

AIMING FOR
AWESOME

2018

1918



Logistics challenge

Teacher's Guide



Royal Academy
of Engineering

THIS IS
ENGINEERING

ROYAL
AIR FORCE
Youth STEM

The aim of this resource is to give students the opportunity to investigate how science, technology, engineering and mathematics (STEM) is used when planning a mission.



Curriculum links

England

Activity	Key Stage	Subject	National Curriculum
Time to plan	KS2	Mathematics	Number: addition and subtraction Number: number and place value Number: fractions
Time to plan	KS3	Mathematics	Working mathematically: solve problems

Scotland

Activity	Subject	Topic	Experiences and outcomes
Time to plan	Numeracy and mathematics	Number and number process Time	MNU 2-03a, MNU 3-03a MNU 2-10c, MNU 3-10a

Wales

Activity	Key Stage	Subject	National Curriculum
Time to plan	KS2	Mathematics	Using number skills: use number facts and relationships Using number skills: fractions, decimals, percentages and ratio
Time to plan	KS3	Mathematics	Developing numerical reasoning: identify processes and connections

Northern Ireland

Activity	Key Stage	Subject	National Curriculum
Time to plan	KS2	Mathematics and numeracy	Number: understanding number and number notation

Preparation

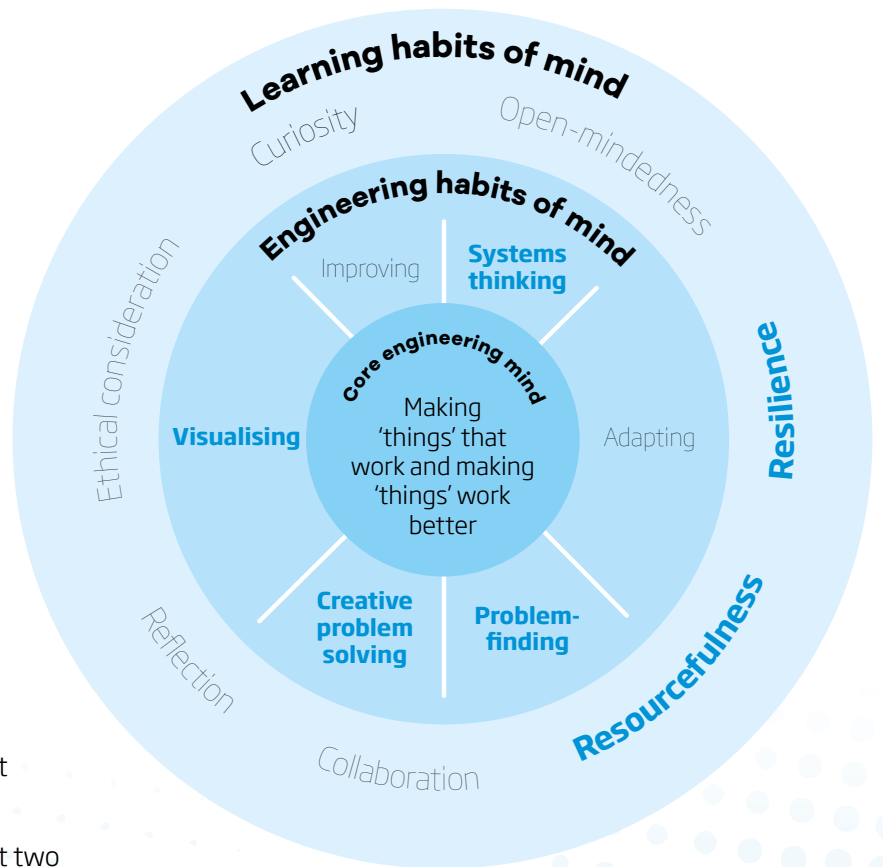
- » Ensure all materials and equipment needed is available well in advance of the session.
- » A full risk assessment should be conducted prior to the session.
- » This session is expected to last 60 minutes.

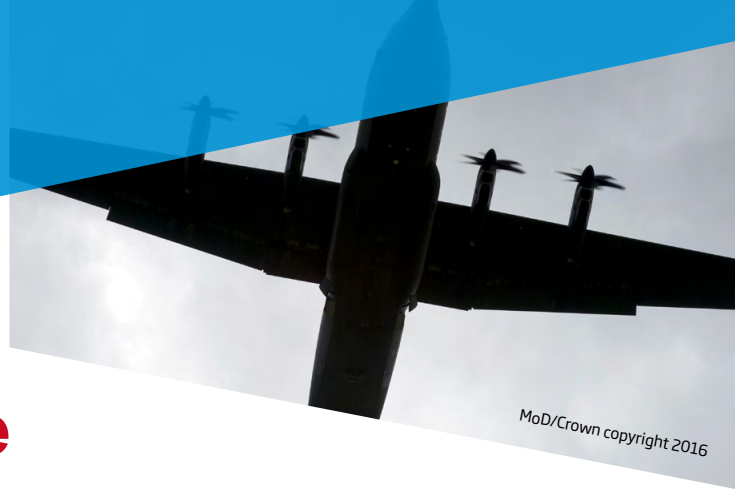
This resource has been linked to the Engineering Habits of Mind (EHoM). For more information about the EHoM please see the information sheet provided or www.raeng.org.uk/l/bae.

Resource list

For this activity, you will need the following per group:

- » Copy of logistics challenge support sheet one
- » Copy of logistics challenge support sheet two
- » Paper
- » Pencil or pen





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Operation Cheshire

Operation Cheshire, the operation to deliver aid to inhabitants of Sarajevo, the capital of Bosnia and Herzegovina, during the civil war in the early 1990s was the longest running airlift in the RAF's history.

Road and rail networks had been destroyed or cut off by the conflict so delivering aid by air was the only way to ensure it was delivered to those who needed it. For almost four years the RAF used Hercules

C130 aircraft to deliver supplies to those trapped by the fighting.

By the end of the operation the RAF had delivered over 26,000 tonnes of supplies.

TIME TO PLAN

You are a logistics team working for the RAF to plan and deliver humanitarian aid to the people of Sarajevo.

You need to use all the information to work out a movement plan that demonstrates how you will deliver all the essential equipment from RAF Leeming to Sarajevo. Delivering humanitarian aid to a war zone requires a different approach to delivering aid in the aftermath of a natural disaster.

To assist with your mission, you have been given access to a Hercules C130s aircraft.

Part one

One of the key supplies that civilians will need is water. It is currently recommended that a person drinks 1.2 litres of water a day.

» If you are delivering aid for 5,500 people to last 10 days, how much water will you need to deliver?

Step 1: calculate how much water one person will need for 10 days.

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Step 2: calculate how much water 5,500 people would need.

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Answers provided to STEM activity leader

Step 1:

For 5 days, a person would need **6 litres** of water

Step 2:

5,500 people would need **66000 litres**

Using the long multiplication method:

$$\begin{array}{r}
 5500 \\
 \times 12 \\
 \hline
 11000 \\
 + 55000 \\
 \hline
 66000
 \end{array}$$

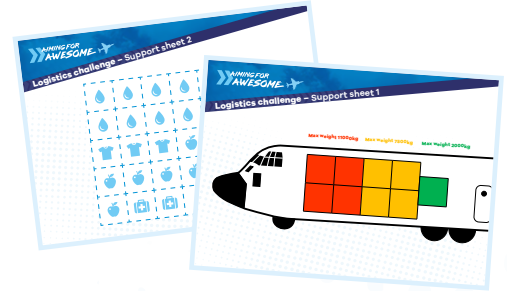
Part two

This much water will take up too much space on an aircraft, so instead of delivering water the RAF deliver water purification systems.

Next, you must pack your aircraft. You will be delivering emergency lifesaving aid, including food, water purification systems, healthcare and clothes. Complete the table below and use logistics challenge support sheet one to work out the best way to pack your aircraft to make the fewest journeys.

Aircraft information

Flying speed:	330mph
Maximum load:	20,500kg
Pallet space:	9 pallets
Range:	2400 miles
Time to load:	5 minutes per 1000 kg of weight
Time to unload:	10 minutes per 1000 kg of weight
Time to refuel:	2 hours



Aid items to be sent:

Item	Quantity to be sent	Number of items per pallet	Number of pallets	Weight per pallet (kg)	Total weight (kg)
Water purification	360	30	12	3000	36000
Food	10000	1000	10	2000	20000
Medicine	1000	500	2	1000	2000
Clothes	500 bags	200 bags	3	500	1500

Answers provided to STEM activity leader

For this task, each group should have a copy of logistics challenge support sheet one and one pack of equipment cards. More cards can be made by photocopying logistics challenge support sheet two.

It will take three flights to deliver all the aid, and the aircraft can be packed as below:

Water purification	Water purification	Clothes	Food	Medicine
Water purification	Food	Food	Water purification	

Total weight = 20500kg

Water purification	Water purification	Clothes	Food	Medicine
Water purification	Food	Food	Water purification	

Total weight = 19500kg

Water purification	Water purification	Clothes	Food	Food
Water purification	Food	Food	Water purification	

Total weight = 19500kg



Part three

Now you must work out the time it will take for you to deliver the all equipment and return to base.

The distance from RAF Leeming to Sarajevo is 1155 miles

Hints:

- » break each stage of the journey down into time to load the aircraft, time to fly and time to unload.
- » do not forget to refuel your aircraft after 2400 miles
- » it might be easier to calculate the time to pack the aircraft in minutes first and then convert to time in hours. Remember; there are 60 minutes in an hour.
- » to calculate the flight time, use the equation $\text{speed} = \text{distance} \div \text{time}$.

What can you do to reduce the total delivery time?

Answers provided to STEM activity leader

The total mission time is 39 hours, 52 minutes 30 seconds. This can be reduced to 36 hours, 32 minutes 30 seconds by loading and refuelling the aircraft at the same time. Pupils will have a different total mission time if they have loaded the aircraft differently.

Flight one

Load time = 1 hr 37 mins 30 sec

$$(19500 \div 1000) \times 5 \text{ minutes} = 97.5 \text{ minutes}$$

Flight time = 3 hrs 30 mins

$$\text{time} = \frac{\text{distance}}{\text{speed}} = \frac{1155}{330}$$

= 3.5 hours

Unload time = 3 hrs 15 mins

$$19500 \div 1000 \times 10 \text{ minutes} = 195 \text{ minutes}$$

Return flight time = 3 hrs 30 mins

$$\text{time} = \frac{\text{distance}}{\text{speed}} = \frac{1155}{330}$$

= 3.5 hours

Total = 11 hours 52 minutes 30 seconds

Flight two

Refuel time: 2 hours

Load time = 1 hr 37 mins 30 sec

$$(19500 \div 1000) \times 5 \text{ minutes} = 97.5 \text{ minutes}$$

Flight time = 3 hrs 30 mins

$$\text{time} = \frac{\text{distance}}{\text{speed}} = \frac{1155}{330}$$

= 3.5 hours

Unload time = 3 hrs 15 mins

$$(19500 \div 1000) \times 10 \text{ minutes} = 195 \text{ minutes}$$

Return flight time = 3 hrs 30 mins

$$\text{time} = \frac{\text{distance}}{\text{speed}} = \frac{1155}{330}$$

= 3.5 hours

Total = 13 hours 52 minutes 30 seconds

Flight three

Refuel time: 2 hours

Load time = 1 hr 42 mins 30 sec

$$(20500 \div 1000) \times 5 \text{ minutes} = 102.5 \text{ minutes}$$

Flight time = 3 hrs 30 mins

$$\text{time} = \frac{\text{distance}}{\text{speed}} = \frac{1155}{330}$$

= 3.5 hours

Unload time = 3 hrs 25 mins

$$(20500 \div 1000) \times 10 \text{ minutes} = 205 \text{ minutes}$$

Return flight time = 3 hrs 30 mins

$$\text{time} = \frac{\text{distance}}{\text{speed}} = \frac{1155}{330}$$

= 3.5 hours

Total = 14 hours 7 minutes 30 seconds





Royal Academy of Engineering

The Royal Academy of Engineering is harnessing the power of engineering to build a sustainable society and an inclusive economy that works for everyone.

In collaboration with our Fellows and partners, we're growing talent and developing skills for the future, driving innovation and building global partnerships, and influencing policy and engaging the public.

Together we're working to tackle the greatest challenges of our age.

What we do

Talent & diversity

We're growing talent by training, supporting, mentoring and funding the most talented and creative researchers, innovators and leaders from across the engineering profession.

We're developing skills for the future by identifying the challenges of an ever-changing world and developing the skills and approaches we need to build a resilient and diverse engineering profession.

Innovation

We're driving innovation by investing in some of the country's most creative and exciting engineering ideas and businesses.

We're building global partnerships that bring the world's best engineers from industry, entrepreneurship and academia together to collaborate on creative innovations that address the greatest global challenges of our age.

Policy & engagement

We're influencing policy through the National Engineering Policy Centre – providing independent expert support to policymakers on issues of importance.

We're engaging the public by opening their eyes to the wonders of engineering and inspiring young people to become the next generation of engineers.



The RAF Youth STEM programme is designed to engage and inspire young people by building their interest in engineering and technical career pathways.

From cyber specialists to aerospace, aviation, electronics, and mechanical disciplines, the RAF is committed to widening participation in STEM, extending opportunities to all, and encouraging greater diversity in this critical area of national skills shortages.

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