

# Plant blindness and art-based learning

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## Background

Approximately 80% of Earth's biomass is plants (Bar-on et al., 2018). They are incredibly important organisms in nature, and without them our life here on earth could not be sustained (Fernando, 2012). Unfortunately, they have often been overlooked perhaps even forgotten in biology teaching, to an extent that Wandersee and Schussler in 1998 introduced the term *plant blindness* to describe this problem (Wandersee and Schussler, 2001). The term was further defined in a guest editorial in the *The American Biology Teacher* (Wandersee and Schussler, 1999). Here, they defined it as:

- The inability to see or notice the plants in one's environment.
- The inability to recognize the importance of plants in the biosphere and in human affairs.
- The inability to appreciate the aesthetic and unique biological features of the life forms that belong to the Plant Kingdom.
- The misguided anthropocentric ranking of plants as inferior to animals and this as unworthy of consideration.

Wandersee and Schussler were deeply concerned about the underrepresentation of plants compared to animals in elementary and middle school teaching. As a response they started campaigning for more plants in teaching across all levels of the school system under the title - *Preventing Plant blindness*. In recent years it has been suggested that the term should be changed "Plant Awareness Disparity", abbreviated to PAD, in the scientific literature, but a change of the term is still debated (Parsley, 2020; Parsley et al, 2022). The paradox with plants is that they are crucial for the survival of most if not all animals and should therefore play an equally important role in biology teaching, but they do not and it

is unclear why (Wandersee and Schussler, 1999). Since the term was defined new studies and discussions of how to address this issue has been published in both scientific journals and communicated more broadly to the public through newspaper articles and books (Allen, 2003; Nyberg and Dawn, 2014; Colon et al., 2020). There is a general agreement that the cognitive bias that results in a lack of awareness towards plants in the environment is connected to the human visual information-processing system. As an example, our brains are more likely to search for movement, conspicuous patterns, and colors in our surroundings rather than static objects like the plants that are part of a given environment (Allan, 2003). Plant blindness seems to be the human default mode, why awareness and interest in the botanical side of life require more of those teaching this subject. The zoocentric focus exhibited in most biology educations also means that basic biological concepts are more likely to be explained using animal examples rather than botanical. Teachers report that a lack of training in botany also influence the way they teach biology, and without the appropriate knowledge and training they are less likely to pass on the information to a class of students. Additionally, studies have shown that students who are introduced to plants and botany at an early age are much more likely to include it in their studies later on (Wandersee and Schussler, 2001; Strgar, 2010; Anderson et al, 2014; Jose et al, 2019).

Botany and other plant related topics require students to learn a substantial amount of subject-specific vocabulary related to both plant morphology, and cellular constructions. The most common mean to achieve this is through class lectures and the identification of living specimens using a flora. Plant identification is an active learning approach, but for students not familiar or comfortable with botanical terminologies, the nuances and specificities of minute details make identification work very hard. The traditional way of teaching botanical terminology and identification is through monologue lecture going through and highlighting each of the key features for a species, family, or genera. Often schematically drawn images are used to illustrate the key features, as the field have a long scientific history of actively using illustrations. Even today, new species are often drawn to highlight the key morphological characters that distinguish them from other closely related species. The active use of drawing in botany and learning how to sketch

a species is no longer an integrated part of plant biology, but perhaps it is time to re-introduce it?

In this study, drawing exercises were introduced in a tropical botany course to help students remember plant families and morphological traits better. To understand why this might have a positive effect on student learning we need to investigate art-based methods and what is known about those in teaching. Art-based methods is a broad concept covering almost 30 different approaches (Leavy, 2017). A single unified definition that will sufficiently cover them all is therefore not possible as they often originate in different scientific fields (Hoppe, 2022). In art-based teaching the artistic methods include creative, visual, poetic, and performative approaches (Bangoli, 2009). For this study focus has been specifically on the use of drawing as a method to enhance student learning of botanical terms related to plant morphology. The theory behind drawing being particularly helpful in boosting memory is the finding that images are often better remembered than words (Fernandes, 2018). In the works by Meade et al. (2018) they showed how words are better remembered by test participants if drawn. The *picture-superiority effect* expressed by these data is well supported and have been tested broadly across demographic groups and paradigms (Paivio et al., 1971). The effect of drawing as an active tool in mnemonics<sup>1</sup> is hypothesized to be the positive result of a dual coding that comes with the concept of having both visual and verbal representation (Paivio et al., 1968). It is this effect that has been suggested to also be at play in drawing-to-be-learned information (Fernandes, 2018).

For this study, it was hypothesized that the *picture-superiority effect* and the active use of drawing plants and specific morphological characters would enhance deep learning and help students retain detailed information about the plants better.

## **Data collection and analysis**

Presentations in the course covered a broad range of plant families across the tropics, and students were expected to know about 120 of them and have more detailed knowledge about 73 of the families. For the teaching sessions short and concise fact presentations of a genera, along with

images were prepared. The inclusion of a drawing task was included for 5 families and prior to getting into each family a short introduction to drawing was given – examples shown in figures 1 and 2. After the general introduction to drawing a brief overview of the family was given and each family was rounded off with a drawing task. Examples of how the in-class drawing assignments were phrased can be seen in figures 3 to 5, and examples of student drawings are included in figure 6.

For all drawing exercises students were encouraged to look up further images of the specific species they wanted to sketch, and living material was brought into class as well. The key task for each drawing exercise was for the student to spend no more than 10 min on the assignment and only draw key identifying features of each plant. This approach was repeated in 3 teaching sessions.

In the third and last session the class had a surprise “POP quiz” with a mixture of live plants and images. The students knew that the plants on display were all from the orders that they had covered during my teaching, which significantly limited the number of species it could be. The students were given answer sheets and it was up to them how specific they wanted to be for each test plant. Answers could be from order to species level. This activity was only for fun and did not result in a grade nor did it count towards the students’ final marks. Comments heard at the POP quiz were: “I remember that one! We drew it...I just need to remember its name”, and “We definitely drew that one. It’s an xxxx”.

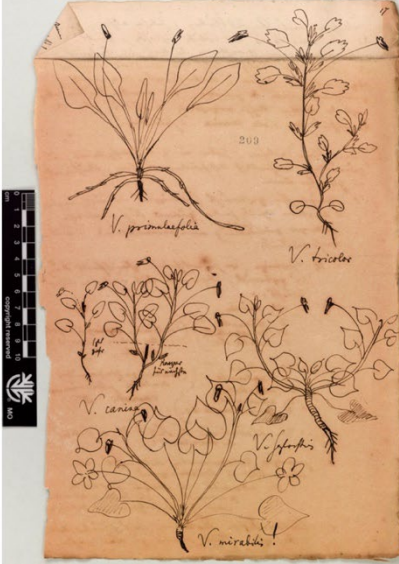
After the class finished, students were asked for their opinion and input on including drawing exercises as part of the teaching. These were some of the comments: “That was really good!”, “I all of a sudden realized what a specific morphological term actually meant when used to describe a species”, “It really forced you to see and look for specific characters in the plants” and “Nice to be active myself”. In addition to this the online anonymous student evaluation included specific comments on these course days: “... Always interesting and fun classes :)” and “Enjoyed the drawing exercises for noticing small details.”

Sketch challenges today

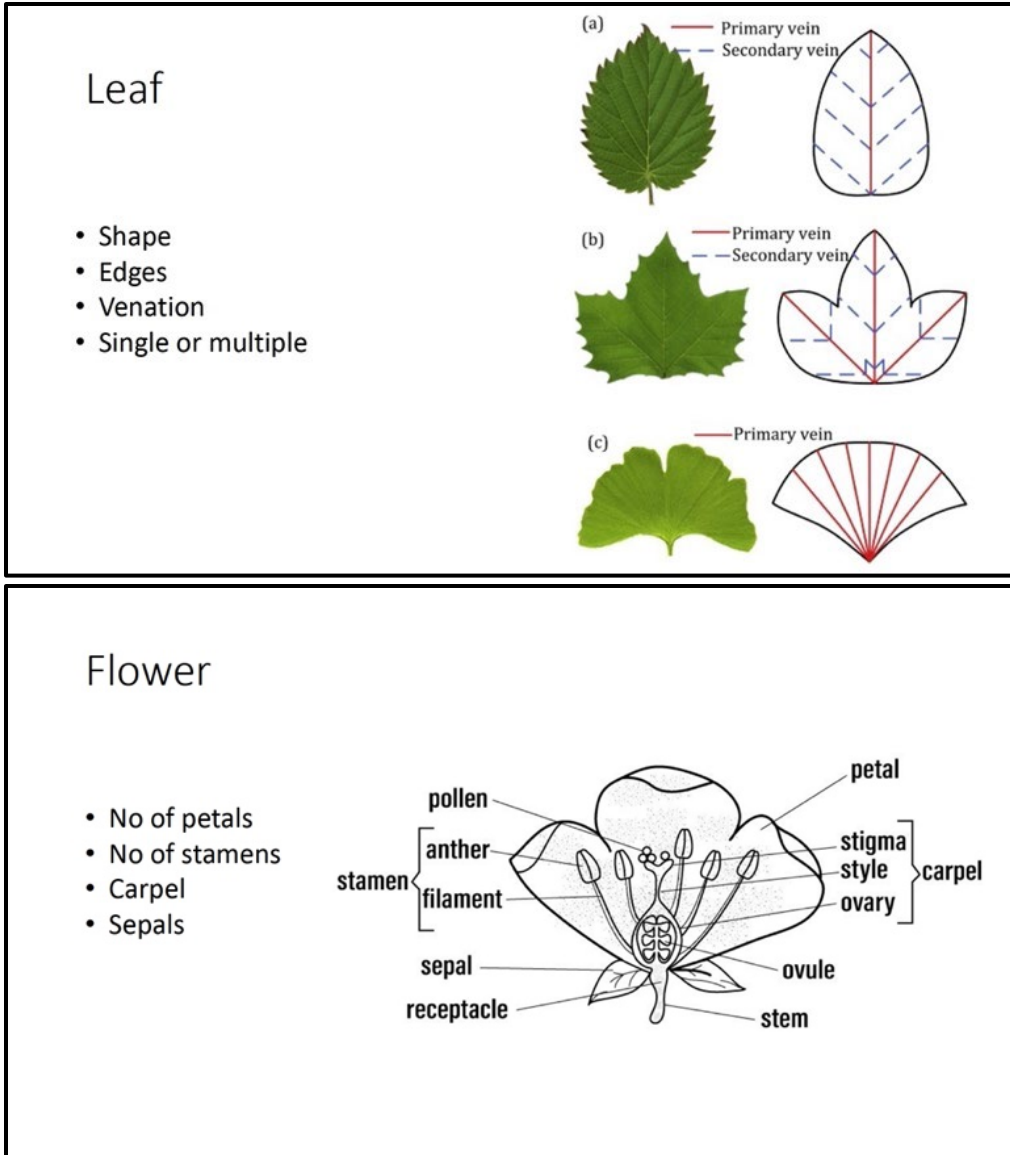
Sketches like this by George Engelmann

By the end of the day

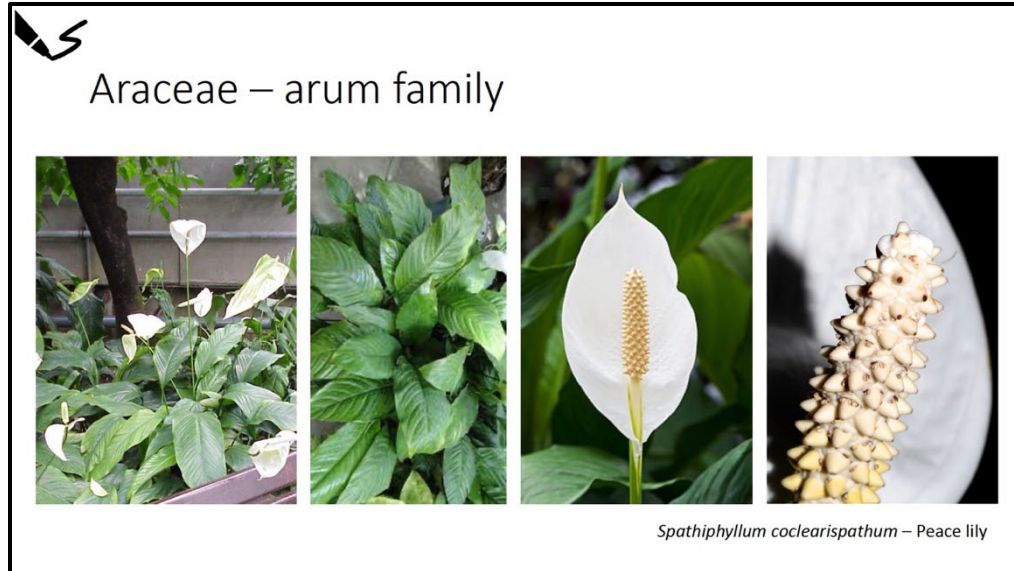
- 5 min sketching
- Aim at 1 sketch per order (5 total)
- Focus on leaf and flower
- Include only the most important details
- Add notes



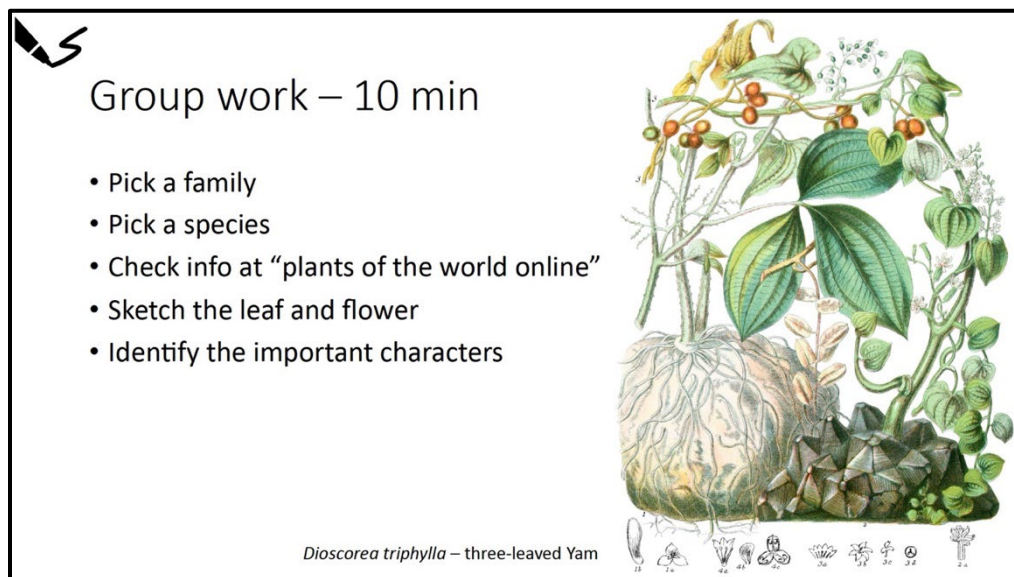
**Fig. 1.** Introduction slide to the drawing activities. It was emphasized that the task was not to make exquisite and beautiful drawings but using drawing as a tool to better recognize and remember specific character traits associated with a specific plant species/family/genera. Roots were left out to begin with to keep the task simple.



**Fig. 2.** To further explain the drawing exercises examples of leaves and flowers were introduced – not from a biological perspective, but from a “what do you need to see to be able to draw it” perspective. The ability to notice the specific characteristics is very important both from a drawing perspective, but also for species identification. Things like the overall shape of the leaf and the way the edges are straight, curved or serrated to the venation and how the leaf is attached to the rest of the plant. The same goes for the flower. Are there petals? Are the petals fused? Where is the ovary placed? These are the types of questions students will meet when they are to identify a species using a key in a flora. They are therefore also the questions they need to think about when they draw.



**Fig. 3.** This was the first drawing challenge the students were given. General information about the family had been provided prior to the task. This was an individual assignment and a live specimen from the Araceae family had been brought to the classroom for inspiration. The students were asked to use their computers to look up species in the family before they picked a specific species to draw.

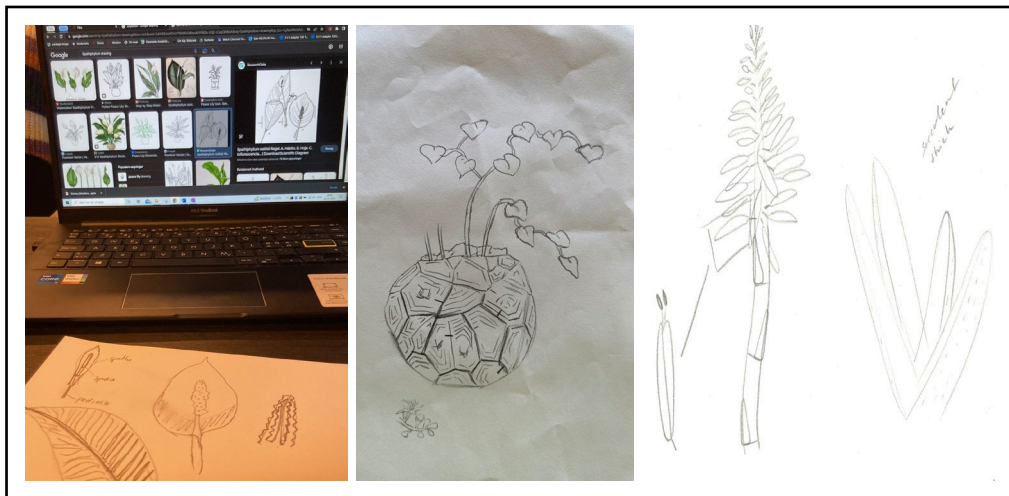


**Fig. 4.** Next plant sketch challenge was more open, and interactive for the students. We were studying the plant order Dioscoreales, and general botanical information were given prior to the task.





**Fig. 5.** Final plant sketch of the day was *Aloe vera*. This species is incredibly well known, but most people only recognize the leaves. For this drawing the students were asked to focus primarily on the flowers and make sure to add notes about their flower morphology like flower shape, placement, and color.



**Fig. 6.** Work in class and three different students plant sketches. The 3 different plants drawn were of the family Araceae, order Dioscoreales and species *Aloe vera* (images from left to right). Images shared with the permission of the students.



## Discussion

It has been over 20 years since the first attempts to prevent plant blindness were introduced, yet the effects of those efforts do not seem to have manifested themselves in our western societies. This calls for even more focus on bringing the plants to the table at all levels of our education system as highlighted by several recent papers (Jose et al., 2019; Parsley, 2020; Achurra, 2022).

Re-introducing drawing as a teaching tool to help students understand and remember the complexity of plant lives and all the terms associated with that seem to be a good option going forwards, however it cannot stand alone. Based on the immediate responses from the students they could see the active and positive use of drawing as a tool to remember and understand plant morphology better. They expressed higher awareness and understanding of the nuances of specific morphological traits, and the approach seemed to help them better remember the terms as well. This experience seems to support the findings by both Fernandes et al. (2018) and Meade et al. (2018).

The general response to the drawing task was overwhelmingly positive by all students I spoke to, and it was encouraging to see how well it was received as a tool during class time. From a teaching point of view these are very easy and very quick activities to include in class, and the outcome seems to far exceed what could have been obtained through the traditional going through of terms and key characteristics. Based on student responses it is hard not to wonder why drawing has not been used and encouraged more in biological and botanical teaching at university level over the past 10-15 years. The *picture-superiority effect* has been known and well supported since the 1970s (Pavio, 1968 and 1971) and with a long history of scientific botanical illustrations it seems like this should have been an integrated approach and tool for the students to use in all courses about plant morphology and botany.

Art-based methods in teaching is a broad concept (Leavy, 2017) and they seem to take different forms depending on the scientific fields they are used in (Hoppe, 2022). In biology and specifically botany drawing seems particularly relevant, and studies have shown that using drawing as part of a learning program is especially helpful as images are

often better remembered than words (Fernandes, 2018). This also seemed to be the case for the students learning tropical botany, and they generally seemed more aware of having learned about the specific plant species they had drawn.

## Conclusion

There is a worldwide need to re-introduce plants and plant knowledge to society and particularly in schools. Plant blindness defines some of the challenges that society faces towards plant awareness and going through art to increase plant knowledge seem like a sensible approach. Introducing artistic elements in natural science education engage students in a different way. Other means of teaching and knowledge sharing about plants and plant life is still necessary, but drawing as a learning tool to increase awareness and support more scrutinizing observations seems like a really good approach.

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