"Is it true that *Cabomba* has been

Most teachers of biology who attend SSERC courses will be familiar with the suite of activities entitled '*Fun with Cabomba*'. These activities, which can be downloaded from the SSERC website [1], were developed to support the learning outcomes which relate to understanding photosynthesis at level 3 in the *CfE* curriculum [2].

I have collaborated on investigations into the process of photosynthesis and I can demonstrate my understanding of why plants are vital to sustaining life on Earth - *SCN 3-02a*.

The first activity [1], whose purpose is to help pupils gain an understanding of carbon dioxide uptake and/or release by plants in light and dark, makes use of an aquatic plant and hydrogencarbonate indicator along with apparatus readily available in school laboratories.

The second activity makes use of an aquatic plant and sodium hydrogencarbonate, again with apparatus readily available in school laboratories, to investigate oxygen evolution in plants in light and dark conditions. By using and/or adapting the basic techniques, pupils can design their own practical work/investigations.

Until recently SSERC recommended the use of *Cabomba caroliniana* (Figure 1) for these simple photosynthesis experiments. *Cabomba* is an aquatic plant, non-native to the UK which has been available for some time from aquarium suppliers as an aquarium oxygenator. In bright light it readily releases bubbles of oxygen-rich gas and the rate of bubbling can be varied very easily by altering the lighting conditions (Figure 2). However, in 2016 *Cabomba*, along with various other plant species, was placed on the EU list of invasive alien species [4]. As current stocks are used up it will become increasingly difficult to source *Cabomba* and ultimately it will be an offence to keep, or supply it [4].

At SSERC we have identified another aquarium oxygenator, also non-native which, to date, is still available to buy. *Egeria najas* (Figure 3) performs just as well as *Cabomba* in these simple classroom photosynthesis experiments (Figure 4).

Egeria najas can be substituted for *Cabomba* and in bright light will give a stream of bubbles from a cut end of stem (Figure 5) and will bring about colour changes in hydrogencarbonate indicator from orange to purple within about 20 minutes in bright light, and to yellow in darkness within about 30 minutes (Figure 6).

We have also used *Egeria najas* as a successful substitute in our '*Cabomba* towers' [5] (Figure 7) and have found that it is sturdy and more easy handled than *Cabomba*,

Figure 1 *- Cabomba caroliniana.*

Figure 2 *- Cabomba caroliniana in bright light releasing oxygen-rich bubbles.*

Figure 3 *- Egeria najas.*

banned from schools!?”

Figure 4 *- Egeria najas in bright light releasing oxygen-rich bubbles.*

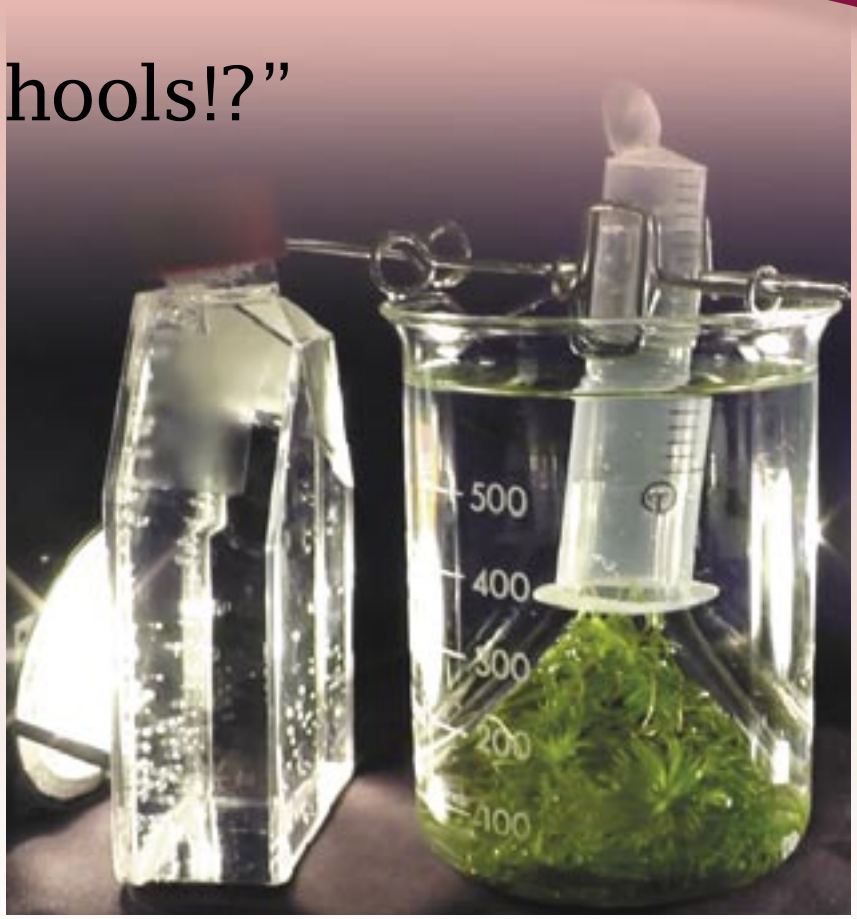

Figure 5 *- Collecting oxygen-rich bubbles of gas produced by Egeria najas in bright light.*

Egeria densa and *Elodea* when it is out of water.

A suite of activities called ‘Fun with photosynthesis’ using *Egeria najas* and comprising protocols for the classroom activities, a technical guide and an accompanying PowerPoint will be available to download from the SSERC website.

We have sourced *Egeria najas* from a variety of suppliers including our local Dobbies Garden Centre [6] and on-line from Urmston Aquatics [7].

If you are going to purchase *Egeria najas* you should note that in our experience even suppliers sometimes confuse it with *Egeria densa* and with *Elodea canadensis*. This is partly because all of these species have common names, including *Elodea densa*, Brazilian elodea and so on. It might help to take a picture with you and to note that compared to *Egeria densa* and *Elodea canadensis*, *Egeria najas* has narrow serrated leaves and compared to *Egeria densa* it has a narrow stem (Figures 8-10).

Since *Egeria najas*, is a non-native species, it may yet join *Cabomba caroliniana* on the EU list of invasive alien species not to be kept or supplied, the Biology Team within SSERC will continue the quest for a native substitute aquatic oxygenator with which to have photosynthetic fun. In the

Figure 6 *- Egeria najas and hydrogencarbonate indicator:*
1) In bright light for 30 minutes;
2) In darkness for 30 minutes;
3) Hydrogencarbonate indicator.

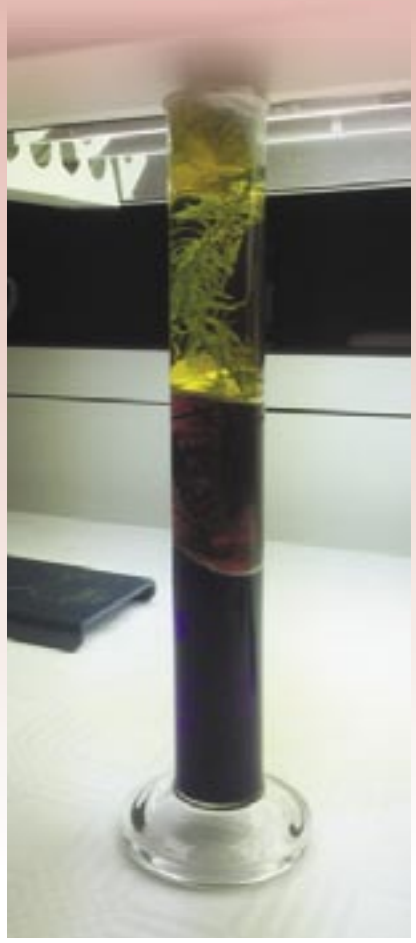

Figure 8 *- Egeria najas.*

meantime *Egeria najas* will serve the purpose, but it should be used on the understanding that care should be taken not to release it to the environment. This is also a point to be highlighted to students. The Code of Practice, *Materials of Living Origin* [8] (Figure 10) states in

Figure 7 *- Effect of irradiation (4 hours) on Egeria densa/hydrogencarbonate mixtures (Figure 7). Prior to irradiation the pH was measured to be 7.4. (i) Upper portion of cylinder covered with black paper during irradiation, (ii) middle portion of cylinder covered with 50% neutral density filter during irradiation, and (iii) lower portion of cylinder uncovered during irradiation after 4 hours irradiation.*

Figure 9 *- Egeria densa.*

Section 3 that using materials from the environment for investigation with care and respect will foster in students an appreciation of living things and "...illustrate the practical need for conservation and thus contribute to their development as responsible citizens and effective contributors to environmental concerns."

Figure 10 *- Materials of Living Origin: A Code of Practice for Scottish Schools and Colleges [8].*

References

[1] http://www.sserc.org.uk/resources/sciences-by-organiser/1355-sciences-biology-levels-3-4/3804-photosynthesis?highlight=WyJwaG90b3N5bnRoZXNpcyJd.

[2] *Curriculum for Excellence: Sciences Experiences and Outcomes* available at https://www.education.gov.scot/Documents/sciences-eo.pdf.

[3] http://ec.europa.eu/environment/nature/invasivealien/index_en.htm.

[4] http://www.plantlife.org.uk/uploads/documents/Banned_Plants_2016.pdf.

[5] http://www.sserc.org.uk/images/Biology/Photosynthesis_Nat4/1-4_Cabomba_Tricolour.pdf.

[6] Dobbies Garden Centre available at http://www.dobbies.com/home.aspx.

[7] Urmston Aquatics, 20 The Circle, Barton Road, Lostock, Manchester, M32 9TR. Available at http://www.urmstonaquatics.com/, telephone 0161-748-9086.

[8] *Materials of Living Origin - Educational Uses: A Code of Practice for Scottish Schools and Colleges*, SSERC, 2012. Available from the SSERC website at http://www.sserc.org.uk/biology-2/health-a-safety-home151.