Magical Mystrica Tour

Colorimetry is a technique that we have written about in the pages of this publication before. And no wonder: it is a simple, powerful and versatile analytical method. The main issue tends to be that of cost; we addressed this in one fashion a few years ago in an article about how to build your own colorimeter [1]. There are times, though, when a commercial device is the only one that will do. There are many devices on the market and we will try to review some of the more common models in future editions but in this article we are going to focus on one in particular - the Mystrica type II (see Figure 1).

We wrote about the Mystrica Mark 1 version back in 2009 [2]. The new version is very similar but with added functionality. For information about the performance of the device, refer to the article in Bulletin 228. It is at the cheaper end of the market, coming in at around £120 and this is still a substantial amount of money for schools who would like to use a class set. To try to alleviate their problem in a small way, last year SSERC placed a set of four Mystrica type II colorimeters with each of the Local Authorities on permanent loan. This year they have been augmented with another 5 so there is a set of 9 that can be borrowed within your authority. (For details of where they are held in your authority, contact SSERC).

Unlike some colorimeters, though, even having just the one will allow some good work to be done with a whole class via the connectivity with computers and/or phones and tablets. The particular advantage of these purpose-built devices is the ability to take readings at set intervals which allows good work on kinetics to be done.

Having made these colorimeters available, we feel a certain amount of responsibility to ensure you know how to use them - hence this article.

Using the Mystrica

For use as a stand-alone device, the Mystrica is very simple and straightforward and there is probably no need to cover it here. In most cases, you will just be recording the readings manually from the display. We will concentrate on taking automated readings.

Using a PC

This is still fairly old school, being done by means of a USB cable. It does mean however that you can display the data to the whole class. Downloading the data means it is easy to arrange that each pupil gets a copy for individual analysis. The software is free to download

Figure 1 - *The Mystrica colorimeter.*

from the Mystrica website [3]. It only works on windows machines. Sorry all you Mac fans and the few Linux aficionados. It functions in exactly the same way as the older Mark 1 has for several years.

1) Switch on the colorimeter and select the appropriate LED.
2) Make sure the Mystrica software is installed on your device and open it. The top left hand corner of your screen will look like (Figure 2).
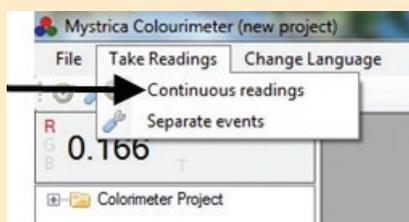

Figure 2 - taking readings with a PC.

3) Go to the 'Take Readings' tab and select 'Continuous readings'.
4) Just click 'next' on the first screen - unless you really want to name the project.
5) That takes you to this screen (Figure 3).
6) Select the, Time to Run and the 'data capture' interval, both of which will vary depending on the experiment you are carrying out. Click 'Next'.
7) Prepare your reaction mixture. As soon as you have added the final reagent, quickly invert to mix the solutions and put the cuvette into the colorimeter.
8) As soon as the cuvette is in the colorimeter, press 'take readings'. This will follow the reaction for the length of time you specified, taking readings at the interval you decided on.

If following the reaction automatically, as described above, you should export the data to allow the concentration to be calculated from the absorbance.
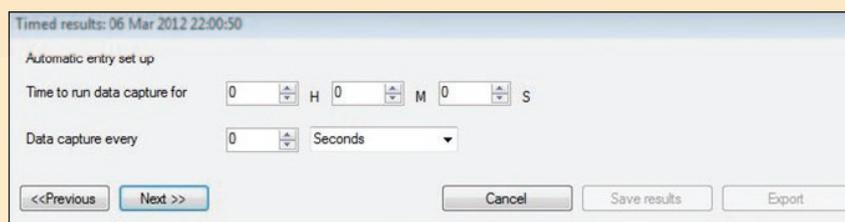

Figure 3 - Setting times for data capture with a PC.

Using a phone/tablet
This is via Bluetooth (only with Bluetooth 4.0 and above - it is best to check if you are using an older device). Being Bluetooth, it only connects on a 1:1 basis but connections are fast and simple so it is not a problem to pass on from pupil to pupil. The data collection interface is intuitive and easy to use and you have the option of emailing the data (in .csv format) so that further analysis can be carried out.

iPad/iPhone app
1) Switch on the colorimeter and select the appropriate filter
2) Download and install the app from the app store. Open it.
3) Here you will see the serial number of any Mystrica devices nearby that are switched on (Figure 4).
4) Select the logging interval (Figure 4).

   The original version of the app only had a choice of every 1, 5 or 30 seconds - which was perfectly adequate - but this has now been extended to with options for 2 minutes and 30 minutes.
5) **Now** click on the connect button.
6) Once you are connected. Switch to the data table view using the bottom tab (Circled in red), or graph view using the button to the right of it.
   The top of both screens has the same layout - as shown in Figure 5.

Connect to the colorimeter here.
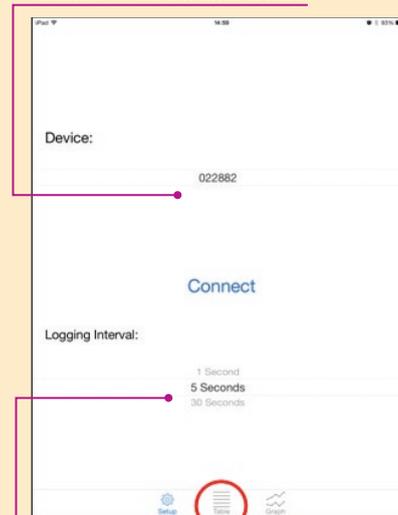
*You will need to change the settings **before** connecting to the device.*

Figure 4 - Connecting and setting sample times with the iOS app.

7) Select the red, green or blue LED (or you can do this manually from the colorimeter itself.
8) Remember to calibrate the colorimeter with an appropriate blank solution.
9) If you want to take individual, one-off readings manually. Just press the 'Separate Event' button. The reading will then appear.
10) If you want to record a continuous series of readings, press 'Start Logging', the software will start recording data at the frequency you specified earlier. ▶
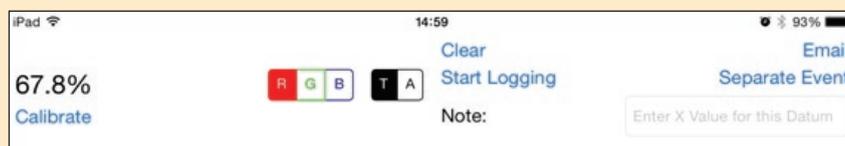

Figure 5 - Controls in iOS app.

Time	Transmittance	Absorbance	Colour	Note
0 s	30.3%	0.519	R	
5 s	32.0%	0.496	R	
10 s	33.6%	0.474	R	
15 s	35.3%	0.452	R	
20 s	37.0%	0.432	R	
25 s	38.7%	0.413	R	
30 s	40.3%	0.395	R	
35 s	42.0%	0.378	R	
40 s	43.6%	0.361	R	
45 s	45.2%	0.345	R	
50 s	46.9%	0.329	R	
55 s	48.5%	0.315	R	
60 s	50.0%	0.301	R	
65 s	51.6%	0.288	R	
70 s	53.1%	0.275	R	
75 s	54.6%	0.263	R	
80 s	56.1%	0.251	R	
85 s	57.5%	0.240	R	

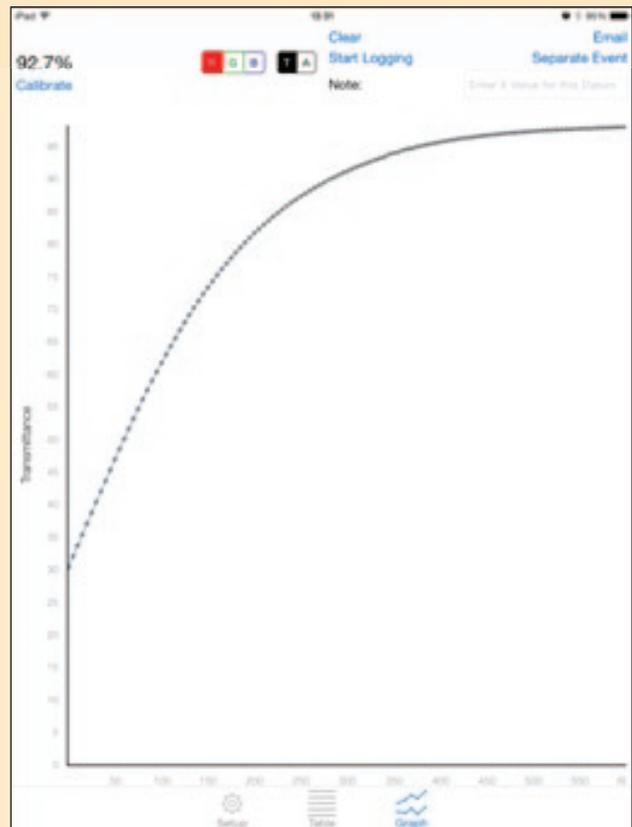*Figure 6* - Sample data table in iOS app.

Figure 7 - Sample graph screenshot from iOS app.

The data is shown here in table view (Figure 6). Note that there is no need to select tranmittance or absorbance as the software records both. As each new reading is taken, it is added to the bottom of the table.

You can switch between table view and graph view at any time without interfering with the readings - but you can't switch diodes during a run.

11) To start again, just press 'Clear' (Figure 6).

12) To download the data for future analysis, just click the 'Email' button at the top right and your email will automatically pop up with the file attached for you to send to yourself, or anyone else. The data is exported as a .csv file which will open in Excel (or other spreadsheet program.

13) If you just want the graph, you can take a screenshot with the iPad/iPhone as you normally would. See Figure 7.

14) The latest version of the app, just out, has the same functionality the Android app does in that it allows you to save sessions on the device for later use, rather than having to email them - See the section on the Android app for more details.

Android app

There is now also an app for devices running Android 4.4 and above but we have yet to manage to put that through its paces. It is quite similar but there are some differences. On tablets the screen is landscape and shows table and
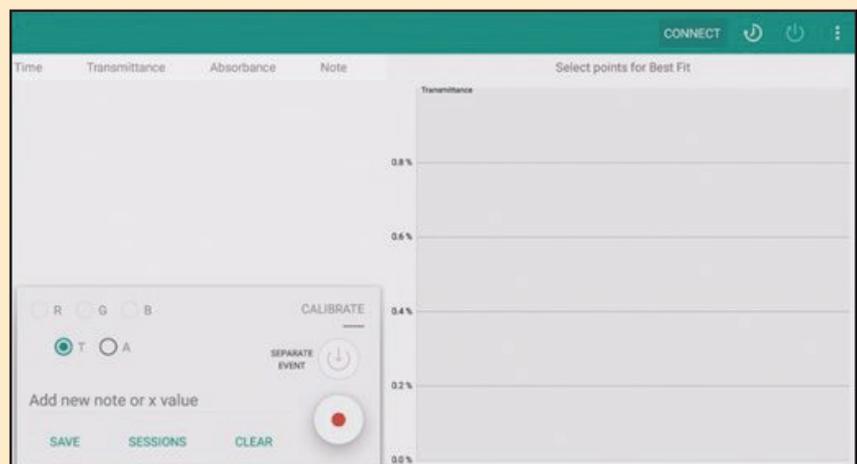

Figure 8 - The Android screen.

graph simultaneously: on phones the screen is portrait and you can toggle between table or graph.

Opening the Android app on a tablet brings up a screen like this (Figure 8).

To connect to a colorimeter, making sure you have switched on Bluetooth!) click on the 'connect' button at the top.

This opens up a new screen where you can select the device if there is more than one in range.

To the right of that are buttons to select the timing options.

Clicking on the left hand one enebles selection of the timing interval, as in the iOS app, while the icon to it's right allows you to set the duration of capture so you can go away and leave it.

To start the session, just tap the record button at the bottom. As in the iOS app, there is also the option for manual operation (or adding in data manually) with the 'separate event' button.

The main difference between the Android and the iOS app (though this is being changed in the new version of the iOS app) is the ability to store sessions on the device. At the bottom left of Figure 8 you can see two buttons marked 'save' and 'sessions'. 'Save', obviously, allows you to name and save your session, while tapping on 'sessions' opens up the screen in Figure 9.
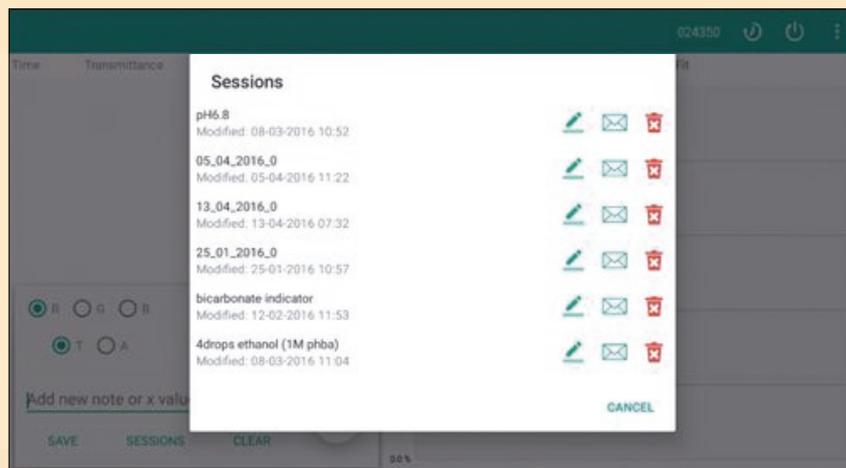

Figure 9 - *Session recall in the Android app.*

You will see all the sessions you have saved and you have a few options.

Tapping on the name allows you to rename the session should you wish to.

You also have three icons on the right of each session.

The 'pen' icon will let you recall the session to see the data and make any edits.

The 'letter' icon allows you to email it (the data as a .csv file and the graph as a .png file) and the 'bin', not surprisingly, deletes the session.

This save/store functionality is being added into the new version of the iOS app in the very near future.

For more details, there are videos of the apps in use and interactive image maps highlighting the various functions in the Mystrica website [4].

Overall, while this device may not be able to replace the larger, more advanced machines for certain pieces of advanced work, it is more than suitable for the vast majority of the colorimetry carried out in schools at all levels. The addition of the mobile apps gives a welcome added functionality and it comes at a price that is hard to beat - especially if you are only borrowing the ones SSERC has put into the Local Authorities.

References
[1] Colorimetry on the cheap (2012), SSERC Bulletin, **240**, 4-8.
[2] The Mystrica colorimeter (2009), SSERC Bulletin, **228**, 10-12.
[3] http://www.mystrica.com/Software/Download (accessed April 18th 2016).
[4] http://staging.mystrica.com/Wireless (accessed April 18th 2016).