BIODIVERSITY OF LAWNS

75 MINUTES
+ GROWING TIME
SBI3U, SBI3C, SVN3M

A high school lesson plan provided by the University of Guelph

There are four different varieties of turfgrass commonly found in lawns in Ontario. While most accounts of turfgrass areas refer to them as monocultures this is generally not true. Lawns consist of many species each with different characteristics that aid in the resiliency, or strength, of the lawn ecosystem. The following activities can be performed with these four species to show the diversity of the species found in lawns, and how those differences can be observed in seed size and germination time.

Curriculum Alignments and Expectations

- Demonstrate scientific investigation skills (related to both inquiry and research) in the four areas of skills (initiating and planning, performing and recording, analyzing and interpreting, and communicating)
- Investigate the structures and functions of plant tissues, and factors affecting plant growth
- Investigate some of the factors that affect plant growth
- Understand the benefits of each type of grass considering condition and germination time
- Understand the difference in germination time and what it means for grass

Learning objectives

- Gain understanding of biodiversity as it relates to plant species
- Develop an ability to calculate number of seeds per gram and a seeding rate based on seed size and percent live seed
- Grow observation skills in a scientific context

Assessment Strategies and Success Criteria

- Peer instructors
- Quizzes
- Think-pair-share

Cross Curricular Links

- Geography – Patterns of Natural and Human Systems
- Geography – Sustainability and Stewardship of Natural Resources
- Career Studies- Communicating with Others and Interpersonal Relations
- Career Studies- Identifying Trends and Opportunities
- Functions- Connecting mathematical concepts to other contexts

Materials

- Turfgrass seed
- Graph paper
- Petri dish or sandwich bag
- Scale
- Paper towel
- Tweezers
- Potting mix
- 4-inch pots
- Eye dropper

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TEACHER NOTES

1. Introduce seeding turfgrass.

Obtaining Seeds: To start the activity seeds for each of the following species will need to be obtained: Kentucky bluegrass, Perennial ryegrass, Tall fescue, and Creeping red fescue.

Seeds can be obtained from many sources. Typically seed bought at hardware stores and garden centers will be a mixture of 2-5 species and can be used for some of these activities. Sod farms and high-end garden stores may carry each species separately.

When seeding turfgrasses, there are a number of factors that must be considered. Typically, seeding rates are expressed as weight of seed per unit area (1kg of seed per 100m2 or 10g of seed per m2). The seeding rate typically varies between different turfgrass species. The different seeding rates are based on the desire to achieve 2 seedlings every square centimeter. Larger seeds need to be seeded at higher rates with greater weights per unit area than smaller seeds in order to get the same number of plants. Another factor that is important in determining seeding rate is the number of seeds that are still viable (alive). Living seed is determined by germinating the seeds under ideal conditions and calculating the percent of the total number of seeds that germinate within the time frame of three times the median germination time.

2. **Activity 1: Determining the number of seeds per gram**

Required materials: Seeds, graph paper, scale

Have the students answer the following questions:

a) Which of the species have the largest seeds from observation?

The seeds vary in size and shape. The tall fescue seed is generally the largest and perennial ryegrass is very similar. Creeping red fescue seeds are long and although they appear large they are actually very light for their size.

b) What are the ecological advantages of having large seeds?

Larger seeds have more reserves and therefore provide more resources for the seedling. Larger seeds can also germinate from deeper in the soil because they will have enough energy to grow up through the soil before getting to the sunlight to make their own energy through photosynthesis.

c) What are the ecological advantages of having small seeds?

Small seeds are lighter and more easily dispersed. Additionally, small seeds take less energy and reserves to produce so the mother plant can produce a large number of small seeds versus a smaller number of larger seed with the same amount of resources. Turfgrasses vary greatly in their seed sizes but compared to most cultivated plants turfgrasses have very small seed sizes.

d) Assuming 100% of the seed is living, how many grams of seed do you need to seed one

square meter (10,000cm2)?

The general recommendations for the species provided are:

- Kentucky bluegrass = 10 g/m2
- Perennial ryegrass = 30 g/m2
- Tall fescue = 30 g/m2
- Creeping red fescue = 20 g/m2

This can vary with cultivar and generally larger seed seeding rates are lower and with smaller seed the seeding rates are actually higher. This has more to do with expected error in application.

Have the students weigh out 50 mg of seed of each species, if the scale will allow, and count the number of seeds. If the scale will not accurately weigh that amount, have the students weigh the least amount of seed possible. Visually separate the weighed seed into four equal parts and count one of the parts. Use the following ratios to calculate the number of seeds per gram:

(4*seeds counted)/(Amount of seeds weighed (mg))= (X seeds)/(1,000 mg)

Solve for X to calculate the number of seeds per gram.

Confirm the answer: Lay 4 letter size sheets of graph paper with 1 cm squares on a table. These sheets will approximately cover ¼ meter squared. Evenly sprinkle ¼ of the amount of seed calculated above for one square meter on the sheet and count the number of seeds in a 5cm2 area on 10 different areas of the graph paper. If they are planted at 2 seeds per cm2, there will be close to 10 seedlings per 5cm2. How close to 2 seeds per cm2 were you with your calculation?

3. **Activity 2: Calculating percent live seed and germination time**

   Required materials: Seeds, petri dish or sandwich bag, paper towel, tweezers, eyedropper

   Preparing the germination incubators: If using petri dishes as incubators, use 4 petri dishes for each species of grass (16 in total) and line each one with a paper towel or filter paper. Wet the paper and place 25 seeds on each paper towel in a grid pattern. Tweezers are useful for this section. Place the lid on the petri dish and place on a shelf.

   If using sandwich bags as incubators, use 4 bags for each species of grass (16 in total). Cut and fold the paper towel so it easily slides in and out of the sandwich bag. Wet the paper towel and place 25 seeds on the towel in a grid pattern. Tweezers are useful for this section. Carefully slide the paper towel into the sandwich bag. If you are having trouble sliding the paper towel into the bag, try placing a thick piece of paper or cardboard under the wet towel.

   Over the next few days/weeks keep the paper towels moist by adding water with an eyedropper being careful to not disturb the seeds. Observe the seeds every other day until germination begins to occur, and then

observe them daily. Record the number of germinated seeds day in each chamber each day. If using petri dishes, it may be easier eliminate the germinated seeds at each count. If using bags, keep a running total of total germinated seeds and subtract from that total to get the number of seed germinating each day. Over weekends, count the number of seeds that germinated and divide the number by 3 for a daily total.

The median germination time of each species is the number of days it takes for half of the seeds to germinate. How does this compare to the average germination time?

Mark the day at which half of the seeds of each species have germinated. When three times this amount of time is achieved, you can calculate percent living seed. For species that take longer to germinate, twice the median germination time is sufficient.

(Calculated seeding rate*100)/(% live seed)=corrected seeding rate

Calculate the seeding rate for each species by correcting for the amount of actual living seed per gram.

Have the students answer the following questions:

a) What factors do you think affect the amount of living seed?

Many factors impact the amount of the seed that is living. Age of the seed has a large influence with older seeds having lower germination rates. In addition, storage in an extremely dry or hot place can cause damage to the seed. Excessive moisture and diseases can impact seed mortality.

b) Why do plants have different germination times?

Plants have different germination times based on the conditions in which the evolution of the plant occurred.

c) What are the advantages to having a short germination time?

Short germination times allow the plants to establish quickly allowing them to take advantage of highly disturbed environments because they germinate quickly and fill in gaps before weeds or undesirable species become established.

d) What are the advantages to having a long germination time?

Plants with longer germination time generally require more stable conditions during seedling development so the plant waits to assure conditions are correct for growth before germination.

e) When is median better to use than average?

Median is better to use when the average is skewed due to a few individuals within the population creating an unrealistic average. The median will also let you know about germination time of a population where some of the plants never germinate

and therefore cannot be included in the average.

4. **Activity 3: Morphological differences**

Required materials: 4-inch pots, potting mix, seeds

For this activity prepare 2-4 pots for each species with potting mix. Use the following to determine the amount of seed per 10cm pots, 4-inch pot (square).

- Kentucky bluegrass = 100mg or 0.5mg or 1/8 tsp,
- Creeping red fescue = 200mg or 1.0 ml or ¼ tsp,
- Tall fescue = 300mg or 1.0 ml or ¼ tsp,
- Perennial ryegrass = 300 mg or 1.0 ml or ¼ tsp

Sprinkle the seeds on the surface and water the pots. Place the pots in window to allow growth once germination occurs. Do not bury the seeds as some light is needed for the seeds to germinate. Once the grasses germinate make observations about how the different grasses differ in their morphology. To maintain the grasses, add fertilizer as you would to a potted plant once every two weeks. Grasses grow very well when they are clipped so "mowing" them with scissors once a week is recommended. Turfgrass ID keys can be downloaded from several sources online. Using a key as a guide, note the characteristics described in order to identify the different grasses. Students can then be encouraged to go outside and discover what grasses are found in the school lawn, if any.

5. **Additional activity: School lawn ID**

What is the most common of the four species in the school lawn?

The most common species of turfgrass in most schoolyards is Kentucky bluegrass followed by perennial ryegrass. Kentucky bluegrass has characteristics such as a boat shaped tip and a wide relatively flat leaf blade with two lines on either side of the midrib. Perennial ryegrass has a pointed tip and the surface of the leaf blade is more ridged than Kentucky bluegrass. Tall fescue has the widest leaf blade and surface of the leaf blade is similar to perennial ryegrass. Tall fescue also has small barbs on the edge of the leaf blade that can be felt by rubbing the finger along the edge of the leaf blade.

6. **Additional activity: Clipping height**

The species provided vary greatly in their tolerance to lower mowing heights. Half of the pots can be mowed at 3cm while the other pots can be mowed at 7 cm. When clipping the pots try not to remove more than 1 /3 of the leaves with each clipping event.

How tall can the grasses mowed at 3cm get before they need to be mowed?

Following the rule regarding maintaining leaf area for photosynthesis if the mower is set at 3 cm then the maximum height the grass should get before mowing is 4.5 cm.

This allows for 1.5 cm of growth between mowing.

How tall can the grasses mowed at 7cm get before they need to be mowed?

Taller grasses can be mowed less often as this grass would not need to be mowed until it reaches a height of 10.5 cm.

Do all of the species do equally well under the two different mowing heights?

Tall fescue will do the least well under lower mowing height and perennial ryegrass will do the best.

7. **Additional activity: Heat tolerance**

Place half of the pots under an incandescent reading lamp.

Which species do best with the increased heat?

Tall fescue general does the best under heat stress.

Which species does the worst?

Perennial ryegrass and Kentucky bluegrass will generally do worse under higher heat levels.

Did you have to water the pots more often or the same to keep the potting mix moist? As the heat increases so does the water loss from the both the leaf and the surface of the soil. Warmer environments increase the need for irrigation.

Additional Resources

Department of Plant Agriculture http://www.plant.uoguelph.ca
Guelph Turfgrass Institute http://www.guelphturfgrass.ca

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