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# K-12 Partnership Lesson Plan

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# *Developing Research Questions Using BEST Plots*

## Overview

The BEST plots are an excellent system for introducing more opportunities for scientific inquiry into the classroom. While there are many teaching opportunities that arise from simply carrying out the data collection that allows us to address our broad questions (can we maximize productivity while still maintaining biodiversity?), students should ideally also be using the plots to develop research questions and experiments of their own. This lesson and the accompanying worksheet provide a useful tool for helping students and teachers (who may not have much previous experience) identify interesting questions and develop hypotheses using the BEST plots. This lesson also allows students to practice the steps of the scientific method prior to physically carrying out an experiment and can easily be used even if students can’t access a BEST plot.

**Objectives**

At the conclusion of the lesson, students will be able to:

* Place their work on the plots in the context of the larger project
* Identify additional questions about the plots
* Develop new questions and hypotheses
* Identify the data needed to address a specific scientific question

**Length of Lesson**

One class period (in addition to time spent on BEST plot protocols)

**Grade Levels**

The activity would be most effective with middle and high school students, but could potentially be adapted for lower grades as well

**Standards covered (NGSS)**

Disciplinary Core Ideas (specific standard depend on the question students choose):

* **MS-LS2-1**: analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem
* **MS-LS2-4**: construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations
* **MS-LS2-2**: construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems
* **MS-LS1-5**: construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms

Cross Cutting Concepts:

* Patterns
* Cause and effect

Science and Engineering Practices

* Asking questions and defining problems
* Planning and carrying out investigations

***Previous Michigan Standards Met:***

* **S.IA.00.12**: share ideas about science through purposeful conversation
* **S.IA.00.13, 03.13**: communicate and present findings of observations and investigations
* **S.IA.05.11**: analyze information from data tables and graphs to answer scientific questions
* **S.IA.05.12**: evaluate data, claims, and personal knowledge through collaborative science discourse
* **S.IA.05.13**: communicate and defend findings of observations and investigations using evidence
* **S.RS.01.12**: recognize that science investigations are done more than one time
* **L.EC.06.21**: describe common patterns of relationships between and among populations (competition, parasitism, symbiosis, predator/prey)
* **B1.1E**: describe a reason for a given conclusion using evidence from an investigation
* **B1.1g**: use empirical evidence to explain and critique the reasoning used to draw a scientific conclusion or explanation
* **L3.p2A**: describe common relationships among organisms and provide examples of producer/consumer, predator/prey, or parasite/host relationship
* **L3.p2B**: describe common ecological relationships between and among species and their environments (competition, territory, carrying capacity, natural balance, population, dependence, survival, and other biotic and abiotic factors)
* **L3.p3D**: predict how changes in one population might affect other populations based upon their relationships in a food web

**Materials**

* Materials for collecting BEST plot data (see protocols online: <http://kbsgk12project.kbs.msu.edu/best-research-network>)
* Worksheet for brainstorming and developing further questions (listed on the “Developing Research Questions…” lesson page on the KBS GK-12 website)

**Background**

Teachers should consult the appropriate BEST plot protocols for relevant background information.

### Activities of the session

1. After doing BEST plot protocols, students will work in groups to complete part one of the worksheets. Students will identify what they have learned from the protocols and brainstorm what other questions they might like to ask using the plots/plot data. If no BEST plot is present in your district, this step can be completed after learning from the background material on the BEST plots located at <http://kbsgk12project.kbs.msu.edu/best-research-network/> .
2. As a class, students can discuss their questions and how the potential variables might relate to one another. This also can provide an opportunity to inspire groups that had a harder time generating new questions they could ask.
3. Students then return to their groups to further develop one of their questions and come up with a hypothesis.
4. Students determine the data they would need and the methods they might use if they were to carry out an experiment addressing their question

**Resources**

* BEST plots questions worksheet (on lesson page)
* BEST plot master data set
* Materials on the BEST plot protocols located at <http://kbsgk12project.kbs.msu.edu/best-research-network/>

**Extensions and Modifications**

Students that have done multiple protocols can be directed more explicitly to incorporate aspects of both protocols into their questions. Students can also take their questions further and attempt to answer them with data from the plots. This could be done either by students setting up an experiment and collecting data themselves, or by providing students with data collected across the entire project.

**Assessment**

Teachers can use the accompanying worksheet to assess student progress after this lesson.