

# TEACHERS' RESOURCE GUIDE



# CONTENTS

COPYRIGHT	2
CREDITS	2
INTRODUCTION TO THE BOOK	3
A WORD FROM THE AUTHOR	3
OTHER BOOKS BY THE AUTHOR	4
BIBLIOGRAPHY	5
ONLINE WATER INFORMATION SOURCES	5
CLASSROOM ACTIVITIES: ONLINE WATER RESOURCES FOR CLASSROOM USE	7
A RIVER RUNS THROUGH IT: CANTERBURY AND THE RIVER STOUR	8
A BEACON OF SUSTAINABILITY: THE ABBOT'S MILL PROJECT	10
TIME ON THEIR HANDS: THE WHITEFRIARS WATER CLOCK	12

## COPYRIGHT

All educational establishments are free to photocopy, distribute and utilise materials in these Teachers' Notes within their respective organisations. Permission for any additional uses, including external publication or dissemination, must be sought in writing from the publisher. This approval does not extend to the book itself, where standard copyright

## CREDITS

These teachers' notes are written and produced by Martyn Barr.

Published by Out of the Box Publishing Limited  
125 Blean Common, Blean  
Canterbury, Kent CT2 9JH

Tel: 01227 450022  
Email: [info@outoftheboxpublishing.co.uk](mailto:info@outoftheboxpublishing.co.uk)  
Web: [www.OOTBShop.co.uk](http://www.OOTBShop.co.uk)  
Twitter: @martynbarr



Sponsored by



# INTRODUCTION TO THE BOOK

Water fills the seas, rivers, streams and lakes. It's frozen in glaciers and in huge ice sheets at the Earth's poles. It floats over our blue planet's surface in clouds, mist and fog. It falls as rain, snow and hail. It lies hidden underground in cavernous reservoirs. It is constantly on the move.

Half of the world's plants and animals live in water. The other half depend on it to live and grow. Without water, life as we know it would not exist at all.

This beautifully illustrated book, by award-winning children's writer Martyn Barr, explores our wonderful water world and why we should never take this AMAZING and PRECIOUS substance for granted.

Copies of Water World can be ordered online at [www.OOTBShop.co.uk](http://www.OOTBShop.co.uk), priced £4.99 including delivery. Discounts of up to 20% are available for bulk educational orders.

The publishers would like to thank the Whitefriars shopping centre in Canterbury for sponsoring this book and making it possible to distribute free copies to local primary schools. We would also like to thank Professor Bob Newport and Professor Dick Vane-Wright from the University of Kent, for checking the scientific accuracy of the text and for their helpful suggestions.

# A WORD FROM THE AUTHOR

It may be hard to grasp, but the same water exists today on our planet as it did hundreds of millions of years ago when dinosaurs roamed the Earth.

This water is constantly on the move, passing from the land to the seas to the air and back. Without water's remarkable properties, life as we know it would not exist at all.

Water is very PRECIOUS. After all, it makes up around two-thirds of you and me! But the impact of climate change, growing populations and increasing demand put huge pressure on our planet's water resources.

I hope after reading this book children will understand a lot more about water and how important it is for us to use it wisely, to ensure that there is enough to go round both now and in the future.

My intended readers are KS2 students, but I know from experience that my books are appreciated by a much broader audience. I've tried to make this book a visual delight for them – a 'coffee table' book for children. Feedback has been overwhelmingly positive and I hope you find the book – and this guide – insightful and helpful.

There is a huge amount of high quality online resources available to assist teachers cover this subject in the classroom. Much of this material is produced by the water companies themselves, many of whom have excellent educational departments. I have not set about

trying to duplicate or even match this, as it is well beyond the scope of my expertise and means. However, what I have tried to do in this guide is to provide a comprehensive list of resources, principally web-based, that you may wish to draw upon. All web links are active, so you will be able to go straight to the relevant page by clicking on the web address.

I've also included information on the River Stour, Abbot's Mill Project and Whitefriars Water Clock, to provide some additional interest for Canterbury teachers. I'm sure children will enjoy creating their own water clocks, so I've researched some online resources for this too.

The beauty of publishing a Teachers' Resource Guide in this format is that it is a dynamic medium. I would be pleased, therefore, to receive additional suggestions for inclusion or corrections to any errors found. These can be emailed to me at [info@outoftheboxpublishing.co.uk](mailto:info@outoftheboxpublishing.co.uk).

Water World is my seventh Young Person's Guide. You can find out more about my other books, and purchase them, at [www.OOTBShop.co.uk](http://www.OOTBShop.co.uk).

**Martyn Barr**

## OTHER BOOKS BY THE AUTHOR

- **The Young Person's History Guide to Canterbury\*** (2009) (ISBN 978-0-9563429-0-4)
- **Lewisham's Got History!** (2010) (ISBN 978-0-9563429-1-1)
- **To Be A Bee\*** (2012) (ISBN 978-0-9563429-2-8)
- **Garden Science** (2013) (ISBN 978-0-9563429-3-5)
- **Paintings in Light\*\*** (2013) (ISBN 978-0-9563429-4-2)
- **The Lost Generation** (2014) (ISBN 978-0-9563429-5-9)

*\*\* Runner-up in the children's publication category in the Association for Cultural Enterprises 2014 Awards.*

*\* Nominated for a Canterbury Culture Award in the Excellence category.*

# BIBLIOGRAPHY

I found these books helpful when researching Water World:

**A Drop in the Ocean: The Story of Water** by Jacqui Bailey and Matthew Lilly  
(ISBN 978-0-7136-6256-6)

**H<sub>2</sub>O A Biography of Water** by Philip Ball (ISBN 978-0-75381-0921)

**National Geographic Kids: Water** by Melissa Stewart (ISBN 978-1-4263-1474-2)

**Our World of Water** by Beatrice Hollyer (ISBN 978-1-84507-648-1)

**The Water Cycle** by Planet Earth (ISBN978-1-84696-521-0)

**Water** by Go Facts Environmental Issues (ISBN 9780713679717)

**Water... the Amazing Journey** by Caren Trafford (ISBN 978-0-9581878-1-9)

# ONLINE WATER INFORMATION SOURCES

**Alliant Energy Kids:** [www.alliantenergykids.com](http://www.alliantenergykids.com)

**Ancient Origins:** [www.ancient-origins.net](http://www.ancient-origins.net)

**Anglian Water:** [www.anglianwater.co.uk](http://www.anglianwater.co.uk)

**Astronomy Know How:** [www.astronomyknowhow.com](http://www.astronomyknowhow.com)

**Atoms in Motion:** [www.atomsinmotion.com](http://www.atomsinmotion.com)

**BBC Climate Change:** [www.bbc.co.uk/climate](http://www.bbc.co.uk/climate)

**Better Health Channel:** [www.betterhealth.vic.gov.au](http://www.betterhealth.vic.gov.au)

**British Hydropower Association:** [www.british-hydro.org](http://www.british-hydro.org)

**Cambridge University Botanic Garden:** [www.botanic.cam.ac.uk](http://www.botanic.cam.ac.uk)

**Dosomething.org:** [www.dosomething.org](http://www.dosomething.org)

**Ducksters:** [www.ducksters.com](http://www.ducksters.com)

**EDF Energy:** [www.edfenergy.com](http://www.edfenergy.com)

**Enchanted Learning:** [www.enchantedlearning.com](http://www.enchantedlearning.com)

**Energy Saving Trust:** [www.energysavingtrust.org.uk](http://www.energysavingtrust.org.uk)

**eSchoolToday:** [www.eschooltoday.com](http://www.eschooltoday.com)

**Fact Monster:** [www.factmonster.com](http://www.factmonster.com)

**Gardening Know How:** [www.gardeningknowhow.com](http://www.gardeningknowhow.com)

**How Stuff Works:** [science.howstuffworks.com](http://science.howstuffworks.com)

**Icebergfinder.com:** [www.icebergfinder.com](http://www.icebergfinder.com)  
**Idaho Museum of Natural History:** [imnh.isu.edu](http://imnh.isu.edu)  
**Kids Fun Facts:** [www.fun-facts.org.uk](http://www.fun-facts.org.uk)  
**Kidsdiscover:** [www.kidsdiscover.com](http://www.kidsdiscover.com)  
**Kidsgen:** [www.kidsgen.com](http://www.kidsgen.com)  
**KidsHealth:** [www.kidshealth.org](http://www.kidshealth.org)  
**Livius.org:** [www.livius.org](http://www.livius.org)  
**Mayo Clinic:** [www.mayoclinic.org](http://www.mayoclinic.org)  
**Met Office:** [www.metoffice.gov.uk](http://www.metoffice.gov.uk)  
**MoonConnection.com:** [www.moonconnection.com](http://www.moonconnection.com)  
**National Centre for Atmospheric Research:** [www.ucar.edu](http://www.ucar.edu)  
**National Geographic:** [environment.nationalgeographic.com](http://environment.nationalgeographic.com)  
**Nat Oceanic and Atmospheric Admin:** [oceanservice.noaa.gov](http://oceanservice.noaa.gov)  
**National Snow & Ice Data Centre:** [www.nsidc.org](http://www.nsidc.org)  
**Onegeology Kids:** [www.onegeology.org](http://www.onegeology.org)  
**Primary Homework Help:** [www.primaryhomeworkhelp.co.uk](http://www.primaryhomeworkhelp.co.uk)  
**Royal Horticultural Society:** [www.rhs.org.uk](http://www.rhs.org.uk)  
**South East Water:** [www.southeastwater.co.uk](http://www.southeastwater.co.uk)  
**Thames Water:** [www.thameswater.co.uk](http://www.thameswater.co.uk)  
**The Bolton Council of Mosques:** [www.thebcom.org](http://www.thebcom.org)  
**The Indianapolis Public Library:** [www.imcpl.org/kids](http://www.imcpl.org/kids)  
**The Water Information Program:** [www.waterinfo.org](http://www.waterinfo.org)  
**The Water Project:** [www.thewaterproject.org](http://www.thewaterproject.org)  
**Union of Concerned Scientists:** [www.ucsusa.org](http://www.ucsusa.org)  
**Waitrose Garden:** [www.waitrosegarden.com](http://www.waitrosegarden.com)  
**Water.org:** [www.water.org](http://www.water.org)  
**WaterAid:** [www.wateraid.org](http://www.wateraid.org)  
**Weather WizKids:** [www.weatherwizkids.com](http://www.weatherwizkids.com)  
**WebMD:** [www.webmd.com](http://www.webmd.com)  
**Wikipedia:** [en.wikipedia.org](http://en.wikipedia.org)  
**Wild About Gardens:** [www.wildaboutgardens.org.uk](http://www.wildaboutgardens.org.uk)

# CLASSROOM ACTIVITIES

## ONLINE WATER RESOURCES FOR CLASSROOM USE

**Anglian Water:** [www.anglianwater.co.uk/community/education/resources/](http://www.anglianwater.co.uk/community/education/resources/)

**BBC KS2 Water:** [www.bbc.co.uk/northernireland/forteachers/water/](http://www.bbc.co.uk/northernireland/forteachers/water/)

**National Ground Water Association:** [www.ngwa.org/Fundamentals/teachers/Pages/Lesson-Plans.aspx](http://www.ngwa.org/Fundamentals/teachers/Pages/Lesson-Plans.aspx)

**Northumbrian Water:** [www.nwl.co.uk/your-home/learn-about-water/Teacher.aspx](http://www.nwl.co.uk/your-home/learn-about-water/Teacher.aspx)

**Oxfam Education:** [oxfamblogs.org/education/water\\_for\\_all/water/notes/index.htm](http://oxfamblogs.org/education/water_for_all/water/notes/index.htm)

**Project WET Foundation:** [www.projectwet.org/teach-and-learn](http://www.projectwet.org/teach-and-learn)

**Saving Water Partnership:** [www.savingwater.org/StudentsTeachers/index.htm](http://www.savingwater.org/StudentsTeachers/index.htm)

**Scottish Water:** [www.scottishwater.co.uk/domestic/old-education/resources-for-teachers/worksheets](http://www.scottishwater.co.uk/domestic/old-education/resources-for-teachers/worksheets)

**Seametrics:** [www.seametrics.com/water-lesson-plans](http://www.seametrics.com/water-lesson-plans)

Teaching Ideas: [www.teachingideas.co.uk/geography/contents\\_water.htm](http://www.teachingideas.co.uk/geography/contents_water.htm)

**Thames Water:** [thameswater.co.uk/wiseuptowater/teachers.html](http://thameswater.co.uk/wiseuptowater/teachers.html)

**The Co-operative Green Schools Revolution:** [www.co-operative.coop/green-schools-revolution/for-teachers/resources/primary-school-resources/](http://www.co-operative.coop/green-schools-revolution/for-teachers/resources/primary-school-resources/)

The Water Project: [thewaterproject.org/resources/](http://thewaterproject.org/resources/)

**The Water School:** [www.thewaterschool.co.uk/teachers.html](http://www.thewaterschool.co.uk/teachers.html)

**United States Environmental Protection Agency:** [water.epa.gov/learn/kids/drinkingwater/teachers\\_4-8.cfm](http://water.epa.gov/learn/kids/drinkingwater/teachers_4-8.cfm)

US Geological Survey: [water.usgs.gov/edu/teachers-water.html](http://water.usgs.gov/edu/teachers-water.html)

**Yorkshire Water:** [www.yorkshirewater.com/education/teaching/teacher-resources](http://www.yorkshirewater.com/education/teaching/teacher-resources)

**Water Aid:** [www.wateraid.org/uk/audience/schools/the-water-resource](http://www.wateraid.org/uk/audience/schools/the-water-resource)

**Water Use It Wisely:** [wateruseitwisely.com/kids/teachers-educators/](http://wateruseitwisely.com/kids/teachers-educators/)

**Welsh Water:** [www.livingandlearningwithwater.com/english/teachers-parents.html](http://www.livingandlearningwithwater.com/english/teachers-parents.html)

# A RIVER RUNS THROUGH IT

## CANTERBURY AND THE RIVER STOUR

### GEOGRAPHY

The River Stour rises near the village of Lenham near Maidstone and flows into the North Sea at Pegwell Bay. Above Plucks Gutter, where the Little Stour joins it, the river is normally known as the Great Stour. The upper section of the river, above its confluence with the East Stour at Ashford, is sometimes known as the Upper Great Stour or West Stour.

The Stour has Kent's largest catchment area after the River Medway. The lower part of the river is tidal; its original mouth was on the Wantsum Channel, an important sea route in medieval times. The river has three major tributaries, and many minor ones. For much of its length it flows in a generally south-west to north-east direction.

Within Canterbury, the river flows in two channels, one through the centre of the city, and the other to the north of the city walls. The two channels rejoin to the east of Canterbury, before the river reaches Fordwich, a former outport of Canterbury and the current tidal limit of the river.

### HISTORY

Archaeological surveys in Canterbury suggest that the area has been visited by people since the Stone Age. When the ancient hunter-gatherers chose to settle down and farm, there is evidence to suggest that one of their earliest settlements may have been beside the river in the area which became Westgate Gardens.

In later prehistory, it just happened to be a convenient place to ford the river. Iron Age carts transporting salt from the North Kent coast are thought to have forded the river here. And the ancient activity at this crossing point in the river may well have been the foundation of the settlement which became today's Canterbury.

Nearly 2,000 years ago the Romans used the traditional fording place for Watling Street, their new road between the south coast and London. They later encircled the town with defensive walls and gates. Not far away, in Tannery Field, a hoard of Roman silver, including spoons, rings and ingots, was discovered.

In the Middle Ages, water mills run by the monks from Christ Church were dotted along the river. The mills declined in number as the river dried up and had disappeared by the end of the 19th century. More recent history of the area is just as important though, with the development of the tanning industry, the use of the area for World War II defences and later 20th century recreation.

Bingley means 'within a river'. It is still encircled by the River Stour and its tributaries. It was once used for grazing. Now tall plants such as purple loosestrife and willows have created a haven for wildlife and an interesting place for visitors to explore.

Tannery Field is the green space between Rheims Way and the river, opposite the site of the former tannery.

In the 19th century a tributary of the Stour, possibly following the original course of the ancient river, looped through the area that became known as Toddlers Cove. This site was transformed into an open air swimming pool in 1876. The Victorian builders found numerous Roman artefacts there, possibly the remains of offerings to pagan gods.

The pool became very popular – and remained so until well into the 20th century. Toddlers Cove provided the city with its own 'riviera' – with boating lakes and a paddling pool as well as the swimming pool. There were also donkey rides and sand pits. The area continues to be a children's play area and riverside picnic site.

## WILDLIFE

The landscape along the Stour in Canterbury – from Westgate towers through Toddlers Cove, Tannery Field, Bingley Island and past Whitehall Meadows – changes from a formal planted garden to semi natural landscape full of wild and native plants. This is a varied habitat for wildlife.

From the studies that have taken place we know that Pipistrelle and Daubenton's Bats; a wide range of birds such as Kestrels, Kingfishers and Woodpeckers; a selection of butterflies and moths, dragonflies and other invertebrates are present. Otters and water voles have also been seen in the recent past.

A recent Environment Agency survey of the Stour at Toddlers Cove discovered 16 types of fish, among them trout, barbel, European eels and elvers, chub, carp, pike and tench.



Above: The River Stour flowing through the Westgate Gardens, Canterbury  
Inset: Kingfisher

# A BEACON OF SUSTAINABILITY

## THE ABBOT'S MILL PROJECT

Abbot's Mill is an educational project located on the River Stour in the heart of Canterbury, with the aim of becoming an urban hub of sustainability and social justice, powered by renewable energy.

### HISTORY

Abbot's Mill was the most impressive of the Canterbury mills. It was designed by the celebrated engineer, John Smeaton, but not built until shortly after his death in 1792. The mill stood on the site of the medieval Abbot's Mill (which had been used for grain and hemp production). It retained the old name, although it was also known as City Mill, as it belonged to the corporation.

In 1896, it was sold to a member of the Denne family, well-known in East Kent milling circles, after which the mill was often referred to as Denne's Mill. There were two waterwheels in the mill driving eight pairs of stones, and the machinery was advanced for its period, being largely of cast-iron. Tragically, the mill was totally destroyed by fire in October 1933. The site is now a scheduled monument.

### WATER WHEEL

The Government has set a target of generating 15% of our energy from renewable sources by 2020. This site – with its clean, green, renewable, power generation capacity – is an opportunity waiting to be realised.

The Abbot's Mill project will include a water wheel, which will be reinstated into the old mill race on the site of the former mill in St Radigund's Street. The Abbot's Mill site (now owned by Canterbury City Council) is part of the Abbot's Garden, a green space and walk that runs from the Miller's Arms public house over the sluices and along the Great Stour up to the Marlowe Theatre.

The water wheel will generate, on average, an estimated 15kW (Kilowatts) of electricity or 20kW (peak). This is approximately enough to power four family homes. The entire project will generate a net surplus of electricity, which will be donated to local community groups or sold to a national, renewable supplier.

### EDUCATION CENTRE

Once the water wheel has been reinstated, the next phase will be an education and research centre that will include a vegan community café and woodland/wildlife garden. This will be on the facing bank of the Great Stour, opposite St Peter's Lane. The two sites are linked by the St Radigund's bridge.

The education and research centre will showcase all aspects of sustainable and compassionate living, including non-centralised renewable energy. It will also provide information about the historic importance of the Great Stour to Canterbury's trade and development as a city.

The whole construction will be an eco-build using sustainable, environmentally-friendly and locally-sourced materials (mainly local chestnut and glass and no concrete). The community café will double as an education/meeting room space, run by and for the local community. The woodland/wildlife garden will be based on the principles of permaculture.

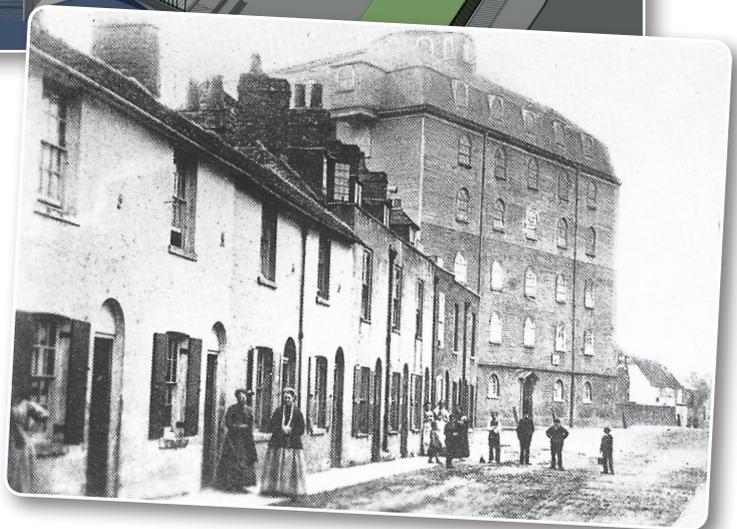
The development will be zero-waste and incorporate rain-water harvesting, biomass power generation and organic composting.

You can find out more about the Abbot's Mill project at [www.abbotsmillproject.co.uk](http://www.abbotsmillproject.co.uk).



*Above: Graphic visualisation of the proposed Abbot's Mill water wheel*

*Right: Abbot's Mill in around 1880*



# TIME ON THEIR HANDS

## THE WHITEFRIARS WATER CLOCK

During the spring and summer of 2015, a team of Year 12 students from Simon Langton Grammar School for Boys were tasked with developing a water clock for Whitefriars – part of our contribution towards Canterbury in Bloom.

The first challenge was to decide on a workable design. The team immediately observed an interesting contrast between Whitefriars and the wider city centre. The wealth of old buildings give Canterbury a very traditional feel, whereas the sleek, glass-fronted stores and pristine buildings in Whitefriars offer an alternative perspective to the city.

After considering a range of approaches for the main body of the clock, the student team developed a unique design in stainless steel that is both contemporary and traditional. After sketching out their initial ideas, they used computer-aided design (CAD) software to detail all the parts. The finished CAD files were then passed to a metal fabricator so that the individual components could be manufactured and the clock assembled. The fruits of their combined labours can be seen above Ernest Jones in Whitefriars Square.

### HOW THE CLOCK WORKS

Water flows into the 'buckets' on the ring on the outside of the clock face. This outer ring mechanism rotates, turning a series of cogs that move the clock hands at carefully timed intervals.

Water in the buckets runs off into a trough on the underside of the clock and is then pumped up to the top of the unit to flow back through the clock again.



*Above: The student team from Simon Langton perfect their design ideas.*

*Right: The clock takes shape.*

## WATER CLOCKS: A BRIEF HISTORY

Although no one is certain when or where the first water clock was made, the oldest known example dates back to 1500 BC. It was found in the tomb of the Egyptian pharaoh Amenhotep I. These earliest water clocks were simply containers marked with lines of measurement. Water flowed in or out of them at a controlled rate. By reading the water level, people were able to tell how much time had passed.

Around 325 BC, water clocks began to be used by the Greeks, who called this device the *clepsydra* (which means 'water thief'). The Greeks used the clepsydra to time speeches in law courts, to prevent lawyers from making speeches that were too long and boring!

But water clocks were not perfect time keepers. The pressure of water had to be kept constant to ensure a steady flow rate. To solve this problem, some water clocks were supplied with water from a large container which kept the water at a constant level.

As the length of day and night varied with the seasons, it was necessary for water clocks to be adjusted. A clever engineer came up with the idea of using a disc with 365 holes of different sizes to regulate the flow of water, one for every day of the year. The largest hole corresponded to the winter solstice, as the day would be shortest, while the smallest hole corresponded to the longest day of the year, the summer solstice.

Over time, water clocks became more and more complex... and more and more accurate, until eventually they would be replaced with clocks and watches with mechanical or electrical mechanisms.

## MAKE YOUR OWN WATER CLOCK

There are numerous web-based resources with classroom ideas for designing your own water clocks. Here are a few:

**Almost Unschoolers Blog:** [almostunschoolers.blogspot.co.uk/2010/03/clepsydra-for-kids-or-how-to-make.html](http://almostunschoolers.blogspot.co.uk/2010/03/clepsydra-for-kids-or-how-to-make.html)

**Deceptively Educational Blog:** [deceptivelyeducational.blogspot.co.uk/2014/04/how-to-make-water-clock.html](http://deceptivelyeducational.blogspot.co.uk/2014/04/how-to-make-water-clock.html)

**eHow:** [www.ehow.co.uk/how\\_2086422\\_build-water-clock.html](http://www.ehow.co.uk/how_2086422_build-water-clock.html)

**Scholastic:** [www.scholastic.com/parents/resources/article/science-nature-activities/water-clock](http://www.scholastic.com/parents/resources/article/science-nature-activities/water-clock)

**School of Dragons:** [www.schoolofdragons.com/resources/make-your-own-water-clock](http://www.schoolofdragons.com/resources/make-your-own-water-clock)

**Science Buddies:** [www.sciencebuddies.org/science-fair-projects/project\\_ideas/ApMech\\_p047.shtml#summary](http://www.sciencebuddies.org/science-fair-projects/project_ideas/ApMech_p047.shtml#summary)

**Science Netlinks:** [sciencenetlinks.com/lessons/building-a-water-clock/](http://sciencenetlinks.com/lessons/building-a-water-clock/)

The Open University: [www.open.edu/openlearn/science-maths-technology/science/physics-and-astronomy/physics/build-accurate-clock-challenge](http://www.open.edu/openlearn/science-maths-technology/science/physics-and-astronomy/physics/build-accurate-clock-challenge)

**The Water Clock Project:** [waterclockproject.wordpress.com/category/research/](http://waterclockproject.wordpress.com/category/research/)

**Wikihow:** [www.wikihow.com/Make-a-Water-Clock-\(Clepsydra\)](http://www.wikihow.com/Make-a-Water-Clock-(Clepsydra))