Example of mood board for a robot:

Video links

https://youtu.be/JKIAOZZritk well branded companies

Stage 3: Possible solutions

What is required of my students for possible solutions:

Using the information gathered, students should sketch at least two possible solutions. They can use a number of sketching techniques.

Possible solutions must:

- explain the operation of the design solution.
- state advantages and disadvantages of each solution.
- Show how it meets the brief

What choice do your students have in this section?

1. Students may wish to generate ideas by redesigning the existing products they researched.

OR

2. Communicate their own new design ideas graphically using sketches.

This means that students have the choice to create a possible solution based on an existing products design or they can come up with their own completely new design.

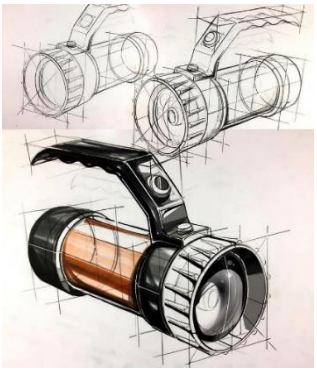
Do my students have to use freehand sketching in this section?

Yes, the student's possible solutions must be represented using freehand sketches. Students should practice sketching their possible solutions before they transfer into book.

- **Teacher Tip:** It would be a good idea to photocopy this section out of book for students to practice on and show you their attempts before they transfer into book

Sketching- practice makes perfect

When it comes to sketching, the more practice our students get the more they improve as designers. Students should be encouraged to practice their sketching techniques if they get any spare time in school or at home. Youtube is full of videos on sketching techniques, if students wish to practice at home.

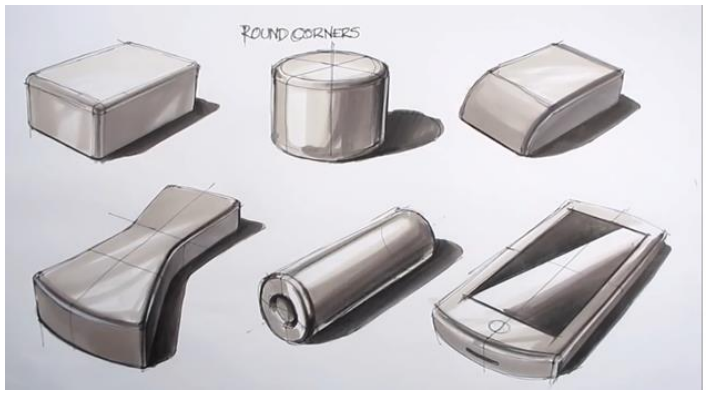


- **Teacher Tip:** You could encourage students that like sketching or who are particularly passionate about design to get themselves a sketch pad to store their sketches.

Sketching exercise

You could get students practising how to sketch basic shapes using the video exercise below.

https://www.youtube.com/watch?v=6ZU-ryDOtLw&t=22s



How should my students present their work?

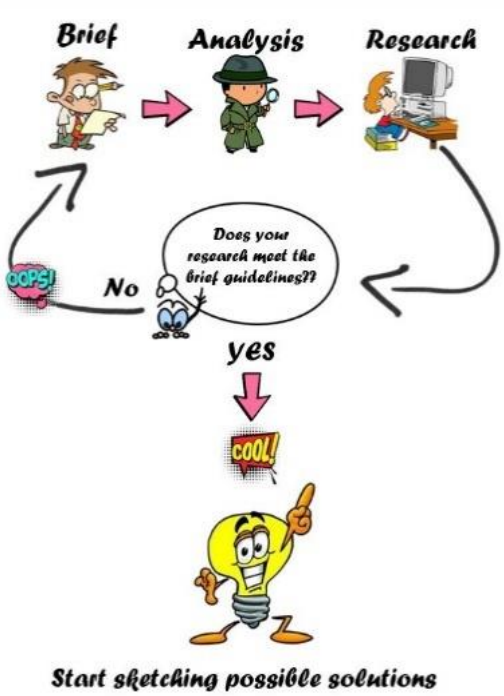
The layout of the sketches is up to the student, they can have a single sketch to present their ideas or a number of sketches. Students should be encouraged to consider the following:

- All sketches should be very neat and tidy. The use of colour and shading is encouraged.
- Students can use a variety of sketching techniques.
- 2D and 3D format are both acceptable, but a combination of both will be a better representation.
- Neat annotations or notes would help in explaining the operation of student designs.
- Students should give at least two advantages and two disadvantages to each design.
- Students may include extra pages to accompany their book for this section.

What guidance can I give my students for possible solutions?

- Look at the details in students research
- pay attention to colour, shape, texture
- what materials are used in my design and what is their pattern.

Use the design process below to help guide your students through preparing for possible solutions.



- **Note:** Does the student's possible solutions meet the criteria of brief? If not give them feedback on areas to change or to come up with another idea

Activity 2.11

Complete at least 2 possible designs. State advantages and disadvantages of each. Encourage rendering or color to enhance designs.

Video link

https://www.youtube.com/watch?v=6ZU-ryDOtLw&t=22s

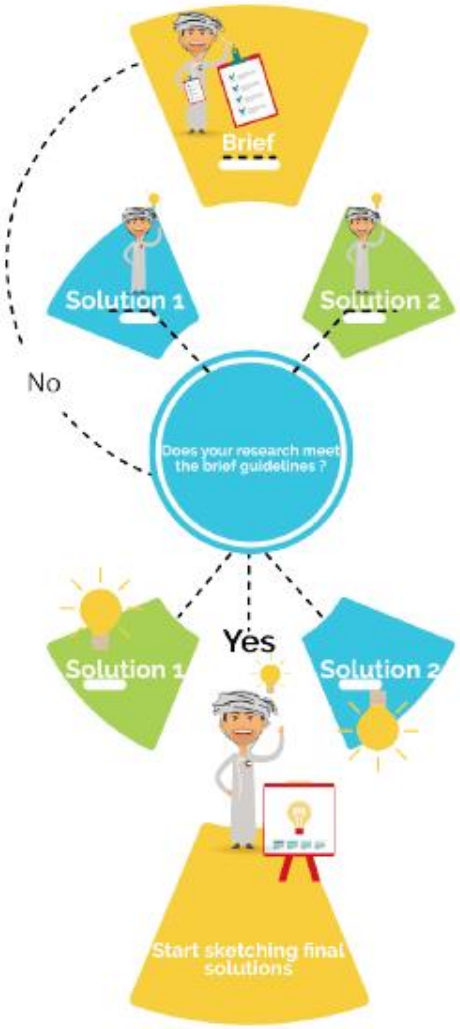
Stage 4: Selection of final solution

What is required of my students for selection of final solution?

In this stage, one final design solution that best fits the brief must be chosen. This solution maybe based on one of the possible solutions or a mixture of possible solutions. It is important that students show the reasons for choosing one solution over another. The way students present their work will be quite similar to the previous section.

What guidance can I give my students for selection of their final design?

Students can follow the diagram below to help guide them in selection of final design: **First and foremost, the final design must meet the criteria of the brief.**



How should my students present their work?

The layout of the sketches is up to the student, they can have a single sketch to present their ideas or a number of sketches. Students should be encouraged to consider the following:

- All sketches should be very neat and tidy. The use of colour and shading is encouraged.
- Students can use a variety of sketching techniques.
- 2D and 3D format are both acceptable, but a combination of orthographic 2D and 3D sketches will be a better representation.
- Neat annotations or notes would help in explaining the operation of student design
- State reasons for choosing this design.
- Select suitable materials for manufacturing and give reasons.
- Students can get creative with how they present their final design.
- Students can include extra pages to accompany their book for this section.

Note: Each groups design should be unique and innovative. Encourage students to think outside the box and try to add features that will make their designs unique and stand out against their classmates.

Answer Key/ Resources

QR code links:		
Page	**Topic**	**Link**
Pg. 79	Da Vinci Robot	https://www.youtube.com/watch?v=0XdC1HUp-rU
Pg. 89	Building the Clawbot using Autodesk inventor	http://curriculum.vexrobotics.com/curriculum/intro-to-autodesk-inventor/building-the-clawbot.html
Pg. 91	Assembling the Clawbot robot	https://www.youtube.com/watch?v=_PUUdnMqp-E&t=4s
Pg. 92	Vex EDR tank	https://www.youtube.com/watch?v=pr15z8V2Fgg
Pg. 97	Programming a Motor	https://www.youtube.com/watch?v=aB2EoQmWWcw&list=PLB7m7EWHl0xyAgh4GAA4YAtXzV06Twlln
Pg. 97	Programming a bumper	https://www.youtube.com/watch?v=dPWDlxj8jv8&index=2&list=PLB7m7EWHl0xyAgh4GAA4YAtXzV06Twlln
Pg. 97	Programming a limit switch	https://www.youtube.com/watch?v=1dtrPXCQzBw&index=3&list=PLB7m7EWHl0xyAgh4GAA4YAtXzV06Twlln
Pg. 97	Programming a light sensor	https://www.youtube.com/watch?v=aW1uARcvdp4&index=4&list=PLB7m7EWHl0xyAgh4GAA4YAtXzV06Twlln
Pg. 97	Programming a potentiometer	https://www.youtube.com/watch?v=UBUfTpI18t0&list=PLB7m7EWHl0xyAgh4GAA4YAtXzV06Twlln&index=5
Pg. 97	Programming a line tracker	https://www.youtube.com/watch?v=X4WiAz3Y43A&list=PLB7m7EWHl0xyAgh4GAA4YAtXzV06Twlln&index=7

Activity 1.1

- Classify the images below as either machines or robots. Put the numbers in the boxes below?

Machines			Robots		
2	3	5	1	4	6

Activity 1.2

- Use your own words to write a definition for the term 'robotics'.

Answers may vary.
Robotics is the study of robots. It's a branch of engineering and computer science that studies robots that are able to perform different tasks responding to sensory input programmed by a human.

- List three examples of where robots are used to help people.

Answers may vary.
1- Car production and assembly lines
2- Space/ underwater exploration
3- Military for transportation and bomb disposal
4- Entertainment

Activity 1.3

- Research the inventors of the first robots and document your research below.

Answers may vary.
Example of inventors to research:
1- Ctesibius an ancient Greek engineer - 270 B.C.
2- William Grey Walter
3- George Devol

Activity 1.4

- Label the image with the correct type of drivetrain. You will need to research these types of drivetrains online?

1- Tank
2- Slide
3- Swerve
4- Mecanum

Activity 1.5

- List any three Autodesk Inventor features and note down their functions below.

feature	function
ViewCube	Allows different views of the workspace
Triad	Shows the x, y and z axes of the workspace plane
Navigation Bar	Provides different tools for surfing the workspace

Activity 1.6

- Use Autodesk Inventor to assemble, render and animate a clawbot. Screenshot your clawbot and paste a picture of it in the space below:

Students will paste a picture of their final modelled clawbot in the space provided.

Activity 1.7

- Use the kit available in your robotics lab to build your clawbot. Paste a picture of your clawbot in the space below:

Students will paste a picture of their final assembled clawbot in the space provided.

Activity 1.8

- How can you modify your robot? Is there anything you can add or remove from your robot's structure to make it work better, or to make it more efficient? Paste a picture of your modified clawbot in the space below.
- Scan the QR code for inspiration.

Answers will vary

Activity 1.9

- You can control your clawbot using the microcontroller. Which mode do you think you are using to control your clawbot when you use a remote control?

Driver mode. The robot does NOT move autonomously as it requires orders from the remote controller to move.

Activity 1.10

- What do you think is going to happen if you program the robot to move forward if both gear sticks are moved downwards?

  The robot will follow the instructions as programmed.

- Is the robot still going to move? If yes, to which direction?

  Yes. The robot will move forward.

- Is that logical??

  No. Logically, the robot should move downwards, but because it was programmed to do the opposite, it's following the instructions even if they are illogical.

- What do you conclude?

  Robots are programmed to do certain things. If the programmer makes a mistake, the robot is going to follow that wrong instruction regardless of how logical that instruction is.

Activity 1.11

- Now that you have designed your own robot, what functions and tasks do you want your robot to do?

  Answers will vary

- What parts of your robot need to interact in order for your robot to satisfy its purpose?

  Mainly, the sensors and actuators.

Activity 1.12

- In future terms, you are going to learn how to program your robot from scratch. You are encouraged to explore and test codes for the other components you used in your robot in order to program it as desired. Your teacher can provide you with the necessary resources.

- Screenshot your code(s) and paste a picture of it in the space below.
- What other component(s) did you program?

  Answers will vary. Encourage your students to search for codes of how to program other parts of their robots. Students will learn how to program their robot in details in grade 12.

Answer Key/ Resources (Lessons 2-4)

NOTE: Lessons 2-4 are self-study

Lesson 2 QR-code table

QR code links:		
Page	**Topic**	**Link**
Pg. 112	DC motor parts	https://ibb.co/cDbv6S
Pg. 113	How DC motor works? Activity 2.2	https://www.youtube.com/watch?v=7bb7vQI3wpQ
Pg. 117	Single and Double-acting Cylinders in a Fluid System Activity 2.5	https://www.youtube.com/watch?v=WEWxG2T9xuQ

Lesson 3 QR-code table

QR code links:		
Page	**Topic**	**Link**
Pg. 123	Zero Radius Turning, Four wheel steering, engineering Projects Activity 3.1	https://www.youtube.com/watch?v=IksiJC4uLyU
Pg. 125	Crab Drive Test with Bump Activity 3.3	https://www.youtube.com/watch?v=q9uck-wRa_8
Pg. 126	Toyota Traction Control System (TRC)	https://www.youtube.com/watch?v=iBU2n-HI2oM

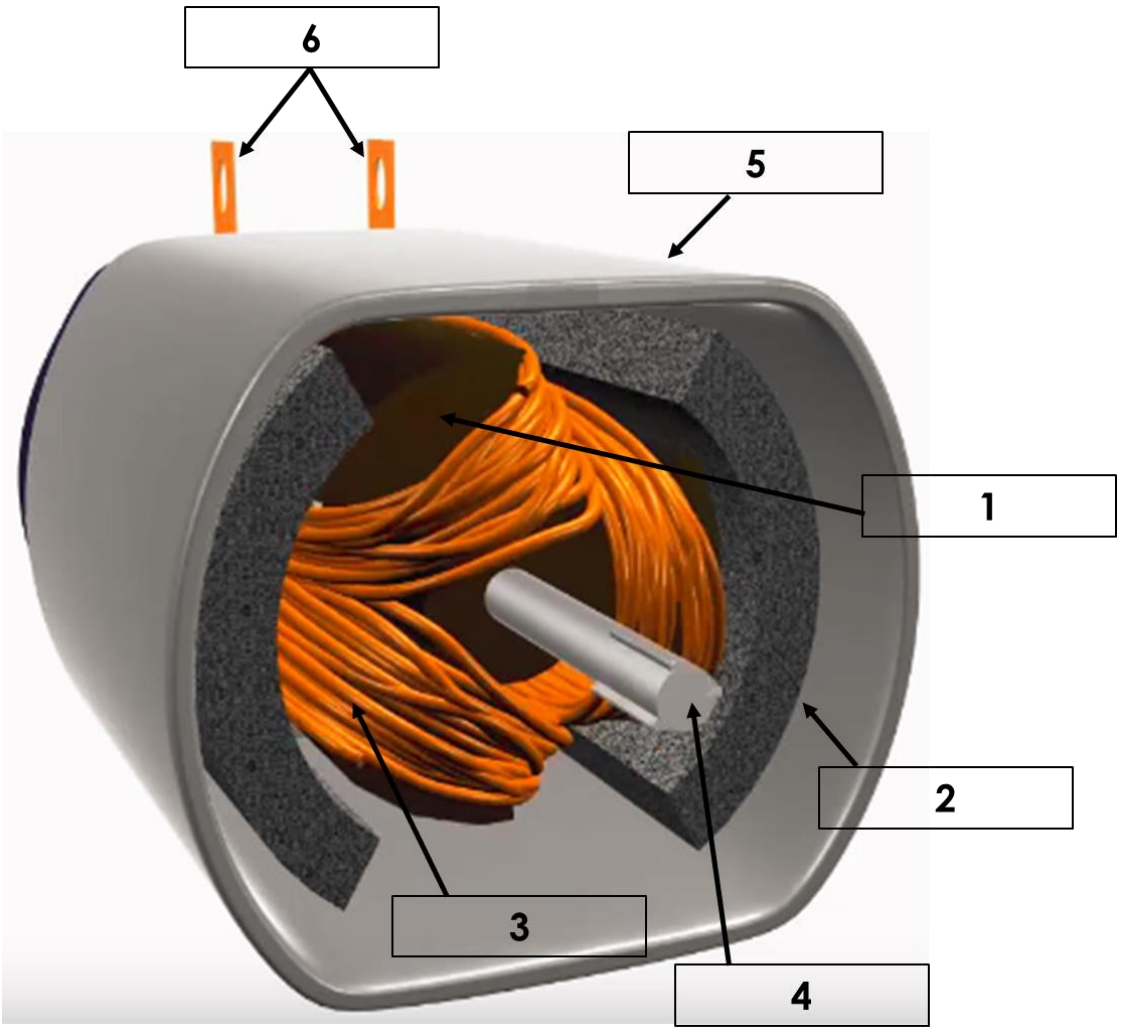
Activity 2.1

- Match the following robotic peripherals to the related human system.

2	obstacle detector	1	skeletal system
1	metallic rails/plates/bars	2	nervous system
3	servo motor	3	muscular system

Activity 2.2

- Fill in the boxes below with the correct label.



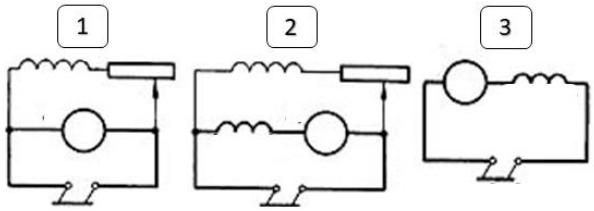
Activity 2.3

- Speed varies widely between no load and full load.
- The motor cannot be used where a constant speed is required with varying loads.

✓	Series DC motor		Shunt DC motor

Activity 2.4

- Match the three schematic diagrams below with the correct DC motor type.



series	3	shunt	1	compound	2

Activity 2.5

- What type of actuators are presented?

  b

- How many ports does each type of actuator have?

  c

- All pneumatic cylinders provide rotational movement because they have a cylindrical shape.

  b

Activity 3.1

- Scan the QR code and answer the question below.
- What are the advantages of using a zero turning radius steering mode? Can you think of real-life applications for it? List them in the space below.

Mainly, reducing the turning radius allows the vehicle to smoothly rotate in narrow areas.
Answers will vary: parking cars in narrow parking lots.

Activity 3.2

- Use the list above to identify the manoeuvring techniques the robot is using in the images below.

Left: Manoeuvre 2 – Right: Manoeuvre 3

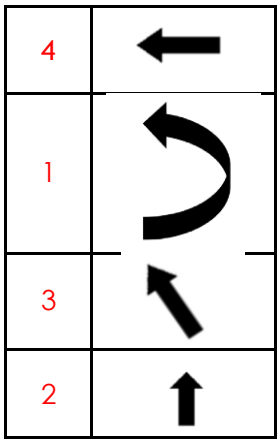
Activity 3.3

- Scan the QR code and answer the question below.
- What are the advantages of using crab drive in robots? Can you think of real-life applications for it? List them in the space below.

Mainly, allows the vehicle movement to be more flexible.
Answers will vary: avoiding obstacles.

Activity 3.4

- Match the directions on the right with the correct 4-wheel omnidirectional-wheel robot.



Activity 3.5

- Two robot drivetrains below are missing their directions. Write the number of the direction in the correct box below.

The upper image :1 – The lower image: 2

Activity 4.1

- How can you get a 1:25 gear ratio using a 12-teeth driver gear? Calculate the number of teeth for the output gear.

$$\text{gear ratio} = \frac{input}{output}$$

$$\frac{1}{25} = \frac{12}{output}$$

$$\text{output gear teeth} = 12 \times 25 = 300\ teeth$$

Activity 4.2

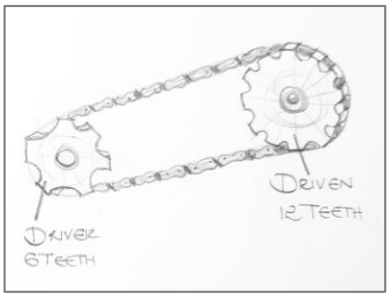
- Match the system properties below with the correct driver and driven gears used for making them.

3
2
1

Activity 4.3

- Sketch a sprocket and chain system below. Your system's ratio should be 6:12. You need to label the driver and driven gears.
- Calculate the reduction for this system.

Answers will vary.



$$\text{gear reduction} = \frac{output}{input} = \frac{12}{6} = 2$$

Note: Students can draw any other system that has the same ratio like 12 input teeth and 24 output teeth. In all scenarios, the reduction will always be 2.

Unit 2: Robotics Project

Week 7 Lesson plan: Stage 5: Design realistaion / manufacture of designed robot or modification

Aim:
This lesson aims to finalise new robot design or Clawbot modification and begin the design realisation process. Students will present their final solution and ensure it satisfies the brief. Students will then become familiar with the 2 main aspects of the design realisation process.

Teacher Learning Objectives: Learning objective refers to what you as a teacher will have taught the student by the end of the lesson. Teachers are to tick the box when the they have covered a learning objective.

- ☐ Give feedback on final design ideas.
- ☐ Present Autodesk inventor lessons as needed.

Student Learning Outcomes: Learning outcomes refer to what the student can expect from the lesson, Teachers must share these outcomes with all students. Teachers are to tick the box when the outcome is achieved. Learning outcomes can be assessed using oral questioning and the written activities.

Students should be able to:

- ☐ Present one final solution
- ☐ Begin to design a 3D robot on Autodesk inventor.
- ☐ Consider both mechanical efficiency and structural stability in their Inventor design.

Keywords	**What are the keywords the students must learn?** • Design realisation • Mechanical efficiency • Structural stability
Resources	**What resources are required?** • textbooks • projector • sketching equipment • Autodesk inventor
Prior Knowledge	• Autodesk inventor • Robotics • Engineering

Possible Teaching Method(s) or Approach for this lesson

- ☐ Collaborative Teaching (student centred)
- ☐ Instructional / Demonstrative Teaching (teacher centred)
- ☐ Inquiry-based Teaching (student centred)
- ☐ Lecture Style Teaching (teacher centred)
- ☐ Coach Style Teaching (teacher centred)
- ☐ Facilitator Style Teaching (student centred)

Essential and non-essential Sections:

In some lessons it may not be possible to cover every section of the book due to time constraints or lesson variables. Below is a guideline to essential sections for examination and project knowledge.

Topic - Unit 2	Page	
	Essential	**Non-essential/Self Study**
Final design	Pg. 62	
Design realisation activity 2.13	Pg. 64-65	

Development [Phases or chunks of learning]: ***Note:*** *All lessons start with Phase 1, Lessons can move back and forth between phases 2 and 3 as content is covered and then students engage. All lessons must finish with phase 4 to evaluate learning.* **Phase 1 of lesson (Connect)** **Starter** Teacher to introduce students to the lesson aim. Teacher to place all student learning outcomes on the board and ensure student understanding of aims and outcomes. Teacher to introduce all key words, discuss meaning and ensure understanding before progressing **Teacher Tip:** *Teacher to set high expectations which inspire, motivate and challenge pupils.* **Phase 2 of lesson (Activate)** Teacher to organise student groups. Students to present final solution Teacher to give feedback based on how well design meets the brief. Teacher to introduce the design realisation stage. Students to begin their robot designs on Autodesk Inventor. Teacher to present micro Inventor lessons on features if needed. Students to explore modelling techniques that will solve their design idea.	**Notes for differentiation:** ***Note:*** *All lessons can be different depending on ability and success of previous lesson. Place additional notes or activities to cater for differentiation where necessary through ought the lesson.*	**Assessment Opportunities:** **Activity P62- Final design** **Questioning.**

Teacher Tip: *Incorporate peer teaching if some groups are more proficient in Inventor techniques than others* **Phase 3 of lesson (Engage and Demonstrate)** Students to demonstrate understanding by completing design on Autodesk Inventor. Students to demonstrate modelling skills on Autodesk Inventor Teacher to facilitate as students work on their designs. **Teacher Tip:** *Use groupwork as appropriate, get to know your class and organise groups to support mixed ability's.* **Phase 4 Plenary (Consolidate)** Teacher to facilitate as student's complete Autodesk Inventor design Question pupils on what they have learned. Have learning outcomes been met? Has the lesson aim been achieved? All groups should have presented a successful final design and have finished modelling on Autodesk Inventor. For homework students can paste images of their Inventor design into their book.		**Oral Assessment** **Activity 2.13**

Unit 2 : Robotics Project
Week 9 Lesson plan: Project assembly and evaluation

Aim:
This lesson aims to assemble all parts designed and modelled on Inventor using the Vex robotics kit.

Teacher Learning Objectives: Learning objective refers to what you as a teacher will have taught the student by the end of the lesson. Teachers are to tick the box when the they have covered a learning objective.

- ☐ Demonstrate assembly techniques.
- ☐ Present evaluation questions

Student Learning Outcomes: Learning outcomes refer to what the student can expect from the lesson, Teachers must share these outcomes with all students. Teachers are to tick the box when the outcome is achieved. Learning outcomes can be assessed using oral questioning and the written activities.

Students should be able to:

- ☐ Assemble all parts and electronic components to create a robot that fits the brief.
- ☐ Test and evaluate finished product.
- ☐ Display images of their finished robot in their books.

Keywords	**What are the keywords the students must learn?** • Assemble • Evaluate
Resources	**What resources are required?** • textbooks • projector • sketching equipment • Vex robotics kit • Autodesk Inventor
Prior Knowledge	• Autodesk inventor • Clawbot • Robotics • Engineering • Vex robotics kit

Possible Teaching Method(s) or Approach for this lesson

- Collaborative Teaching (student centred)
- Instructional / Demonstrative Teaching (teacher centred)
- Inquiry-based Teaching (student centred)
- Lecture Style Teaching (teacher centred)
- Coach Style Teaching (teacher centred)
- Facilitator Style Teaching (student centred)

Essential and non-essential Sections:

In some lessons it may not be possible to cover every section of the book due to time constraints or lesson variables. Below is a guideline to essential sections for examination and project knowledge.

Topic	Page	
	Essential	**Non-essential/Self Study**
Assembly of robot	Pg. 66	
Evaluation	Pg. 67-68	

Development [Phases or chunks of learning]: ***Note:*** *All lessons start with Phase 1, Lessons can move back and forth between phases 2 and 3 as content is covered and then students engage. All lessons must finish with phase 4 to evaluate learning.* **Phase 1 of lesson (Connect)** **Starter** Teacher to introduce students to the lesson aim. Teacher to place all student learning outcomes on the board and ensure student understanding of aims and outcomes. **Teacher Tip:** *Teacher to set high expectations which inspire, motivate and challenge pupils.* **Phase 2 of lesson (Activate)** Teacher to introduce students to assembly techniques using Vex robotics kits. Students to discuss their groups project and what assembly techniques could be used for their project. Teacher to present evaluation questions and ensure understanding. **Teacher Tip:** *Incorporate peer teaching if some groups are more proficient in assembly techniques than others* **Phase 3 of lesson (Engage and Demonstrate)** Students to begin assembling all parts of the of the robot or modification using Vex robotics kit. Teacher to facilitate as students assemble their robot. Students to power on and test their robot. Teacher to facilitate and provide feedback as necessary **Teacher Tip:**	**Notes for differentiation:** ***Note:*** *All lessons can be different depending on ability and success of previous lesson. Place additional notes or activities to cater for differentiation where necessary through ought the lesson.*	**Assessment Opportunities:** **Questioning.** **Assessment of Final assembled robot**

Use groupwork as appropriate, get to know your class and organise groups to support mixed ability's. **Phase 4 Plenary (Consolidate)** Teacher to facilitate as students complete final evaluation Teacher to break down the evaluation questions and ensure student understanding of what is being asked. Question pupils on what they have learned. Have project learning outcomes been met? Has the project aim been achieved? All students should complete student learning reflection.		**Written evaluation** **Oral Assessment** **Student reflection**

Answer Key/ Resources

Stage 6: Evaluation

Once students have finished modelling their project and assembling it with robotics kit, students should finish by testing and evaluating their work on this project.

Why is evaluation important?

It might be useful to discuss with students why evaluation and self-reflection is an important final stage of their project.

Evaluation affords the opportunity to reflect on the completed project. What went well and what could be improved in the future or what could I do better. It is a worthy learning process for overall improvement of our students in the subject of CDI.

What guidance can I give my students in completing the evaluation?

- Break down the evaluation questions and ensure student understanding of what is being asked.
- Facilitate as student's complete evaluation and submit.
- Encourage students not to just concentrate on the negatives but to really think about the positives, what went well and what are they most proud of.
- Facilitate students as they complete the student reflection section and point out the importance of reflection in all projects they complete.