

# Grasslands and Climate Change

Lesson Title: Grasslands and Climate Change

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First, you should start by asking students questions about how to set up the experiment. Suggested questions include:

### Where should we locate our experimental lines?

The experiment should be located in an area where the transect lines will not be disturbed by students or others. It also should be located in as flat an area as possible to minimize water runoff into other transect lines.

### Do you want any distance between controlled and watered lines?

If the transect lines are physically side-by-side, water from the experimental lines could easily run into your control lines. If your

grassy area is hilly, water may run from the watered plots into the control plots. In either case, the additional water in the control plots would bias your data; this is also true for the question above.

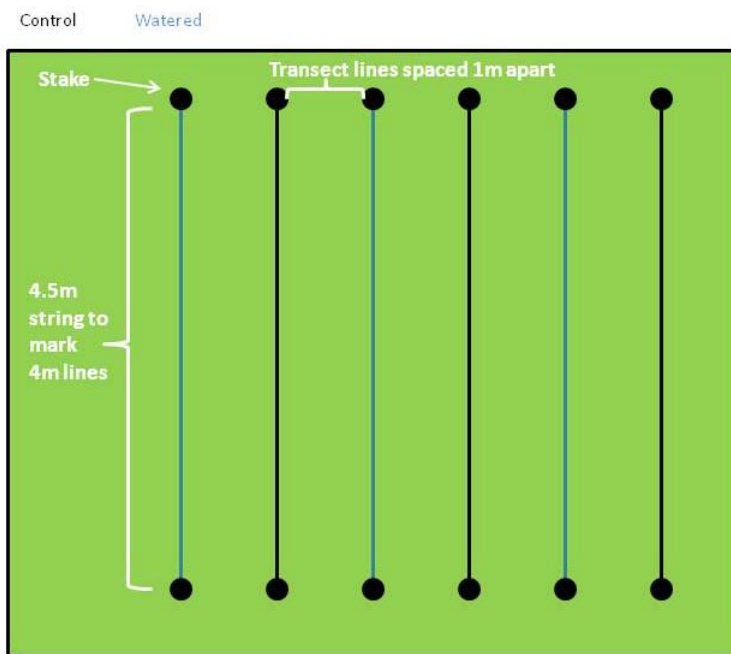
### What is the purpose of the control/non-watered lines? Why are they so important?

Control transect lines are for comparison. Controls serve as the “normal” condition against which you measure the experimental condition. In this case, the control grassy lines will grow as they “normally” would without any additional water. The experimental grassy lines will receive more water than normal. Your students will measure any changes between quantities of reproductive structures (fruits and seeds) in the control vs. quantities in the experimental lines.

Next, determine the experimental layout and how to run the experiment (see Figure 1).

- Determine layout
- Determine watering regime (who waters the lines, how often, how much, for how long, etc.)
- Number your transect lines 1-6 for data collection

One potential experimental layout:



### A potential experimental layout (not to scale):

Six 4m-long transect lines marked with 4.5m of non-degradable string or cord. The string is held in the ground with a stake at the end of each transect line.

### A potential watering regime:

Assign pairs of students to water transect lines on a rotating basis.

Add one gallon of water to each non-control transect line along the distance of the string. Do this three days per week for 8-12 weeks.

- Run the experiment—add water to three of the six transect lines on a regular basis.
- Collect data using a modified point-frame technique.

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## Teacher Sheet

- Have students observe the grassy area where you will set-up your experiment and look for any grasses and non-grasses on site; check to make sure the students can accurately identify plants in each group.
- You should assign 2-4 students to be in charge of the data collection per line.
- Set-up the six transect lines making sure to keep the string taut between the stakes; gently pick up each string and set it back down to re-set it along the transect lines.
- Have students observe the fruits and seeds (reproductive structures) growing on the grasses and non-grasses that are touching the string. They will need to be able to determine what parts need to be collected (see the Reproductive Plant Structures PowerPoint slides (<http://www.sciencenetlinks.com/student/ppts/plantstructures.ppt>) for examples of fruits and seeds of grasses and non-grass plants. The USDA Plants Database Image Gallery (<http://plants.usda.gov/gallery.html>) can be used to find grass-like plants [select by Growth Habits: 'graminoids'] and non-grass plants [select by Growth Habits: 'forbs/herbs'] for your area [select by State]).
- Have students use scissors to cut off the fruits and seeds of both the grass and non-grass plants touching the string; make sure the fruits and seeds are kept separate for each group.
- Have students place their clipped fruits and seeds in appropriately labeled brown paper bags (line # and non-grass or grass). If the suggested layout is used, you should have 12 labeled brown paper bags at the completion of fruit and seed collection.
- You should dry all of the plant material in the bags in a drying oven. If you do not have access to a drying oven, the bags can be placed in a warm, sunny spot and the material can dry naturally for about two weeks.
- When the plant materials are dry, the students should determine the mass of fruits and seeds for each group—both grass and non-grass—and record their measurements. The students should share their data with the rest of the class so that everyone has data from all of the transect lines.
- Have the students graph the collective data (the mass of the grass/control, grass/watered, non-grass/control, and non-grass/watered) and make comparisons in terms of how the water addition affected growth of reproductive structures overall, as well as potential grass/non-grass interactions (competition, etc.).

Variation on a theme: If no grassy area exists at your school or you cannot get permission to use your school grounds to run this project, you could run the experiment in pots outdoors or in a greenhouse. This potentially could be done in several ways.

- Eighteen clay pots, plastic pots, or some type of growing container could be arranged using the layout highlighted in the layout. Six lines (3 pots per line) of pots will provide a total of 9 control pots (normal watering) to simulate normal precipitation for your area; and 9 treatment pots (normal + additional water) to simulate greater precipitation. If you are doing this outdoors, you could use garden soil. However, in a greenhouse, sterile potting soil would probably be best. If using garden soil, mix the soil thoroughly before placing in pots. The soil in the pots should be as uniform as possible. Sprinkle a 50%/50% mixture of grass and clover (a non-grass, nitrogen-fixer) seed, purchased from a local garden center, into the pots. Plant the same amount of seed in each of the 18 pots. Allow the plants to become established (plants are at least an inch high). Run your experimental watering regime for a month or so until you have fruits and seeds on the grass and non-grass plants. Harvest fruits and seeds and compare data after drying the material as described above.
- Seed from other plants could be used for this experiment too; however, we would suggest a grass species (annual or perennial, early or late season, native or domesticated) in combination with a nitrogen fixer (clover, beans, peas, native species). These are two important functional plant groups (see the Climate Change Research in California video for more information).
- The seed mixture percentage used could be varied too. If you have a local grassy area, check the grass/nitrogen fixer ratio and plant your seed in the pots based on the observed ratio.
- Pot arrangement can vary. This would be a great time to continue your discussion of experimental design with students.

**Post-Experiment Questions**

Now that you have completed your experiment, reread the short EurekAlert article and pp. 26-27 in the Cherry & Braasch book.

**How was your experiment similar to or different from those performed at the Angelo Reserve?**

*The Angelo Reserve research involved plots and the collection of multiple functional groups of plants. Your research involved transect lines and only two functional groups of plants (grasses and non-grasses). Whole plants were harvested at the Angelo Reserve, which causes more destruction to the experimental area but your students were harvesting the reproductive parts (fruits and seeds) only to minimize disturbance to the school yard. Fewer functional groups will minimize confusion when processing your plant parts. There is more emphasis on reproductive output in your students' experiment.*

**How was your experiment similar to or different from those performed in the Tundra (pp. 26-27 in Cherry & Braasch book)?**

*Again, both your students and the tundra research were done to simulate what might happen as a result of global climate change. The tundra experiments focus more on varying temperature as the experimental variable, where your students focused on differences in amounts of water.*

**Did the amounts (mass) of fruits and seeds (reproduction) differ between your control and experimental plants due to increased water?**

*You should see greater fruit and seed production on the experimental transect lines versus the amount collected from the control transects.*

**Do you think increasing or decreasing rainfall in your school yard would change plant reproduction?**

*You should see greater overall fruit and seed production with increases in water and the opposite with decreases in water. The interesting comparison, however, is the relative amounts you find between the experimental and control transects. Your students should see the connection between more water and more fruits and seed production (reproductive output).*

**Do you think increasing or decreasing rainfall could also affect the animals that live in your school yard (remember reading about the grasshoppers and spiders in the Angelo Reserve, and caribou in the tundra)?**

*Hopefully your students will understand the connection between plant production and animal production from the reading. If the amount and kinds of plants change, the amount and kinds of animals which feed on the plants will probably also change too. If you have the opportunity to count plant feeding insects along your transect lines, this might help them see the connection.*

**Do you think increasing or decreasing rainfall might affect the crops and horticultural plants grown in your town or state?**

*This is an extension of the previous question. If the connection between wild plants and animals exists, this connection must also exist between humans (we are also animals) and the plants we feed on and grow. This is the connection between global climate change and us.*