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# THE GREEN, GREEN GRASS OF DOME

football turf, grass morphology, grass species
biology
12–15 years
Students have to know how to use an optical microscope.

## 1 | SUMMARY

This teaching unit is about identifying the properties of the grass that is needed for growing the best football turf. What qualities does it need?

Different species of grass have different qualities. Certain qualities are needed in football turf, whereas others are not important. In this project we aim to find the perfect grass species for football turf and to compare its morphology to existing grass species.

## 2 | CONCEPTUAL INTRODUCTION

Different grass species have different qualities. What qualities are needed for the turf on a football pitch?

- A firm root system prevents grass flying around.
- More-horizontal growth forms are more durable (less likely to be damaged by trampling by football boots).
- Fewer stomata make grass more drought-resistant.

For this project you will need:

- CD cases (to grow the grass, **FIG. 1**)
- potting compost
- seeds (ryegrass (*Lolium perenne*), Bermuda grass (*Cynodon dactylon*), *Poa annua*, any other grass species that might be suitable)
- a microscope (to see the stomata)
- nail polish
- packing tape
- hand lens

## 3 | WHAT THE STUDENTS DO

### 3 | 1 General introduction to football turf

Football-turf grass suffers a lot. It is trampled and worn by players slipping and cutting up the surface. However, it is important to have beautiful green turf throughout the year, particularly for premier league and international matches. Approximately 8,000 different species of grass exist all over the world. Not all grasses are suitable for football turf. Two of the qualities needed by football turf are roots that are firmly attached to the soil and leaves that are not damaged by trampling. You are going to design the perfect football turf grass and compare its features with the grasses used on actual football pitches.

### 3 | 2 Design the perfect football turf grass

Draw a grass plant (root system, leaves, stems) that would be perfect to play football on. Think of the following:

Find a picture of a grass on the Internet in order to see the general growth form of grasses. Bear in mind that the grass must not be damaged too much by trampling and should be firmly attached to the soil, as well as having other desirable qualities.

### 3 | 3 Grow football grass

Fill half of a CD case with compost and plant the seeds 1 cm under the surface. Stand the CD case on its side in a tray filled with 2 cm of water (so that the soil stays damp). It should look like the picture shown in the figure below **(FIG. 1)**. Let it grow for a period of time **(FIG. 2)** on a sunny windowsill and check regularly to ensure it has plenty of water. Do this for ryegrass, Bermuda grass, *Poa annua* and other species found growing outside of your school or home. Each species should have its own CD case and stand on the same windowsill.

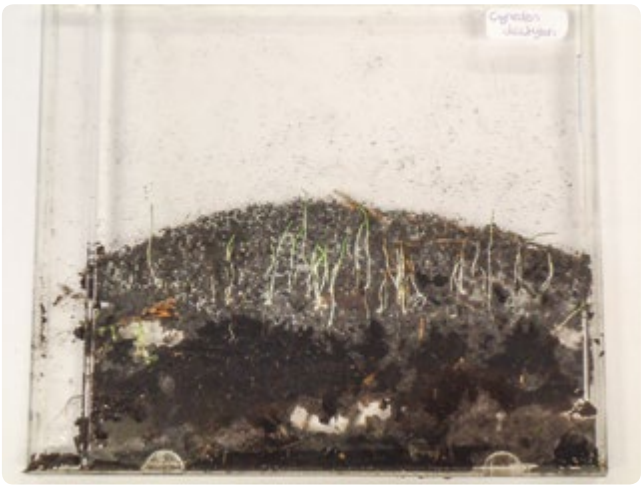

**FIG. 1** *Cynodon dactylon*

It takes time for grass to germinate and grow to a size so you can study it. Below you can see how much time it takes **(FIG. 2)**.

**FIG. 2 Time of growth**

| Species | Days to germination | Days to study |
|---|---|---|
| *Cynodon dactylon* | 11 | More than 30 |
| *Poa annua* | 5 | 30 |
| *Lolium perenne* | 4 | 30 |

### 3 | 4 Study the stems and leaves

Your grass has grown—well done! You are now going to make two drawings per grass species. The first drawing is of the stems and leaves to show how they are distributed in the CD case (you can open the CD case to get a better view). The second drawing is of the stem and leaves of one piece of grass.

Answer the following questions:

- How long is the stem?
- At what distance does the first leaf appear?
- How many leaves have formed?
- How long are the leaves? How wide are they at their widest point?
- What species comes closest to your ideal football turf grass?

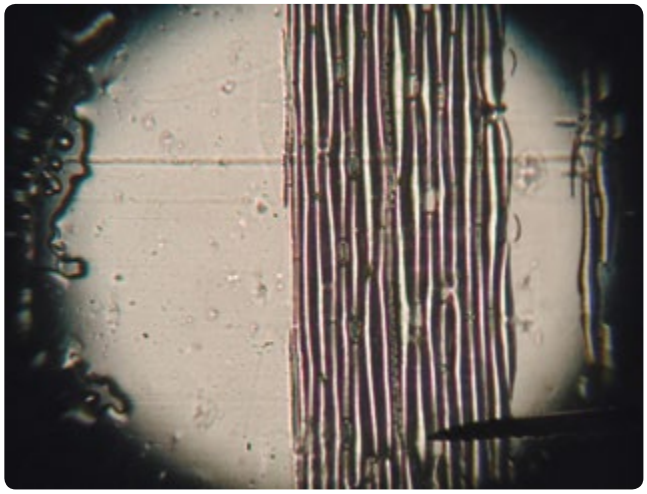

**FIG. 3** *Poa annua* stomata 100×

### 3 | 5 Study the stomata (FIG. 3)

The stomata on the underside of the leaves make the exchange of gases possible. When the stomata are open, carbon dioxide comes in and oxygen goes out in order to facilitate photosynthesis. Water also leaves the plant via the open stomata. This keeps water flowing through the grass, and this flow is essential for the plant's uptake of minerals. But on a very dry day and on a dry turf, the grass will wilt and eventually die if the stomata stay open. Lots of stomata increase the amount of photosynthesis but also increase the risk of wilting.

You are going to count the number of stomata for all of your grasses, according to the following instructions **(FIGS. 4–7)**:

- Paint clear nail polish on the bottom of the first leaf. Let it dry.
- Use packing tape to remove the nail polish and place the packing tape (with the print of the nail polish) on a slide (mark the slide).

Put the slide under a microscope and magnify 400×. Draw one stoma, together with the surrounding cells. Then magnify 100×, define the leaf surface in the field of view and count all the stomata that are captured in the field. Calculate the number of stomata per $mm^2$. Repeat with all the species.

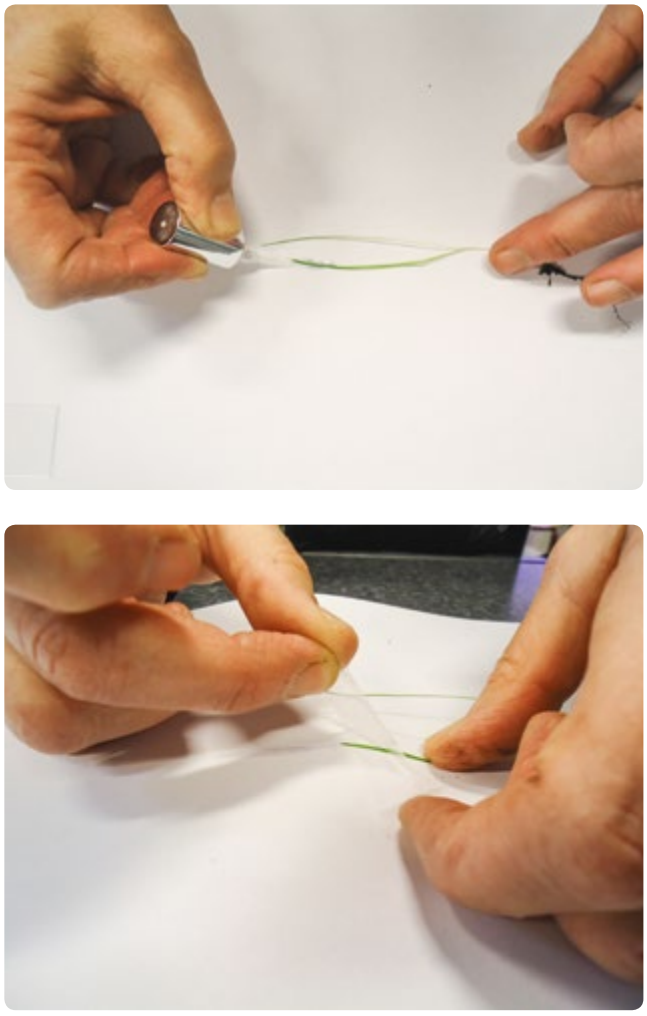

**FIG. 4–7** Technique to find out the number of stomata

Answer the following questions:
- What was the number of stomata per field of view for each species of grass?
- Which one is best adapted to a dry climate?
- Which one is best adapted to a wet climate?
- Which one would grow best in your country? Explain why.

### 3 | 6 Study the root system

Now that the grass has grown, we can study the roots as well. The first drawing you should make is of the way the roots are organised in the CD case (you can open the CD case to get a better view). The second drawing is of the root of one piece of grass. Carefully pull one out and use a hand lens to magnify it.

Answer the following questions:
- How long is the root?
- How many divisions does the root have?
- On what part of the root (upper, middle, lower) are the divisions?
- Is/are the root(s) capable of keeping the soil together? (Think of a way to test this.)
- What species comes closest to your ideal football turf grass?

## 4 | CONCLUSION

You have designed the perfect grass for a football turf and you have grown different species of grass in order to study their qualities. Explain which grass species best fits the title “best football turf grass” for your country.

We have assumed the best turf is a monoculture, but perhaps a mixed culture would be better. Give two reasons why a mixed culture may be preferable to a monoculture.

## 5 | COOPERATION OPTIONS

Students can work together with their peers in different countries and compare the best grass species for their own respective countries. The grass that is best for the Netherlands may be different from the best grass for Hungary. The students can think about what factors are contributing to good growth (light, humidity, temperature etc.). By comparing the respective climates of your partner countries, try to explain why they chose their particular grass species.

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**TAKEN FROM**
iStage 3 - Football in Science Teaching
available in Czech, English, French, German, Hungarian, Polish, Spanish, Swedish
www.science-on-stage.eu/istage3

**PUBLISHED BY**
Science on Stage Deutschland e.V.
Poststraße 4/5
10178 Berlin · Germany

**REVISION AND TRANSLATION**
TransForm Gesellschaft für Sprachen- und Mediendienste mbH
www.transformcologne.de

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**DESIGN**
WEBERSUPIRAN.berlin

**ILLUSTRATION**
Tricom Kommunikation und Verlag GmbH
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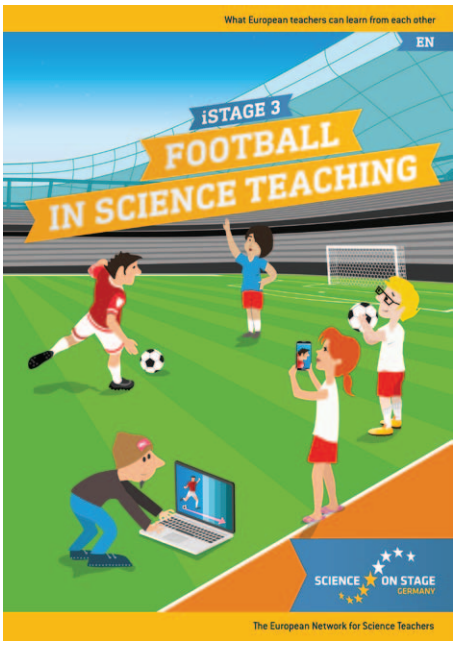
First edition published in 2016



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