



UNIVERSITY OF
GOTHENBURG

WHAT IS GROWING ON THE DISC?

An introduction to Virtue



www.virtue.science.gu.se



Virtue is a tool for enabling students to take initiative and do experiments with aquatic environments. Virtue provides ample opportunity to take an investigative approach to one's work; setting up experiments; carrying out measurements in the field, classroom or laboratory and interpret and report the results.

The students are given an insight into the concept of biological diversity and also the systematics of organisms and their interaction with different ecosystems. Personal observations make it easier for students to see the connection between what they observe and theoretical models.

To sum up Virtue:

- Virtue is suitable for all ages, from kindergarten to adult education.
- Virtue can be used in several different subjects.
- Virtue can help to establish contact with other schools in Sweden and abroad.
- The tests can be carried out in both saltwater and freshwater.
- It's easy to get started with Virtue.
- Virtuerack kits can be ordered free of charge by Swedish schools (a limited number can be sent to schools abroad).
- There are digital support for reporting and sharing results.

Different school subjects and all ages

Virtue can be used from preschool up to adult education, since the project can be adapted to different ages and degrees of maturity. Younger children are fascinated by what they see, and this activity might awaken an interest in life below the sea surface. Older students can do comparative studies and record their discoveries themselves on the Virtue database, etc.

The investigations can result in collaboration between different school subjects and are therefore well suited for theme work. Virtue is also well suited for teacher collaboration, both within a school and between schools. Mathematics, arts, languages etc. can all be integrated.

For students of all ages in collaboration with other schools

Virtue can help you set up contacts with Swedish schools experimenting with fouling. A school which has discs in fresh water might, for example, compare its results with schools that have had discs suspended in sea water. The measurements carried out on the water in the test area are adapted to the equipment employed by the school.

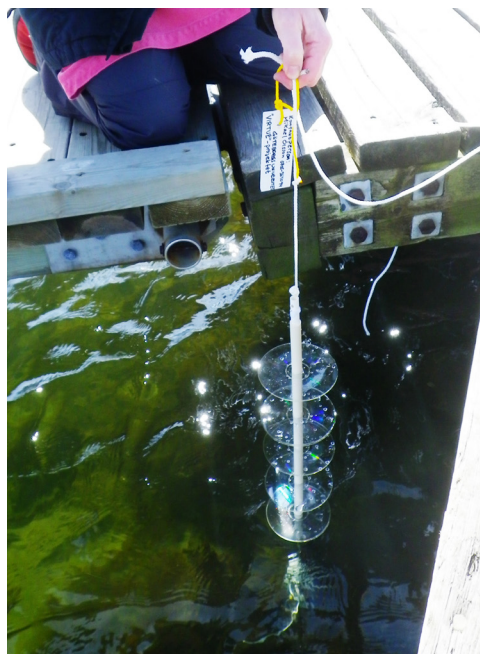
The Virtue website provides support for video conference calls with and between Swedish schools, whereby the students can, for example, present their results and discuss these with each other.

In different water environments

Experimenting with fouling can be done in all kinds of water environments. In marine water, the greater the salinity of the water, the more species there are to be found on the discs, and the organisms will also be larger in size.

Easy to get started

Use of a stereo microscope to study fouling is generally considered good enough. An alternative is the USB microscope, which is a kind of webcam connected to a computer, allowing images and film to be easily saved straight on the computer or else displayed on a projection screen. Larger organisms, such as blue mussels, can of course be studied using no aids at all.





Blue mussel on a Virtue

Sometimes a microscope with greater magnification is required. This applies particularly if the discs are raised after a short period of time and if they are placed in fresh water.

The rack can easily be assembled by the students themselves, who in this way receive practice in reading technical drawings.

Digital support for reporting results

The species identified, measurements taken, photographs and other information regarding these investigations can then be entered in the Virtue database www.virtuedata.se/en. In this way it is also easy to compare results over time and from other sites. The results of the experiments can be presented on the school's website, in the database, by an exhibition at the school, and by the students reporting on and showing discs with fouling at parent-teacher meetings.

Virtue
Reporting for schools




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VIRTUEDATA

Virtue's web site for reports and communication

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LATEST BLOG POSTS



2015-12-16

OBSERVING OUR VERY FIRST CDS obtained from the Barcelona Aquarium



2015-12-11

Welcome to Virtuedata

Virtuedata is a web site where you and your students can report what you have found on the discs, compare your results with other classes and schools and much more. You can also blog about your observations. There is also a feature to help identifying species.

Are you not yet a member of the Virtue community? In that case, sign up and get help and support to get started! Want to know more about Virtue? On www.virtue.science.gu.se you will find more information, pictures, videos, tips, literature suggestions and links.

▶ Get Started!

Learn how to use new Virtuedata

▶ Create report

2015-06-28

Virtue becomes a book!

We are writing on a chapter for the book 'Exemplary Practices in Marine Science Education - A Resource for Practitioners and Researchers' (Springer).

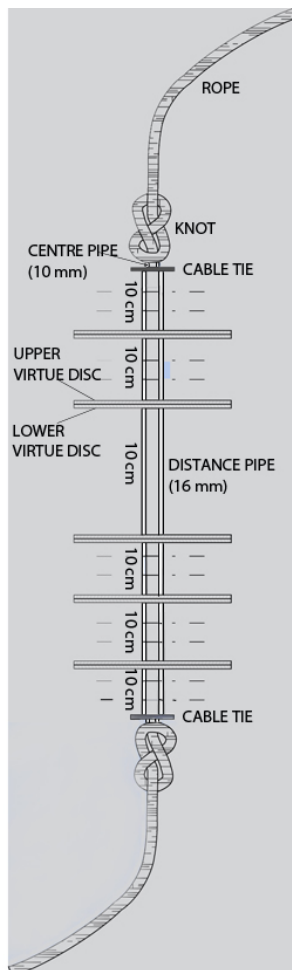
The book will be published in 2017!

How to build a Virtue rack

This is what you need for 1 rack:

- 10 transparent CDs
- 1 PVC pipe (for electrical use, made of plastic) (centre pipe) with an outer diameter of 10 mm (length approx. 65 cm)
- 6 PVC pipes (distance pipes) with an outer diameter of approx. 16 mm (length 10 cm)
- 2 cable ties (made of plastic)
- 1 plastic name tag (in order to supply contact information and rack-ID)
- 1 fastening rope (approx. 200 cm)
- 1 weight

1. Begin by inserting the rope in the centre pipe.
2. Then insert and secure a cable tie in the bottom hole.
3. Next, assemble a 10 cm distance pipe, followed by 2 Virtue discs, 1 distance pipe, 2 Virtue discs, and so on.
4. Finish off by inserting and securing a cable tie in the uppermost hole.
5. Make a simple knot on the rope nearest the top end and the bottom end of the center pipe.
6. Fasten the name tag on the rope high enough so it remains above the surface of the water.
7. Tie a weight to the bottom end of the rope (which should not touch the sea or lake bottom!)





When you raise the rack in the autumn, do save the distance and center pipes and scrape off the fouling. These can then be used over several seasons! We save the environment and money, and all you need to order are new discs or reusable discs, rope and cable ties.

A short instruction video is available on www.virtue.science.gu.se/eng.

Swedish schools can order complete add-ons free of charge from Virtue once they are registered on www.virtuedata.se/en. (You will need to organize the weights yourself.) Rack kits sent by post come with a three-part center pipe. For schools outside Sweden, please contact us on: virtue@science.gu.se

What to consider before and when you put the rack into the water

How many racks should be placed in the water depends on how many students are to be given objects to study, whether you want to have racks in a variety of environments, whether you plan to employ controls etc. Each rack supports 10 discs for investigation – 5 upward-facing and 5 downward-facing. It is essen-

tial that you have your questions ready before starting the experiment. What is it you want to investigate? Maybe you only want to study flora and fauna at a particular site or carry out a more complex investigation by comparing different environments? How will you carry out the experiment in order to receive the answers to your questions? The Virtue website lists many more questions. The racks can be placed in all types of aquatic environments – lake or sea. They should be easily accessible to students and should ideally be situated on jetties or in similar locations. The ideal is to have the rack freely suspended in the water. If you want the distance between the surfaces of the water and the discs to remain constant, fasten the rack to a floating jetty or buoy. For safety reasons we recommend that the racks to be recovered by students are suspended from a jetty.

Don't forget to:

- Place the racks on sites where they are not too exposed to wind and waves. Consider also that in coastal areas water levels can vary enormously as a result of wind and tides.
- Place the racks where they do not interfere with navigation. Get in touch with the berth owner or harbour captain and tell them about the experiment and what you have hung from the buoys or jetties in order to avoid any conflict. Mark the racks in a suitable way, such as with a name and telephone number.

Unfortunately, you must reckon with the fact that sometimes the racks will disappear or be destroyed if they are in a place where they are not kept under supervision. Wind and waves and occasionally even ice will also take their toll. Make a habit of checking the racks from time to time.



Do carry out measurements of salt content, temperature, pH etc during the period the discs are in the water. The more measurements carried out, the better the picture gained of the variety of environmental conditions at that site.

Foulings in form of barnacles.

Investigate environmental factors

Do compile measured values other than those you record yourself; for example, make use of weather charts in newspapers and on weather sites, such as the Swedish Meteorological and Hydrological Institute www.smhi.se/en. Many organizations also carry out regular measurements across the country. It could be that a water management association measures “your” water, or maybe there are measurements recorded by an environmental control programme there?

Describe the test area as fully as you can: where it is located (it should be marked on Virtuedata’s interactive Google maps); how it is affected by wind and wave (degree of exposure); whether the water is rapid-flowing or stagnant; how saline the water is, and whether there is an outflow of fresh water in the vicinity; whether there are buildings in the vicinity; harbour activity, boat traffic, etc.

All this can be registered on www.virtuedata.se/en, where you can also see the sites where others have placed their Virtue racks. You can register temperature, water transparency, salinity, pH, concentrations of phosphate and nitrate etc – all according to your need and school equipment available. Carry out measurements both when the discs are put in place and when they are taken up and preferably also several times in the intervening period.



During the winter months in northern Europe there is very little new fouling by larger marine organisms. During this period you will mostly find bacteria and diatoms. However, organisms such as tiny larvae, which have settled on the discs earlier on in the autumn, will also grow during the winter, albeit slowly. If you study the discs over a lengthy period of time, you will also see how the species composition changes.

During the period June – September in northern Europe there are plenty of larvae in the water. Growth is rapid – you can discover changes in fouling every week.

When the Virtue discs are raised

Your experiment might be focused simply on studying what can be found on the discs at different times during the year. In that case, all the discs can be raised at the same time. If you wish to track the change in species composition over time, take up a number of the discs and allow the others to remain in place so you will have fouling over different lengths of time. If the organisms have remained undamaged, you can also put back the discs you have examined.



Ascidians and blue mussels on a Virtue disc.

The discs can be transported from test site to laboratory in different ways, either in plastic boxes or buckets with lids (filled with water taken from the test area) or in plastic bags covered with moist newspapers. Once back at the school, place the containers or plastic bags in a fridge. Remember to bring water from the test area in a separate container, keep chilled and change the water in the containers with the discs if it is not possible to do an investigation straight away. Don't forget to open the lids of the containers. Once your investigations are complete, pipes and can be cleaned and equipped with new discs (or clean the discs if you are using re-usable discs) and put back in water for new fouling, or else put back just as they are. You can then also study the way different organisms survive stress to which they are subjected to when taken up on land and examined. At a later stage you can compare these with a rack nearby which has been allowed to remain untouched.

Investigation of the fouling on the discs

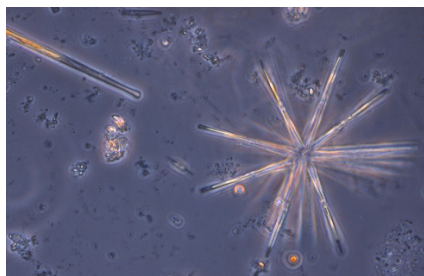
Normally stereo microscopes may be used with 20-40 times magnification in good lighting conditions. Place the disc supporting fouling upright in a shallow glass or plastic bowl. Large petri dishes made of glass are quite expensive. A cheaper alternative is to cut off the bottom part of a white plastic container with a bottom diameter of at least 14 cm. Pour enough water from the test area to cover the fouling on the disc. Normally light-coming from a source above, but sometimes light coming from below is best.



You may choose to look at the various organisms only; how they stick to the plate, whether there is further fouling on existing fouling, etc. Students usually also like to identify the group or category of species to which the organisms belong. In the case of salt water organisms, the Virtue Project has an identification help and a database for registering discoveries,

uploading images, blogging about the school's Virtue Project etc on www.virtuedata.se/en. Virtue has also started developing a guide for species identification for freshwater organisms.

A reporting form is also available for downloading as a pdf on <http://science.gu.se/english/cooperation/virtue>. It can often be worthwhile scraping off a little of the fouling, prepare it and study it in an ordinary microscope with higher magnification. This is especially applicable when there are few larger scale organisms or if you want to study diatoms which are abundant in wintertime and unicellular creatures. If there are numerous small brownish-yellow particles, you can find out if these are diatoms or "rubbish" by adding little acetone. A green colour indicates chlorophyll and thus algae. It might be of interest



Diatoms – a organism group that often grows on the surface of freshwater. Photo: Jan-Erik Svensson

to count the number of different organisms. How many organisms of a certain species or group of species are adhering to the disc? If you have only a few large organisms, you can count the number on the whole disc. If the organisms are small and many in numbers, you might choose to record only the degree of cover.

If it is not possible to identify an organism to the species or group of species, make a drawing or photograph the organisms and upload the images on Virtuedata and describe in the caption what you think they are. Virtuedata also allows schools to report and describe organisms which cannot be done on the reporting. If you want to calculate the biological biodiversity, you do not need to know the name of each organism! An excellent resource for calculating biodiversity is Biofilms and Biodiversity. http://ww2.mdsg.umd.edu/interactive_lessons/biofilm/



More tips, instructions, images, etc. are available on <http://science.gu.se/english/cooperation/virtue>.

Sea anemone with filamentous algae and mussels.

VIRTUE

- has been a school project since the 1990's
- is for all ages: kindergarten to adult education
- is a cooperation project between the University of Gothenburg and the Maritime Museum and Aquarium in Gothenburg, Sweden
- aims to awaken an interest in natural sciences in students and contributes to further development in teachers