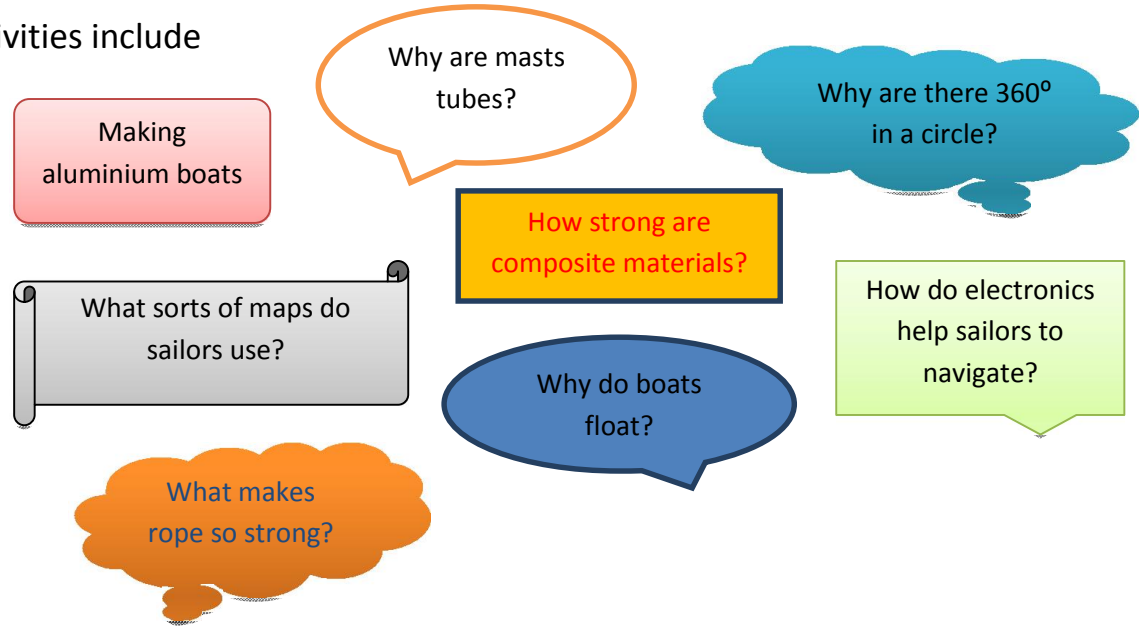
Secondary School Boat Show Resources

Notes for Teachers

The purpose is to create a series of engaging cross curricular lessons, that will help students to get a lot more out of Boat Show visits.

Activities include



The Department for Education is in the process of updating the national curriculum. One of the aims is for schools to provide a stimulating curriculum, with relevance to real world situations. Though these resources are aimed at key stage 3, we encourage schools to adapt them to suit individual needs.

These resources are divided into 4 main areas as set out below

Navigation

Curriculum Areas	Learning Objectives
Key stage 3 Geography Key stage 3 Maths Key stage 3 Design and technology Key stage 3 ICT	1. What is latitude and longitude 2. Why there are 360^{o} in a circle 3. Characteristics of charts 4. How electronic aids help with navigation.

Boat Building

Curriculum Areas	Learning Objectives
Key stage 3 Science Key stage 3 Design and Technology	1. Advantages of different boat building materials. 2. How boats made of materials heavier than water can float. 3. How boat builders make boats stronger.

Ropes and lines

Curriculum Areas	Learning Objectives
Key stage 3 Science Key stage 3 Design and Technology Key stage 3 History	1. The difference between synthetic and natural fibre rope. 2. How ropes are made. 3. What affects the properties of rope?

Masts and Rigging

Curriculum Areas	Learning Objectives
Key stage 3 Science Key stage 3 Design and Technology	1. The effect of shape on mechanical strength. 2. How mast riggers can make strong, tall masts.

As all schools vary in the equipment available and duration of individual lessons, it is important that teachers use the suggested lesson plans just as a guide, and adapt them to their own school conditions and needs of the pupils.

With all school based experiments, it is the teachers own responsibility to thoroughly risk assess all activities before taking part in them with their pupils.

Contents

These teachers notes go with the separate pupil packs for each section

Navigation

Learning objectives:

What is latitude and longitude?

Why there are 360^{o} in a circle.

The Characteristics of marine charts.

How electronic aids help with navigation.

Resources needed:

A large globe that you can write on with a dry wipe pen is useful to show the equator, prime meridian and to show the answers to some of the questions on the sheet.

You may find it useful to have copies of a school atlas showing the UK with latitude and longitude lines, or to search for a suitable image on the internet. Students can also obtain the coordinates of a place from Google maps by right clicking on a place and selecting “what is here”. This will drop a green arrow on the map, and when the curser next passes over it, the latitude and longitude are shown.

Navigation Lesson Plan

Introduction

10 Minutes If you have access to a computer projector a good scene setter is to have an image of the Scilly Islands showing as the class come in, and to start the lesson with a recounting of the loss of 2000 men in the Scilly Naval disaster of 1707. Pose the problem to the class of how could the Navy have known where the Scilly Isles are? The technique before Longitude was to use ***dead reckoning***. This is done by accurately knowing how far you have sailed and in which direction.

Main Activity

10 Minutes Introduce the concept of latitude and longitude, using the student sheet.

10 Minutes The section on why there are 360^{o} to go around in a circle is a useful link to maths, and helps students to understand some short cuts in navigation later on in their studies.

10 Minutes This is an introduction to maritime charts. The buff coloured areas are land all the time. Green areas cover and uncover with the tides. The blue to white areas show water, the deeper the water, the lighter the colour. The little numbers show the depth of water at the lowest astronomical tide in meters and tenths of a meter. Finally on the Bramble Bank question the line under the little numbers on the green areas show by how much these areas stick up out the water at the lowest astronomical tide.

Navigation Lesson Plan continued

Plenary

10 Minutes Talk about the challenges faced by Hilary Lister in her circumnavigation of Britain. This is a good way to introduce the need for a passage plan and to introduce modern electronic navigation aids, which can be picked up on with the boat show exercise.
The passage plan exercise question on latitude and longitude could be set as a homework exercise.

At the Show

The boat show 7 questions, at the end of the navigation student sheets are designed to encourage students to find out how modern electronics can both be an aid to navigation and to increase safety at sea. Very brief and massively simplified answers to these questions are.

1.) An autopilot uses an electronic compass linked to a computer to automatically steer the ship.
2.) A chart plotter is an electronic copy of a chart, but it shows more than just where your boat is relative to land, all sorts of other electronic information can be shown as well, such as the positions of other ships.
3.) Radar gets its name from **ra**dio **d**etection **a**nd **r**anging. Radars bounce microwaves of other ships to work out how far they are away and in which direction they are in.

4.) Echo sounders use sound instead of microwaves, but work out how deep the sea is in a similar way to radar, by measuring how long it takes for a ping of sound to bounce off the bottom of the sea and back to the ship.

5.) A.I.S. is the Automatic Identification System. In simple terms ships fitted with an A.I.S. unit send out a signal that identifies the ship, it's position and how fast it is going among other things. Other boats can then receive this information and show the location of the other boats on a suitable chart plotter.

6.) A DSC radio is a digital selective calling radio. A DSC ships radio has an emergency distress button. After a short press the person can select the nature of the distress such as fire. The radio will then send an automatic signal with the location of the vessel on fire to the coast guard and other ships.

7.) There are many smart phone applications that are being developed all the time. These are very good additional aids to supplement existing equipment that is onboard the boat. They should not be the sole means of communication however, as though other vessels can pick up a VHF radio call and come to assistance, a phone call made on a smart phone cannot be picked up by others who may be able to help the boat that is in distress. Smart phones using an internal GPS do not tend to have a long battery life, so unless there is a means to charge them onboard, they may go flat half way through a voyage.

Boat Building Materials

Learning objectives: Advantages of different boat building materials.

How boats made of materials heavier than water can float.

How boat builders make boats stronger.

Resources needed:

How do boats float?

Tall large glass beaker or jug, Cooking Oil, Golden Syrup,

Water, String, Newton meter or spring balance,

Objects to test for example a metal block, rubber bung and piece of wood.

This is best run as a class demonstration, but it a very good explanation of the effects of relative density on flotation. You could start by asking the children to predict which liquid will float on which.

You need to ensure that your Newton meter is sensitive enough to record the weight of the objects. As you lower the objects into the beaker, on their bits of string, you should be able to see a difference in weight.

The different objects should float at different levels in the Jug depending on the density of the object and the density of the fluid. For brighter students, this is good opportunity to bring in how submarines work and the Plimsoll line on ships.

Boat Building Materials continued

Boat Building Materials continued

You must carry out your own risk assessment, if you are breaking materials.

Because the pykrete will take overnight to freeze this will probably need to be run over several lessons. A suggestion is to do the why boats float activity, followed by making up the pykrete in the first lesson. Use the second lesson to carry out the making aluminium boats, and the final lesson to actually test to destruction the pykrete and super pykrete.

Introduction

10 Minutes

A possible scene setter is to have images of the SS Great Britain alongside images of modern yachts showing on the white board as the class enters the room. You could start by saying that when Brunel suggested building a ship out of iron, lots of people thought that because iron sinks his ship would sink. This is a good starting point for a class brainstorm on what boats are made of.

Main Activity 1

15 minutes

Why do boats float? Start with the oil, syrup and water in separate beakers. Pour the water in first, ask the students what will happen when you pour the oil in – this should be easy for the students to answer. Finally pour in the syrup. Ask the class what the relationship is between what they observed and the relative density of each liquid.

Next try asking the students to predict what will happen to the weight of the metal block, rubber bung and piece of wood as you lower them into the big beaker of liquids.

The rubber bung should sink through the oil and water but float on the syrup layer. As the wood is lowered in the force on the newton meter should go to zero at the point where it is floating (This is when the up thrust buoyancy force is in equilibrium with the gravitational force due to its mass). With the metal block, you should see a slight decrease in the newton meter reading as the block is submerged in the water even though it sinks to the bottom. The gravitational force on it is greater than any up thrust on it so its sinks.

This demonstration is a good starting point for a discussion on how submarines float, or the need for the Plimsoll line on ships.

10 Minutes If a solid metal block sinks, how do metal boats float? This is a good opportunity for a class discussion to get the students ideas. At this point you can outline what you are going to investigate next lesson with regards to making boat hulls, and the need this lesson to make up the composite materials for the final lesson.

10 Minutes As a teacher demonstration make up a plate of resin on its own; resin plus glass fibre and the pykrete and super pykrete for lesson 3. Draw the students attention to the ice being comparable to the resin, the wood being comparable to the glass fibres, and the super pykrete being comparable to the way carbon fibre works, with unidirectional fibres.

Boat building materials continued

Plenary

10 Minutes What other materials are boats made out of? Do all of these materials need to be able to float? What are some of the advantages or disadvantages of each material.

Boat building materials part two

How can you make an aluminium boat that floats?

Learning objective: Most boats need a structural framework to give them rigidity.

How different shaped hulls affect their stability

Introduction

5 minutes Recap on why boats float. Introduce the activity using the student sheet, “can you make an aluminium boat that floats”. Give out the first sheet of aluminium foil and weights.

Main Activity

10 minutes Students in groups of 3 have a go at folding the aluminium foil square into a rectangular barge shape. (a barge is easier than a boat shape)

They put their foil barges in a bowl of water and try adding weights. Ask the groups to feedback their observations.

5 minutes Explain to the class that boats normally have an internal framework of hull stiffners, bulkheads, ribs and beams to strengthen a relatively thin skin on the outside of the hull.

10 minutes Give the groups a second sheet of foil, some drinking straws and sticky tape. Ask the students to have a go at making an aluminium foil barge with hull stiffeners made of straws. The idea is to make a barge that is as stable as possible and can carry the biggest load.

Boat building materials continued

10 minutes Have a competition as to which groups barge is the best.

Plenary

10 minutes Discuss which groups barge was the most stable and could carry the largest load. A low flat barge with the load evenly distributed is likely to be more stable than a tall thin barge.

Boat building materials part three

Testing Composite Materials

Learning objective:

How the strength of composite materials is stronger if all the component materials are mixed together than if they were used separately.

How the orientation of the fibres can affect mechanical strength.

Introduction

10 minutes

Use the student sheet to tell the students about the invention of pykrete. Remind the students about the comparison between how pykrete works and how fibre reinforced plastic works in boat building.

Main activity

10 minutes

Testing to destruction of each material should be carried out by the teacher, with everyone wearing safety goggles. It is safest to do it on the floor. Start with the ice, put it between two wooden blocks and load weights onto it until it breaks. Secondly try the saw dust pykrete. If it doesn't break after 3 large weights have been put on it, cover it with a cloth and either ask someone to gently stand on it, or hit it with a hammer.

(Continued on next page)

Boat building materials continued

10 minutes

Show and image on the white board of a carbon fibre boat hull or carbon fibre mast. Explain how unidirectional carbon fibres can increase the strength in high stress areas, but only along the direction of the fibres.

Test the first piece of super pykrete with the paper strips running parallel to the wooden block supports – this should fail easily

Now test with the strips running at 90^{o} across the blocks – this should be very strong indeed.

10 minutes

If you think it safe to do so, test the cured resin disk with a hammer(this should definitely be covered with a cloth and tested behind a safety screen due to the risk of splinters of resin and do the same for the glass reinforced resin (GRP)

Plenary

10 Minutes

Discuss with the students how a fibreglass boat is made. This is done using a mould, which is first scrupulously cleaned and polished. Then a gel coat is put into the mould to give the boat its colour and shine. Finally several layers of resin and glass or carbon fibre and built up to give the boat its strength.

Boat building materials continued

Boat Show Activity

This is to complete a worksheet in the student pack, on how different boats at the show are made. This could form the basis of a class room wall display.

Rope

Learning objectives:

The difference between synthetic and natural fibre rope.

How ropes are made.

What affects the properties of rope?

Resources needed:

Make your own rope

Newzealand flax leaves (Phormium) or nettle stems,

Supermarket plastic bag, scissors, string, science lab clamp stand, ruler, felt pen, safety screen, optional rope scraps for knots.

You must carry out your own risk assessment.

This could be carried out as a teacher led demonstration, but the students may enjoy making their own platted rope and testing the stretchiness. This is a bit like the Hooke's law physics experiment for the deformation of springs, and can be used by the students to create good comparative graphs for the deformation of the two materials.

Newzealand flax fibres are very strong, and not very stretchy compared to polythene, so will withstand supporting a large weight then suddenly snap. For this reason the breaking strain part of the experiment may be best carried out as a teacher demonstration if it is platted into a 3 strand braid.

The best way to test the homemade rope samples is to tie a loop of string to either end; one end goes on the clamp stand the other for hanging weights on

Rope lesson plan

You may want to split this into two lessons as the knot tying is a very popular hands on activity, in its own right.

Introduction

10 minutes

Pupils brainstorm the uses of rope and lines. The two video clips on the student sheets are a good way to get the ball rolling. Things that will hopefully come up are, hoisting sails, controlling the angle of sails, controlling the shape of sails, guard lines, safety lines, trapeze lines (these help dinghy sailors get their weight right outside the boat), mooring lines, securing things to the boat, anchor lines, and of course the only line that is called a rope on board a ship – the bell rope. Though this is slightly tongue in cheek it emphasises that all of the ropes on board a boat have a name that fits its purpose. Depending on the background of your students you may want to introduce some of the proper names for the ropes such as sheet and halyard.

Main activity

10 minutes

Use the student sheet to introduce the property of rope and how it is made. If you have some old rope ends of various types, it may be useful to use these to hand round to the pupils so that they can see the fibres, yarns and strands; and to see what happens if a 3 strand rope is twisted against its lay.

Rope continued

20 minutes	Making and testing their own rope. It is a good cross curricular activity to get the students to draw a line graph to show the stretchiness or other wise of their platted natural and synthetic rope. You may wish to finish off with a teacher led demonstration of breaking strain. **You must try this first and properly risk assess this activity.**
Plenary	
10 minutes	Match the rope to the job activity. Emphasise the construction and the material the rope is made of affect the ropes final properties.

Lesson two Knotty knots

Learning objective : How to tie some basic knots.

This is a very useful activity if students are going to go on to have a go at practical water sports. It is also a nice break for students from writing based activities. You will need to lay some ground rules before you start. The rope must not be tied around any body part. The rope must be laid flat on the table while the teacher is explaining what to do.
Each pupil will need a rope end about one metre long. 8mm polyester braid on braid is ideal.

Introduction

10 minutes Ask the class for all the situations when you might need to tie a knot onboard a boat.
lay down the ground rules for the knot tying

Main activity

35 minutes You may not get through tying every knot. The order of knots on the sheet are: reef knot, which is of limited use as it comes undone so easily; figure of eight, round turn and two half hitches, clove hitch, bowline, and finally rolling hitch**.**

Plenary

5 minutes where could you use the knots in shore based situations, for example which would be the best knot to use to fix a towline to a car?

At the boat show

The object to this exercise is to match the different ropes that they have studied to real applications on other exhibitors boats at the show.

Masts and Rigging

Learning Objectives: The effect of shape on mechanical strength.

How mast riggers can make strong, tall masts.

Due to the length of the practical activities this is best run over two school periods

Resources needed:

Why are most masts tubes?

A3 paper *sticky tape* *masses (weights)*

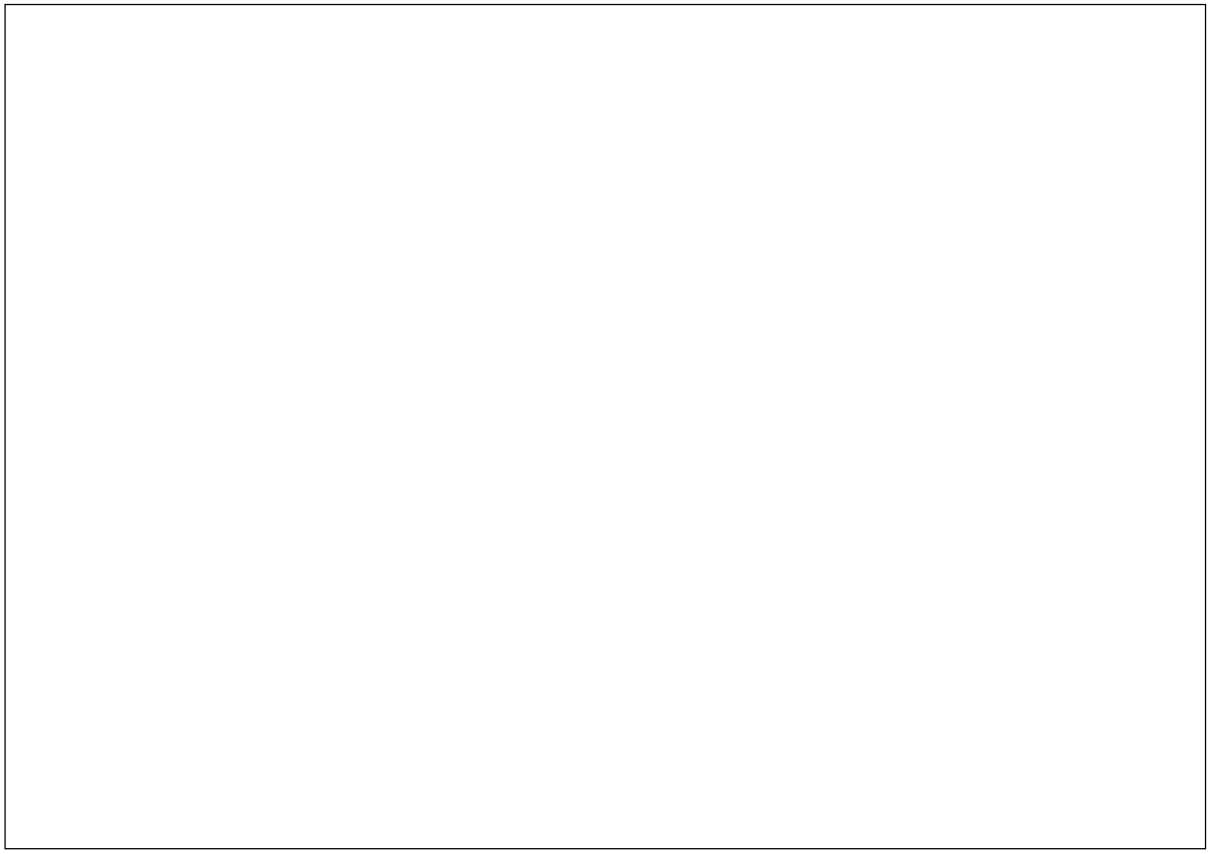
This is ideal for group work for example in threes. Per group you will need some sticky tape, two sheets of A3 paper, and either a pair of stools or science lab clamp stands.

Pupils roll one sheet of paper as tightly as they can along its long edge and tape it shut as a rod. The other they roll into a tube and tape it.

Although masts are usually vertical, we found it easiest to test the stiffness horizontally between stools, by hanging masses in the middle of the spar or mast. The best way to hang the masses on is to make a hanging loop out of sticky tape at the mid-point, as string cuts in and deforms the tube.

In any discussion on the merits of tubes over rods, it is important to emphasize that you are comparing equal mass tubes and rods. A solid 20cm diameter aluminium mast would be a lot heavier than a hollow 20cm diameter mast. When a rod is bent most of the stretching and compression of the material in the rod is in the outside edge around the material in the middle.

Masts and Rigging continued



Masts and Rigging Lesson Plan

Please note this is just one suggested route through these lessons.

Introduction

10 minutes For the scene setting, show the students a few minutes of internet video of the Star and Finn classes from the 2012 Olympics, ask the class to focus on the masts and rigging. After the clips ask the pupils to feed back what they noticed were different between the two classes of boat (Finn masts are unstayed – Stars have spreaders, more rigging and are stiffer). Then hand out the mast activity sheets and have a discussion centred on the speech bubbles at the top of the sheet.

Main Activity

15 minutes Pose a question along the lines of "so why are metal and carbon fibre masts tubes, would not thinner solid masts have less wind drag than a fatter hollow one?"

To make the masts only takes a few minutes – you could have a short brainstorm of how to test their stiffness or suggest the method given on page xyz.

5 minutes Students discuss in pairs why they think tubes rather than metal rods are used for masts, spars and on building sites for scaffolding poles.

5 minutes Pool ideas. Are there any other considerations as to why a hollow mast may be used (Weight aloft and capsize risk. Note solid wooden masts make a boat roll more slowly, so on traditional boats can make the boat more comfortable in rough seas.)

Masts and rigging continued

Plenary

10 minutes Show some images of tall yacht masts and introduce the next lesson's challenge of how to build the tallest mast out of 15 straws.

Masts and Rigging Part Two

Introduction

10 Minutes Set the scene by having images of yacht masts on the whiteboard as students come in. Explain the challenge is to build a mast as tall and stiff as possible. Hand out the activity sheet.

Main Activity

10 minutes In groups of 4, students collect the materials and plan how they are going to carry out the task

10 minutes The groups build their masts. You may wish to have a stop clock running.

10 minutes The groups compare each other's masts. You may want to test their stiffness with a desk fan.

Plenary

10 minutes What made the best masts so strong? Which shapes are the strongest? **Extension for brighter students** Which parts of the mast and rigging are under tension and which parts are under compression (think about how spreaders work)

At the Show

Not all masts have rigging. Compare the Finn Class Dinghy that Ben Ainslie won gold in, to the mast on a Star Class keel boat that Ian Percy and Andrew Simpson won silver with at the 2012 Olympics.

Marine Industry Careers Information

The marine leisure industry is varied and exciting, and offers a wealth of career openings. These pages will help you to find out about the various opportunities available in this diverse sector, as well as give you advice on entry routes into your chosen career and marine qualifications and training courses.

There is no set career pattern in the industry. People tend to specialise in particular areas and expand their experience, qualifications and ability as time goes on. Some people develop their careers in one company whilst others move from firm to firm. Take a look at the whole industry before deciding what you want to do and then find out what skills are needed for your chosen career. The boating industry values people with a wide range of skills and practical experience and those who are prepared to work hard and use their initiative. People skills are especially important for some jobs Job types include:

- Welders
- Boatbuilders
- Yacht Designers
- Plumbers
- Watersports Instructors
- Marina Managers
- Electricians

For details about the entry routes and skills required for these roles and many more click below:

http://www.britishmarine.co.uk/upload_pub/27441_bmf_your_future41.pdf

Extra BMF Curriculum resources available click below:

http://www.britishmarine.co.uk/careers_home/educational_resources/curriculum_materials.aspx

School Based Maritime Qualifications

The London Nautical School was founded in 1915, as a consequence of the official report into the loss of the "Titanic".

In 1990, it became one of the country's first 11-18 comprehensive secondary schools for boys to be awarded grant maintained status. It is still a state school in Lambeth and keeps its fleet of boats on the London docks. The nautical program in the sixth form attracts male and female students from right across London, with some students travelling in from Kent and Essex.

The school still maintains a thriving nautical faculty. Nautical study is part of the compulsory curriculum in year 7 and 8 (the first two years at secondary school), and is a very popular optional subject from year 9 through to the sixth form. For more information, or for feedback to the author of these resources please contact James Bullar via email ***jbullar@nautical.lambeth.sch.uk***

Courses offered at LNS

Level 2 Award in Maritime Studies

At LNS, this course is offered to year 10 and 11 students, as an extra optional subject. The course has been developed by the Maritime Skills Alliance, of which the British Marine Federation is a member www.maritimeskills.org .

The course currently consists of two units, The Maritime Sector Overview which is worth 3 credits; and Maritime Employment, Environmental and Health and Safety Practice, which is worth 2 credits.

The course is on the Register of Regulated Qualifications.
http://register.ofqual.gov.uk/Qualification/Details/500_3142_9

Level 2 Safety (STCW) Award in Maritime Studies

This course has also been developed by the Maritime Skills Alliance. At LNS we offer this course to sixth form students, in collaboration with the United Kingdom Sailing Academy on the Isle of Wight, which issues the STCW certificates. The course consists of 4 units, certified by the Scottish Qualifications Authority, which exactly follow the STWC basic training course.

Students who follow the course can thereby gain both SQA certificates worth 7 credits at level 2 and the STCW certificates in the following.

STCW sea survival,

STCW Vessel Fire Prevention and Fire Fighting,

STCW Maritime Security,

STCW Emergency First Aid in response to maritime accidents or medical emergency.

In addition we offer the students an SRC radio course, the RYA radar course and the RYA diesel course.

The course is studied alongside normal A level subjects, and attracts students to the sixth form, who either have a love of going afloat, want a career at sea, or want to go onto maritime related degrees.

www.maritimeskills.org/docs/MSQ_matrix2012.pdf

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www.maritimeskills.org/docs/MSQ_matrix2012.pdf

Useful Links

On The Water is a British Marine (BM) project that aims to help new and potential boaters discover the joys and wealth of benefits that boating offers. **www.onthewater.co.uk** is your essential online guide to boating and watersports - packed with guides, tips, information and everything you need to discover boating and make the most of your leisure time, whether you have just one day, a weekend or longer!

This is a programme set up by the Royal Yachting Association to get more young people into sailing and windsurfing. OnBoard Officers are a very good source of information and support for schools wishing to take young people afloat. To find you nearest Officer visit www.ruob.co.uk.

For more information on OnBoard visit www.rya.org.uk

UNITING THE YOUTH OF TODAY WITH THE MARITIME OPPORTUNITIES OF TOMORROW

Sea Vision is the national campaign working to raise awareness of the value and importance of the sea and the maritime sector among young people. The campaign works to promote maritime in an educational context and to raise awareness of the wide range of exciting job and career opportunities across

the sector. The Website is a very good source for more educational resources, general information about the maritime and guidance on a wide range of career opportunities in this diverse sector, from leisure marine to offshore renewable energy.

http://www.seavision.org.uk/

This website is run by the Merchant Navy Training Board. It provides a lot of information about the commercial shipping industry and links to sponsor funded HND and Degree courses. (The Sponsor usually pays the candidates tuition fees and gives a training allowance). Careers at Sea Ambassadors are volunteers from the shipping industry, who go into schools to give lively and informative presentations on the maritime sector.

http://www.careersatsea.org

The prime purpose of the MSA is "To work together for UK Maritime skills development". It is the place to look for information on professional maritime qualifications and career pathways.

http://www.maritimeskills.org