07

The Smallpeice Trust

ENGINEERING @SCHOOL

The Keyhole Surgery Challenge

Subject: STEM/Engineering

Year group: 5-7

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#EngineeringAtSchool

KEYHOLE SURGERY SIMULATOR TEACHER GUIDANCE

This activity can be used as one of eight towards students obtaining the CREST SuperStar Award.

What Is CREST?

CREST is a nationally recognised scheme for student-led project work in the STEM subjects (science, technology, engineering and maths).

CREST gives young people aged 5–19 the chance to choose their own subject and methodology when completing their hands-on investigation.

CREST provides activities and project ideas for a range of ages, group size and abilities. From off-the-shelf, one-hour long challenges through to large-scale, student-led projects of over 70 hours work or more, CREST can be done by anyone.

What is CREST SuperStar?

SuperStar level is designed to be easy-to-run and low-cost for children typically aged 7-11 years. Children gain an Award by completing eight challenges.

You can download a CREST SuperStar passport template for your students to track their progress once you create an account via

www.crestawards.org/crest-superstar

ENTRY FEE per child: £1 UK / £4 International*

Within four weeks of payment, you will receive certificates and fabric badges to give out to your class.

LENGTH OF LESSON: 1-2 HOURS

How to make your keyhole surgery simulator:

https://bit.ly/2YaHLNy

LESSON OVERVIEW

Students work in teams of "engineers" to design and build their own keyhole surgery simulator out of everyday items. They test their laparoscopic instruments, evaluate their results, and present to the class.

Learning Objectives

During this lesson, students will:

- Design and construct a keyhole surgery simulator
- Test and refine their designs
- Communicate their design process and results

Learning Outcomes

- To develop and understanding of biomedical engineering
- To develop an understanding of keyhole surgery
- To design and build models by using different materials and to test selected functional characteristic of the model built with the chosen materials

Key Vocabulary:

LAPAROSCOPY, KEYHOLE, SURGERY, SURGEON, BIOMEDICAL, ENGINEERING

Curriculum links

SCIENCE KEY STAGE 2

- Working scientifically: asking relevant questions and using different types of scientific enquiries to answer them
- Working scientifically: setting up simple practical enquiries, comparative and fair tests
- Working scientifically: making systematic and careful observations and, where appropriate, taking accurate measurements using standard units, using a range of equipment, including thermometers and data loggers
- Working scientifically: gathering, recording, classifying and presenting data in a variety of ways to help in answering questions
- Working scientifically: recording findings using simple scientific language, drawings, labelled diagrams, keys, bar charts, and tables
- Working scientifically: using results to draw simple conclusions, make predictions for new values, suggest improvements and raise further questions

DESIGN & TECHNOLOGY KEY STAGE 2

- Use research and develop design criteria to inform the design of innovative, functional, appealing products that are fit for purpose, aimed at individuals or groups
- Generate, develop, model and communicate their ideas through discussion, annotated sketches, cross-sectional and exploded diagrams, prototypes, pattern pieces and computer-aided design
- Select from and use a wider range of tools and equipment to perform practical tasks [for example, cutting, shaping, joining and finishing], accurately
- Apply their understanding of how to strengthen, stiffen and reinforce more complex structures

INTRODUCTION

What is Biomedical engineering?

Explain to students that: Biomedical engineers design, test, modify, and evaluate medical equipment used to interface or interact with the human body.

What is keyhole surgery?

Explain to students that: keyhole (laparoscopic) surgery, is a minimally invasive surgery where a surgeon inserts surgical instruments to perform complex operations.

What instruments do surgeons use?

Explain to students that: Specific surgical instruments used in keyhole surgery include obstetrical forceps, probes, dissectors, hooks, and retractors.

Materials

1. CAMERA-ENABLE DEVICE (E.G. SMARTPHONE)
2. CARDBOARD BOXES
3. CARDBOARD TUBES
4. STRING/RIBBON
5. SELLOTAPE
6. SCISSORS
7. STRAWS
8. BAMBOO SKEWERS
9. COCKTAIL STICKS
10. BLUE TAC
11. PIPE CLEANERS
12. PAPERCLIPS
13. RUBBER BAND

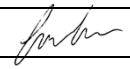
MAIN ACTIVITY

1. Students will need to work in pairs for this activity.
2. Explain that students must develop a keyhole surgery simulator from everyday items.
3. Ask students to develop a plan for their keyhole surgery instruments. They will need to decide and agree on the materials they will use, write/draw their plan, and present their plan to the class.
4. Show students the student activity sheet and explain that they will need to follow the instructions to make their keyhole surgery simulator.
5. Student groups next execute their plans and build their simulator using the materials they have chosen. They may need to rethink their plan, request other materials, or start again if the materials chosen are not working.
6. Next, teams will test their instruments on their simulator.
7. Teams complete an evaluation / reflection worksheet, and present to the class.

PLENARY (QUESTIONS TO ASK STUDENTS)

1. **Did you succeed in creating a simulator?**
2. **Which materials did you use for your simulator?**
3. **What challenges were you able to complete?**
4. **Did you decide to revise your original design or request additional materials while in the construction phase? Why?**
5. **If you could have had access to materials that were different than those provided, what would your team have requested? Why?**
6. **Do you think engineers have to adapt their original plans during the construction of systems or products? Why might they?**
7. **If you had to do it all over again, how would your planned design change? Why?**
8. **What designs or methods did you see other teams try that you thought worked well?**
9. **Do you think you would have been able to complete this project easier if you were working alone? Explain…**

STEM Day Risk Assessment

Risk Assessment for	Engineering at School Projects
Assessment undertaken on	31/03/2020
Assessment undertaken by	Jessica Lee
Signed	

No.	Activity/area being assessed	Associated risk	Who is at risk?	Existing control measures in place?	Level of risk (low, medium, high)	Responsibility
1	General Activity and Workspace	**Slips, trips and falls:** Injury due to tripping over items	Students and adults	Activity supervised by adult supervisor. Deliverer reminds students about safety in video introduction.	M	Students and adults
2	Use of Materials: paper/card, plastic containers	**Injuries:** Injury due to paper cuts, cuts from sharp edges **Injuries:** Injury due to misuse	Students and adults	Activity supervised by adult supervisor.	L	Students and adults
3	Use of materials: elastic bands, sellotape, glue stick, blu-tack, small toys, paper fasteners, LEGO pieces, nuts & bolts or equivalent.	**Injuries:** Injury due to use as a missile **Slips, trips and falls:** Injury due to slipping on dropped items **Injuries:** Ingestion risk of choking.	Students and adults Students and adults Students and adults	Activity supervised by adult supervisor. Activity supervised by adult supervisor. Activity supervised by adult supervisor.	L	Students and adults
4	Use of materials: plastic, corrugated carboard	**Injuries:** Cuts from sharp edges	Students and adults	Activity supervised by adult supervisor.	L	Students and adults

No.	Activity/area being assessed	Associated risk	Who is at risk?	Existing control measures in place?	Level of risk (low, medium, high)	Responsibility
5	Use of sharp tools: Scissors, craft knives	**Injuries:** Cut to self	Students	Activity supervised by adult supervisor.	M	Students and adults
		Behaviour: Cut to others	Students and adults	Activity supervised by adult supervisor.	L	Students and adults
		Behaviour: Vandalism of property	School or home	Activity supervised by adult supervisor.	L	Students and adults
6	Testing of projects: bathtub, drop from height, items on floor	**Spillage of water on floor**: damage and injury due to slip	Students and adults	Activity supervised by adult supervisor.	L	Students and adults
		Slip, trip or fall: Injury due to falling from testing area, tripping over items in testing space	Students and adults	Activity supervised by adult supervisor.	L	Students and adults

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The Keyhole Surgery Challenge

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Suitable for ages:	Time needed:
5+	1hr+

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DESIGN A KEYHOLE SURGERY SIMULATOR

You are a team of engineers who have been given the challenge to design your own keyhole surgery simulator out of everyday items.

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What is keyhole surgery?

Laparoscopic surgery, also called keyhole surgery, is a minimally invasive surgery done literally through keyholes, of which the surgeon inserts surgical equipment to perform complex operations.

PLANNING STAGE

In your team, discuss the problem you need to solve. Then develop and agree on a design for your keyhole surgery simulator and instruments. You'll need to decide and agree what materials you want to use.

Draw your design in the box and label the different parts and materials you plan to use. Present your design to the class.

You may choose to revise your team's plan after you receive feedback from class.

KEYHOLE SURGERY SIMULATOR DESIGN & MATERIALS

MATERIALS

1. CAMERA-ENABLE DEVICE (e.g. SMARTPHONE)
2. CARDBOARD BOXES
3. CARDBOARD TUBES
4. STRING/RIBBON
5. SELLOTAPE
6. SCISSORS
7. STRAWS
8. BAMBOO SKEWERS
9. COCKTAIL STICKS
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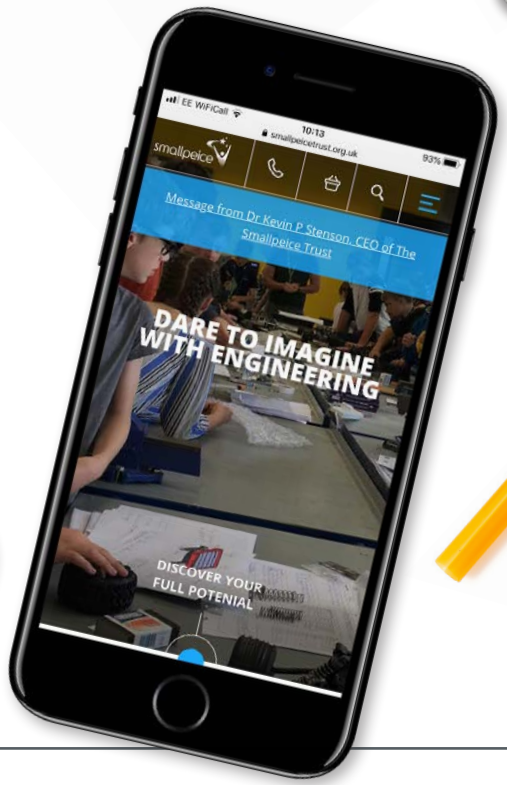
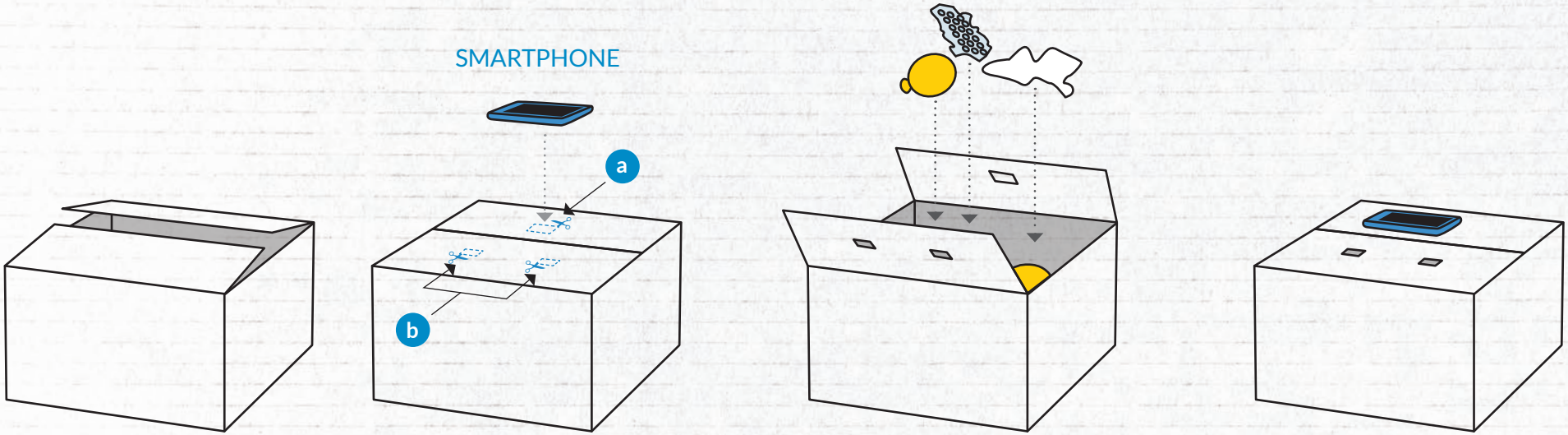
13. RUBBER BAND



CREATING THE SIMULATOR



1.

Source a large cardboard box.

2.

Cut three holes into the top:

- **a** One for the camera and flash
- **b** Two for the keyhole surgery tools

3.

Create some obstacles inside the simulator. For example, you could line the inside with balloons, tissue paper, packing peanuts, bubble wrap – whatever you can get your hands on!

4.

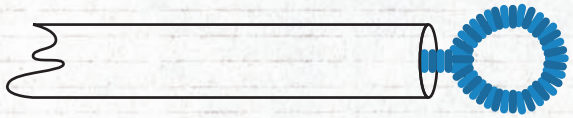
Design your challenges. There are three examples on page 6, but be creative!

DIFFERENT TYPES OF INSTRUMENTS YOU CAN BUILD

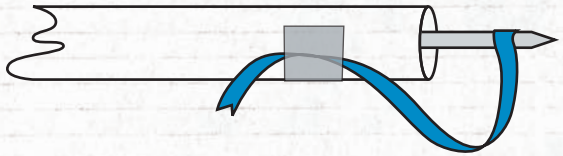
HOOK

TRIDENT

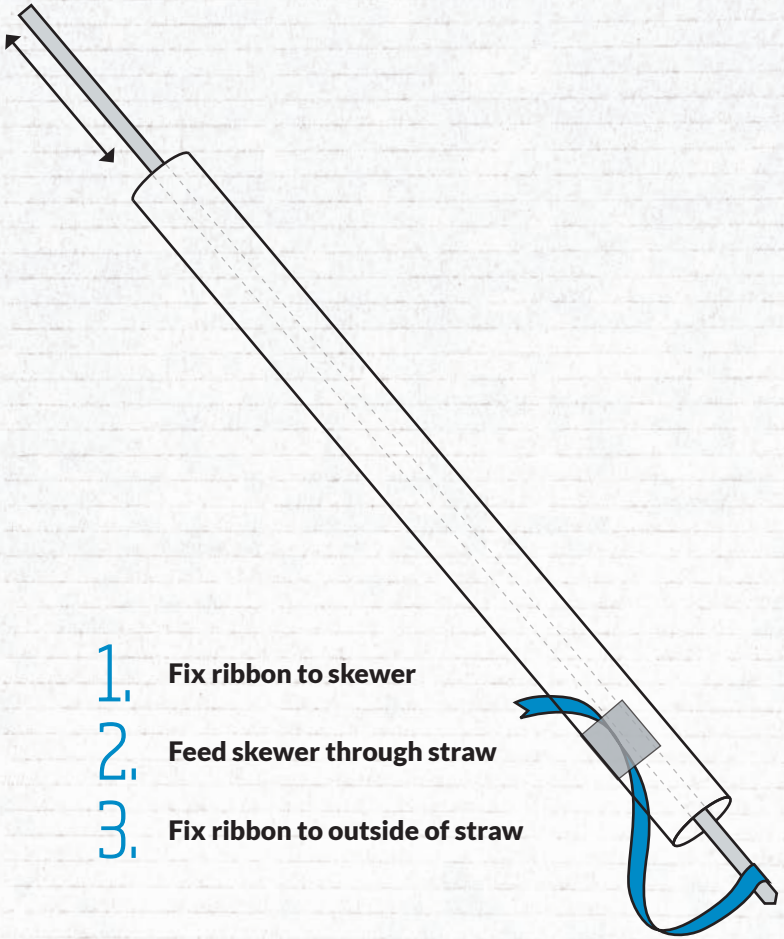
LOOP



SNARE

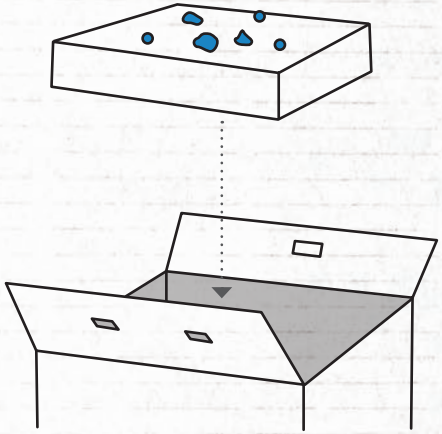


CRAFTING A SNARE



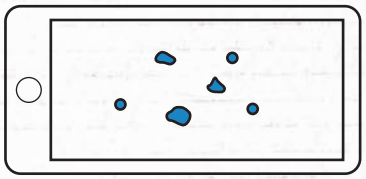
1. **Fix ribbon to skewer**
2. **Feed skewer through straw**
3. **Fix ribbon to outside of straw**

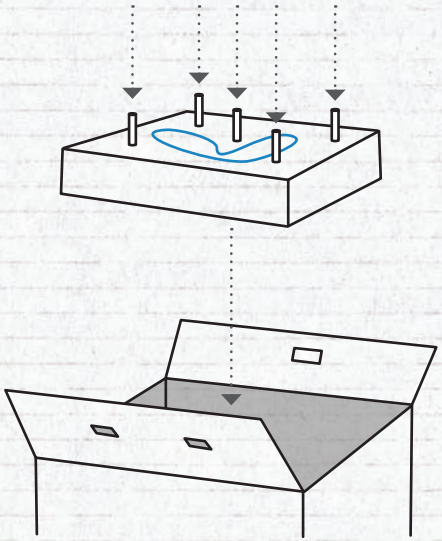
CHALLENGE EXAMPLES



#1 AGAINST THE CLOCK

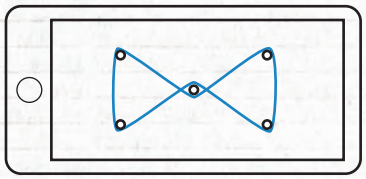
Remove the marbles as quickly as possible

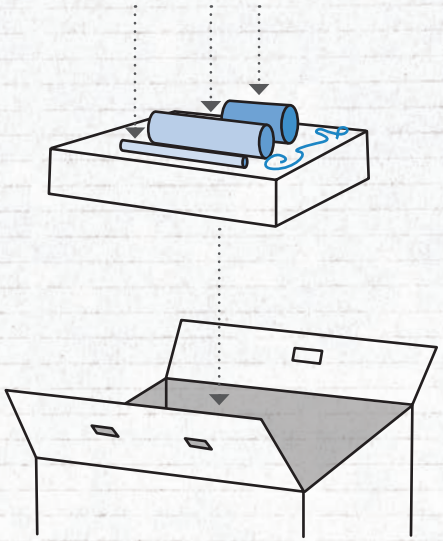




#2 FIGURE OF EIGHT

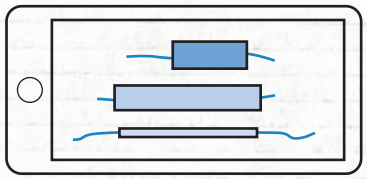
Loop the rubber band around the sticks in a figure of eight





#3 THROUGH THE LOOP

Loop the shoelace through the different tubes



TESTING STAGE

Each team will test their simulator.

KEYHOLE SURGERY SIMULATOR DATA

	Surgeon One	Surgeon Two
Test 1 AGAINST THE CLOCK	TIME:	TIME:
Test 2 FIGURE OF EIGHT	TIME:	TIME:
Test 3 THROUGH THE LOOP	TIME:	TIME:

EVALUATION STAGE

Evaluate your team's results, complete the evaluation worksheet, and present your findings to the class.

Use this worksheet to evaluate your team's results in the Keyhole Surgery Simulator Challenge.

1. **Did you succeed in creating a simulator?**

2. **Which materials did you use for your simulator?**

3. **What challenges were you able to complete?**

4. **Did you decide to revise your original design or request additional materials while in the construction phase? Why?**

5. **If you could have had access to materials that were different than those provided, what would your team have requested? Why?**

6. **Do you think engineers have to adapt their original plans during the construction of systems or products? Why might they?**

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