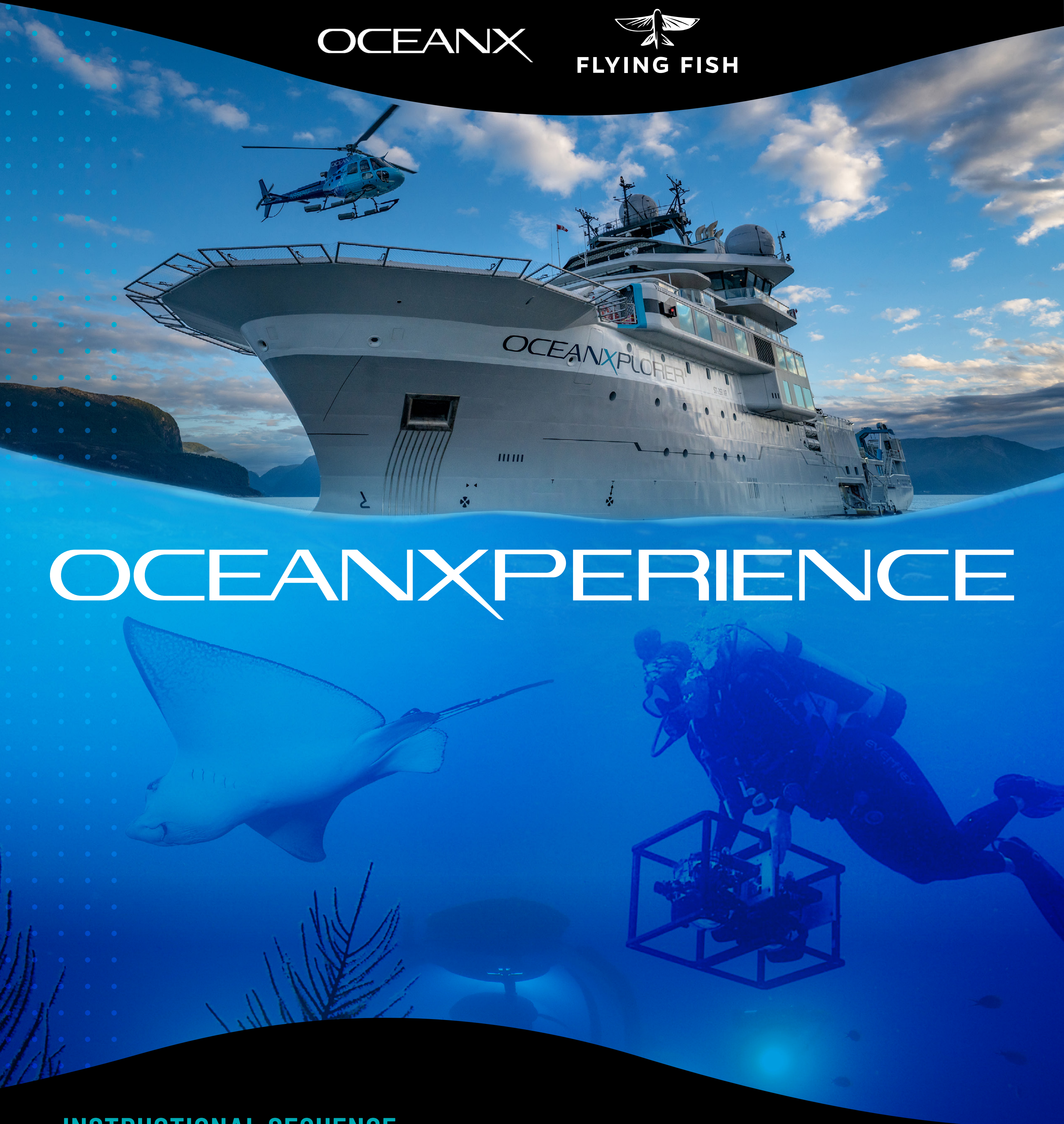
OCEANX
FLYING FISH



OCEANXPERIENCE

INSTRUCTIONAL SEQUENCE

DEEP-SEA VEHICLE ENGINEERING DESIGN CHALLENGE

The Engineering Process, Career Exploration

GRADE LEVEL: 6–8

ARIZONA SCIENCE CENTER
Never stop wondering.
Never stop imagining.™

Presented for Australian audience by:
WAM WESTERN AUSTRALIAN MUSEUM

PURPOSE

Marine scientists need a safe way to explore the depths of the ocean. Currently, deep-sea vehicles are used to aid scientists in conducting ocean research.

OBJECTIVE

Students will utilize 21st-century skills and the Engineering Design Process to design a model of a deep-sea vehicle similar to what they saw during their field trip to OceanXperience.

YEAR 6

DESIGN AND TECHNOLOGY

Design thinking skills – Investigating and defining:
WA6TDEDTID1 - Break down a design brief to define the purpose, requirements and constraints for a given task.

Design thinking skills – Designing:
WA6TDEDTD1 - Design alternative solutions achieved through an iterative process, including critical thinking, graphical representations, use of a range of technologies, techniques, technical terms and/or a sequence of steps.

Design thinking skills – Producing and implementing:
WA6TDEDTPI1 - Use a range of technologies, components and/or equipment to implement agreed protocols to produce a designed solution.

Design thinking skills – Evaluating:
WA6TDEDTE1 - Develop negotiated criteria to evaluate design features, graphics, selected technologies, processes and functionality with consideration of constraints for the designed solution.

YEAR 7

DESIGN AND TECHNOLOGY

Contexts - Materials and technologies specialisations:
WA7TDECMT1 - Properties of combined materials, features of production systems, given components, tools and equipment for quality, safely produced products. Social and ethical considerations for the design and development of products using specialised technologies, including ways products evolve locally to achieve designed solutions.

Technologies and society:
WA7TDETS1 - People in design and technologies occupations consider competing factors, social and ethical influences and existing technologies for designed solutions.

Design thinking skills – Investigating and defining:
WA7TDEDTID1 - Investigate and define the problem and requirements of a given design brief.

Design thinking skills – Designing:
WA7TDEDTD1 - Design processes and solutions with given technologies and techniques, using appropriate technical terms.

Design thinking skills – Producing and implementing:
WA7TDEDTPI1 - Implement agreed protocols and use a range of technologies, components and/or equipment to produce designed solutions.

Design thinking skills – Evaluating:
WA7TDEDTE1 - Use given contextual criteria to evaluate design processes and solutions.

YEAR 8

DESIGN AND TECHNOLOGY

Contexts - Engineering principles and systems:
WA8TDECEP1 - Force, motion and energy are used to control and manipulate engineered systems
Ethical and sustainable considerations for the design and development of engineered products and systems, including economic factors, use of locally or regionally sourced materials and reliable supply chains to achieve designed solutions.

Technologies and Society:
WA8TDETS2– Products, services and/or environments are designed and developed with creative and innovative application of technologies.

Design thinking skills – Investigating and defining:
WA8TDEDTID1 - Investigate a problem for a given need or opportunity.

Design thinking skills – Designing:
WA8TDEDTD1 - Design processes and solutions considering a range of technologies and techniques, using appropriate technical terms.

Design thinking skills – Producing and implementing:
WA8TDEDTPI1 - Implement agreed protocols, a range of technologies, techniques, components and processes to produce designed solutions.

Design thinking skills – Evaluating:
WA8TDEDTE1 - Use student-developed contextual criteria to evaluate design processes and solutions.

YEAR 9

DESIGN AND TECHNOLOGY

Contexts - Engineering principles and systems:
WA9TDECEP1 - Properties of materials, combined with force, motion and energy influence the design of engineered products and systems. Social, ethical and sustainable considerations for the design and development of engineered products and systems, including consumer and/or producer values and management of resources to achieve designed solutions for a specified community need.

Design thinking skills – Investigating and defining:
WA9TDEDTID1 - Ideate a problem and define the needs of an end user, through interviews and/or surveys.

WA9TDEDTID2 - Develop a design brief for a solution based on end user needs.

Design thinking skills – Designing:
WA9TDEDTD1 - Design alternative solutions considering available technologies, usability and aesthetics, using appropriate technical terms.

Design thinking skills – Producing and implementing:
WA9TDEDTPI1 - Select, implement and test a range of technologies, techniques and processes to produce designed solutions and/or prototypes.

Design thinking skills – Evaluating:
WA9TDEDTE1 - Evaluate design processes and solutions against student-developed criteria.

VOCABULARY

DEEP-SEA VEHICLE
A special type of vehicle that can travel and operate underwater.

BUOYANCY
The ability or tendency to float in water or air or some other fluid.

SUBMERSIBLE
Adjective: designed to be completely submerged or to operate while submerged.

Noun: a submersible boat or other craft, especially one designed for research and exploration.

BIOMIMICRY
When people use ideas from nature to solve real-world problems

MATERIALS

DEEP-SEA VEHICLE EDP HANDOUT

ASSORTMENT OF RECYCLED MATERIALS:

- PLASTIC BOTTLES OF DIFFERENT SIZES
- CARDBOARD
- PAPER PLATES
- STRAWS
- MASKING TAPE
- STRING
- PAPER CLIPS
- ALUMINUM FOIL
- CUPS
- ETC.

COMPUTER WITH INTERNET ACCESS

ONLINE RESOURCES

DEEP SEA VEHICLES

NEW DEEP-SEA ROBOT WILL HELP US EXPLORE OCEANS THROUGHOUT THE SOLAR SYSTEM

INTERVIEW WITH ERIC STACKPOLE, OCEANX MECHANICAL ENGINEER

ENGAGE

WHAT PROBLEM ARE WE TRYING TO SOLVE?

Thinking back to our field trip to *OceanXperience*, we were able to take a look at some of the deep-sea vehicles (DSV) that have been used to research the ocean in some way.

Have a quick class discussion about what students remember learning about the DSVs while on their field trip.

Another name for a DSV could be called a 'submersible'. How do you think we could define the word submersible?

Generate a student-friendly definition using student's ideas and responses. Add 'submersible' to class word wall.

Students view a **video** showing another one of OceanX's DSVs, named Orpheus.

Ask students- what is Orpheus' purpose? What are the researchers hoping to accomplish using Orpheus?

Tell students that Eric Stackpole is an inventor of one of the DSVs called OpenROV. Eric needs our help! The OceanXplorer's mechanical engineers need new ideas for their next DSV. They need you to design a DSV that can research the ocean while keeping ocean life safe.

Distribute a copy of DSV EDP handout to each student.

Ask students- What problem are we trying to solve? Possible responses may include: How can I design a DSV that can explore the ocean while keeping the ocean life safe?

Students fill in the 'Ask' section of the handout.

EXPLORE

IMAGINE SOME SOLUTIONS!

Students will use their research from the 'Ask' section to brainstorm at least two ideas for a new DSV that can explore the ocean without harming the creatures that live there.

Students should complete the 'Imagine' section independently, using drawings and/or descriptions to explain their DSV ideas. Remind students that their design will be unmanned.

LET'S MAKE A PLAN!

After students complete the 'imagine' section independently, arrange students into groups of three or four.

Within their groups, students take turns sharing their ideas for their DSV. After all members have shared, groups must decide on a shared plan to build as a team. Encourage teams to include ideas from each member of their group in their final design.

Once teams decide on a design, students complete the 'plan' section of their handout, including a diagram and a list of materials they will use to create a model of their DSV.

TIME TO BUILD!

After teams have finalized their design and planning, it is time to build! Provide students with an assortment of recycled materials, such as plastic bottles of different sizes, cardboard, paper plates, straws, masking tape, string, paper clips, aluminum foil, cups, etc. to use to make a model of their design.

EXPLAIN

CAN WE MAKE IT BETTER?

Once teams have finished creating their models, facilitate a feedback session with the class. Explain to students that half of their team will stay with their model while the other members of their team visit the other groups. Halfway through the feedback session, have team members switch roles to provide an opportunity for everyone to both receive and give feedback.

Teams note feedback and decide on something that they need to improve. Give teams time to improve their original models.

Students complete the 'Improve' section of the handout.

EXTEND

Students can learn more about Eric Stackpole and his career as a mechanical engineer specializing in DSVs. A good resource is this **video** of an interview Eric did with students from several different schools:

Students can use 3D printing software such as **TinkerCAD** to create a model of their DSV.

Educators can connect with scientists specializing in mechanical engineering, marine biology, or other areas via **Skype** a Scientist. This platform will connect classrooms with a scientist via Skype or Zoom. Students can present their models to the scientist for feedback.

Students can modify their original designs by adding at least one feature that is based on biomimicry.

Challenge your students to use their knowledge of ratios and proportions to make their model a ratio of a true-to-size model.

EVALUATE

Students complete the 'Reflection' section of the handout.

DEEP-SEA VEHICLE CHALLENGE

ASK		
What problem are we trying to solve? Use the OceanX Deep-Sea Vehicle webpage to answer the following research questions: **https://oceanx.org/oceanxplorer/deep-sea-vehicles**		
NAME OF DEEP-SEA VEHICLE:	INTERESTING/USEFUL FEATURES:	PURPOSE:
NADIR + NEPTUNE		
ARGUS ROV		
REMUS AUV		

IMAGINE

What are some solutions? (at least two)

PLAN

Choose the best idea from the 'Imagine' section.
Draw a diagram of the idea including labels.

Decide what materials are needed.
List the materials and the quantity needed.

CREATE

Build your design.	
What worked well?	What didn't work so well?

IMPROVE

How can I make my design better? Try again!	
Revised design	What worked well?
Revised materials	What didn't work so well?

REFLECT

Do you think exploring the ocean floor would be as interesting as exploring space? Why or why not? Compare and discuss your answers as a group.