# Monthly Monitoring on Campus (or at home)

## OVERVIEW
Students will learn how set up an ecological site, make scientific observations, collect data, interpret what they've collected, and brainstorm solutions to conserve ecosystems.

## GRADE LEVEL
Elementary and middle school; can be adapted
to fit older audiences.

## SUBJECTS
Ecological monitoring, Biological interactions, Biodiversity, Community Science, Data interpretation, Human impacts, Stewardship.

## NGSS
- K-LS1-1
- K-ESS3-1
- 2-LS2-1
- 2-LS4-1
- 2-ESS2-2
- 2-ESS2-3
- MS-ESS3-3
- MS-LS2-3

## DURATION
Three lessons total that are 1.5 hr each (3 x 1.5 = 4.5 hours total).

## SIZE
Preferably, class size no larger than 25 students.

## SETTING
Outdoors.

## MATERIALS
- Chalkboard/whiteboard
- Students' journals
- Pencils and colored pencils
- 2+ litterfall tubs (can use large bowl or tub, doesn't have to be BEMP tub)
- Trowels
- Plastic cups and lids
- 6"x6" wood or cardboard covers
- Precipitation gauge and vegetable oil
- Arthropod field guides (optional)
- Arthropod visual (with drawing/photos of arthropod types)
- Journal set up visual (see resources)
- Gallon Ziplock bags
- Magnifying glasses for arthropod ID (optional)
- BEMP field guides or plant field guide
- Scissors
- Tape

## LESSON SUMMARY
A three-part lesson where students practice ecological monitoring. This lesson can be done on campus, at home, or any other outdoor space. Students will learn that ecological monitoring can happen anywhere with minimal equipment. At the end of these lessons students will be able to connect various types of data including litterfall, arthropod biodiversity, and precipitation to the gauge the health of their ecosystem.

## LEARNING OBJECTIVES
At the end of this lesson students will be able to:
- Be familiar with methods for collecting BEMP litterfall, precipitation, and arthropod data.
- Understand how to collect ecological data and why it is important.
- Make a map make observations of key features and landmarks for map making.
- Make observations about nature in their journals with the prompts "I notice", "I wonder", and "It reminds me of".
- Understand what defines an arthropod and the types of arthropods.
- Sort arthropods into groups based on their physical characteristics.
- Gain an understanding of the plant communities that make up their campus (or other outdoor space).
- Make distinctions between plant species via leaf anatomy.
- Understand what non-native and native plants are.

## KEY CONCEPTS
Ecological Monitoring, Biodiversity, Litterfall, Arthropod Identification, Plant Identification, Nature journaling, Map Making, Exotic Species Impacts, Data Interpretation.

## VOCABULARY
- Abiotic and biotic
- Arthropod
- Exotic, non-native, and invasive species
- Leaf margin
- Litterfall
- Native species
- Precipitation
- Venation (leaf)

BEMP
Bosque Ecosystem Monitoring Program

# MM on Campus

## BACKGROUND:

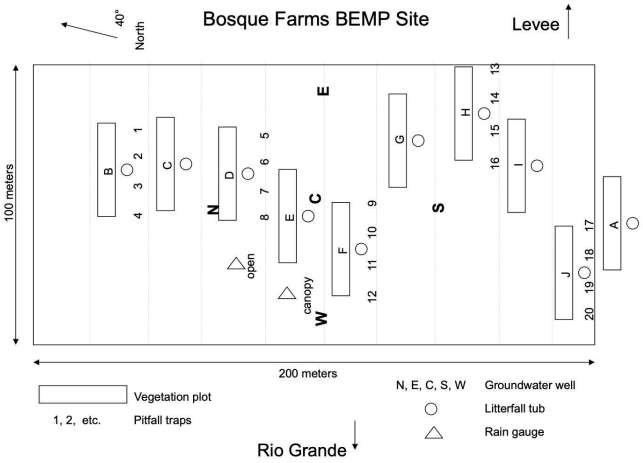
The Bosque Ecosystem Monitoring Program was established in 1996 as a collaboration between the University of New Mexico's (UNM) Department of Biology and Bosque School. In 2020, BEMP became a non-profit 501(c)(3) corporation retaining the same partnerships and mission (below). For the past 25 years BEMP has engaged K-12 students from across New Mexico and their teachers to track long-term ecological changes in the Middle Rio Grande and the surrounding riparian forest, or bosque.

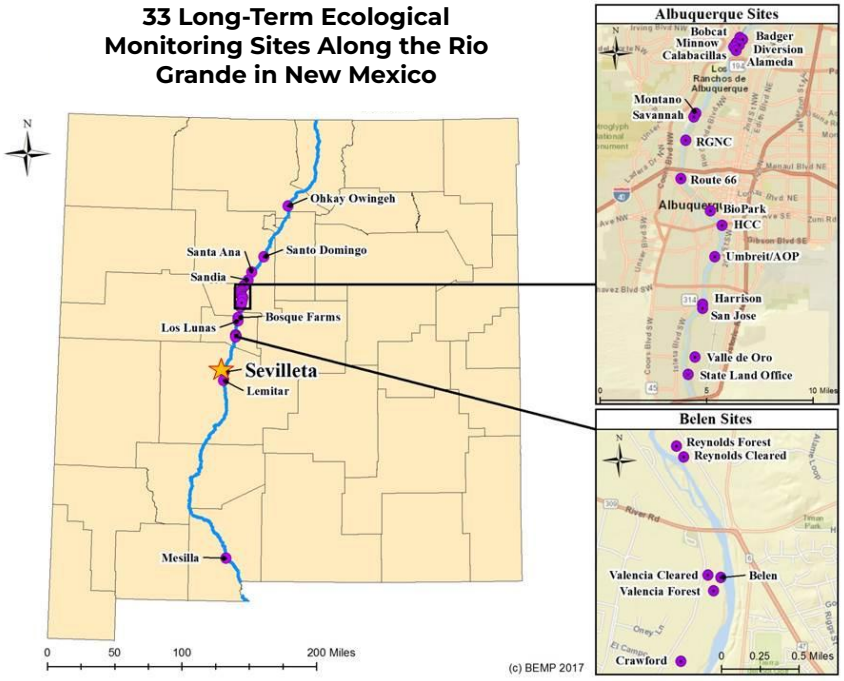
Managers make decisions within the bosque in response to fire, floods, anthropogenic impacts, and climate change by using community scientist collected data. Engaging students in the scientific processes of collecting data and understanding ecosystem responses both in the field and through additional classroom programming is essential towards creating stewards of this special place.

### *BEMP's Mission*

*Community Science, Education, and Stewardship: Equitable and inclusive hands-on student research essential to the management of the Rio Grande ecosystem.*

Depending on funding, there are 26-33 active BEMP field sites along 270 miles of the Rio Grande (see map) with dozens of schools participating in the hands-on data collection. Sites, typically located between the river and the levee, should be representative of the forest composition in the area. Each study site is comprised of 10 litterfall tubs, 20 pitfall traps, five wells and two rain gauges (see image).




The following lessons will teach students how to set up their own monitoring site either at home or on their own campus, how to process the collected data, and why collecting these data are important to the health and resilience of our bosque. To prepare for this lesson, we recommend you familiarize yourself with the plants on your campus or whichever outdoor space you will be using. It may also be helpful to review our monitoring protocols at: [https://bemp.org/research-guides-protocols/](https://bemp.org/research-guides-protocols/)



BEMP
Bosque Ecosystem Monitoring Program

# MM on Campus

Additional Resources:
Download related curriculum: https://bemp.org/summer2021/

How to make a precipitation gauge: https://www.youtube.com/watch?v=Kzcoadw7g64

Backyard Monitoring: https://www.youtube.com/watch?v=rxAilrDjilw

To identify local plants use the free iNaturalist app:

Additional datasets (for higher MS/HS graphing):
Access all of BEMPs historical data at this website. Students can compare litterfall, precipitation, or arthropod data from previous years to what they collected at their own site. Students can also graph this data or use it to make predictions about the future. https://bemp.org/data-sets/

Journal set-up:
Journals should include date, time, weather, location, and image labels. Record observations through notes, sketches, pressed plants, poetry, data collection, photographs and more (see example below)!

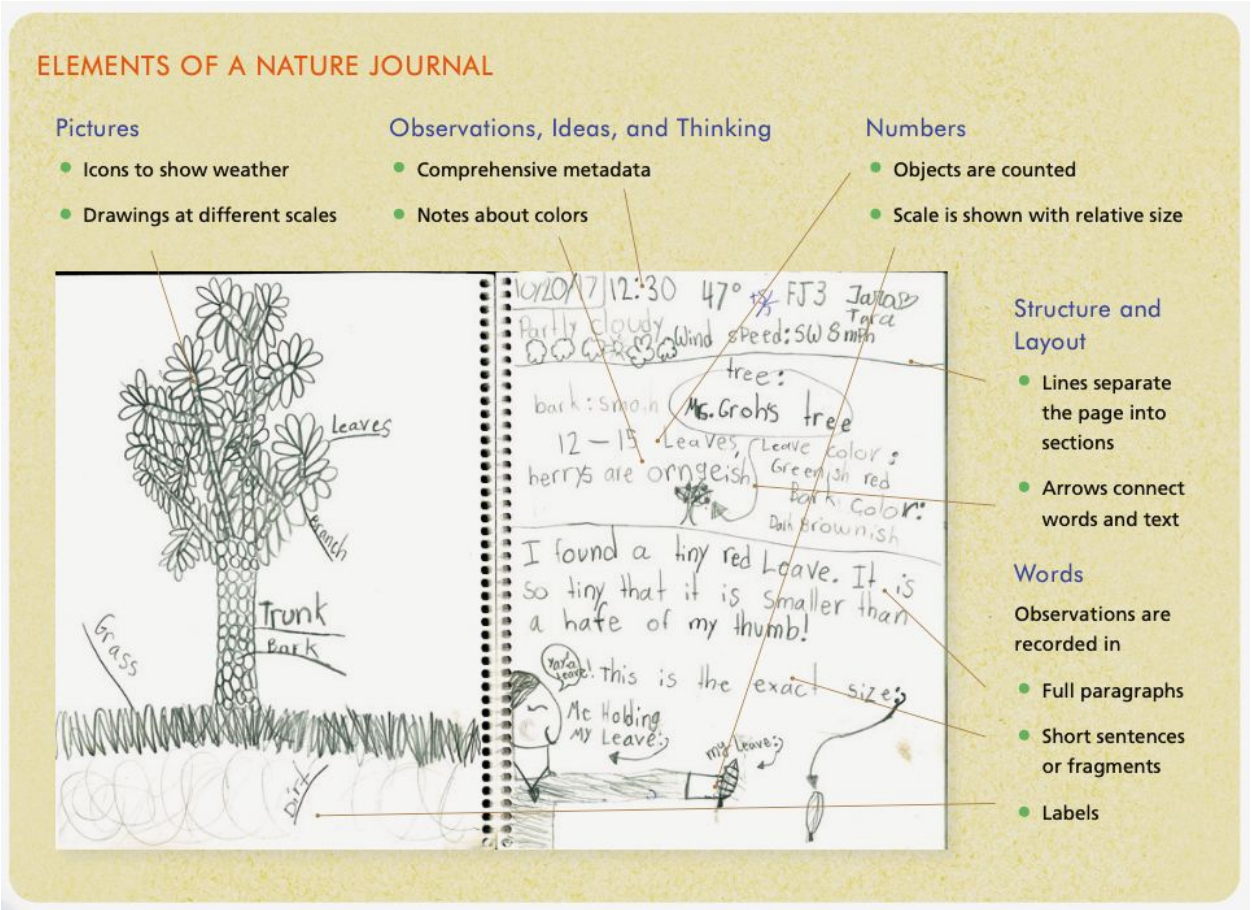



Image from: How to Nature Journal by John Muir Laws and Emilie Lygren.



BEMP Bosque Ecosystem Monitoring Program

## SESSION ONE:

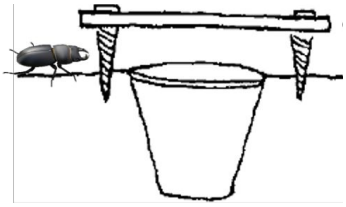
### Setting Up Your Monitoring Site

1. Intro to BEMP: If students are unfamiliar with our program, go through this section. This can also be used as a quick refresher.
    a. Go over these terms: B - bosque; E - ecosystem; M - monitoring; P - program
    b. Ask students: *What have you seen in the bosque? What lives there? What does bosque mean in english? Is it any kind of forest?*
    c. Define the terms biotic and abiotic with examples. *Abiotic*- Nonliving parts of an ecosystem like the sun, rocks, and water. *Biotic*- Living parts of an ecosystem like plants, animals, bacteria.
    d. Ask students: *If you could do a movement with your body that represents monitoring what would it be (binocular sign)?*
2. What we do at BEMP?
    a. Put acronym works together: We monitor the bosque ecosystem with many different kinds of people (program).
    b. Ask students: *Why do we monitor?* To get general knowledge about the ecosystem, to learn how we can help it, to learn how we can coexist with it, and so much more.
    c. Ask students: *What do you think a healthy ecosystem means?* Animals and plants have access to food and shelter and are reproducing.
3. What we're doing to do today: Practicing nature journaling, setting up a mini monitoring site, making a map.
    a. Nature journaling: Space out students (at least arms length apart) and have them respond to the prompt "I notice" in their journals for five minutes. Ask them to take a quiet look around. What do they hear, see and smell? After five minutes ask:
    *What did you see/hear/etc that you never noticed before?* (write in journal)
    *What did you see that you can collect data about?* (write in journal)
    b. Discuss the datasets that we'll be collecting and why we collect those:
        - Leaf litter - tells us what plants are growing at our site, how abundant they are, and when they're flowering, fruiting, dropping leaves, etc.
        - Precipitation - tells us how much water is entering the ecosystem. Ask: *How might the amount of precipitation affect plants and animals?*
        - Arthropods - tells us which arthropods and how many are in our ecosystem. Seeing many types of arthropods (high biodiversity) indicates a healthy ecosystem. Ask: *Do you think populations are affected by precipitation and the types of plants around?*

    Ask students: *How do you think these sets of data are related?*
    c. Scope out a place to set up the site. Students can decide where to set up a site. Guide students by asking them if certain places would be good or bad to set up a site.
    d. Draw a map to the decided site location. Ask: W*hat do you need to add to it to be able to help you get there? What sorts of landmarks will be helpful? What should your map include* (north arrow, a legend, landmarks, etc)?

e. Setting out tubs and precipitation gauge: As a group decide where to place your precipitation gauge(s). Add oil to the gauge(s) to prevent water from evaporating. Add the gauge(s) to their maps. Break up into groups and hand out tubs (one/group).Groups can place their tubs where they think it'll be best. Guide them if they are in a walkway or super crooked, etc. Add the tubs to their maps.

f. Setting up pitfall traps: Make sure to talk about safety with the screws!
   - Hand out supplies for two traps/group: four plastic cups (two with holes, two without), a trowel, two covers.
   - They get to pick a place to set their trap that is near their tub. Guide them if they are in a walkway or super crooked, or cup isn't flush with ground, etc. Make sure they have their holey cup on the bottom! Add their pitfall traps to their map.
   - Add the date and time that the traps were set, leave these traps open for at least two days* before you check them for Part 2.



4. Reflection - Ask: *Now that we've finished the activity, did you notice anything you didn't before? Is there anything you wonder about as we prepare for our next time together?*

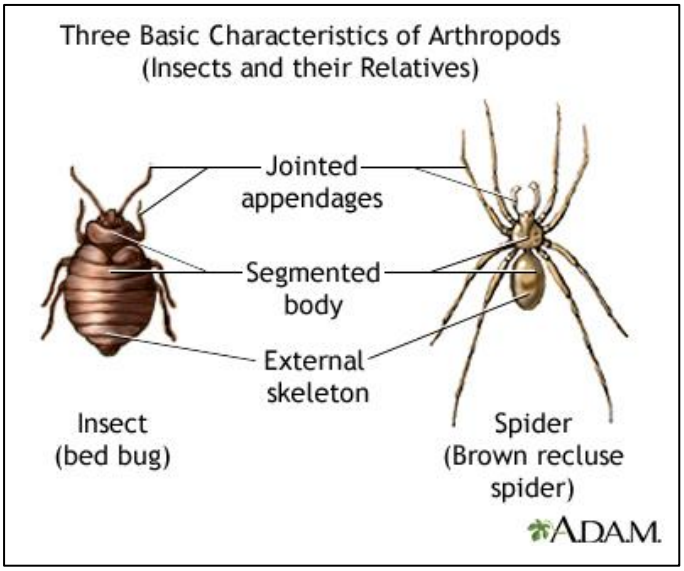
*If you don't have enough time to set traps with students, make sure you set the traps two days before part 2.

## SESSION TWO: Arthropod Biodiversity

**(Two days after session one)**

1. Review of BEMP (if needed - see Part 1)
2. What we're doing today: Nature journaling, collecting our pitfall traps, and making observations.
   a. Nature journaling: Space out students (at least arms length apart) and have them respond to the prompt "I wonder" for five minutes. Ask students to write/draw in their journal something that they wonder about in nature. This could be related to what they wrote for "I notice". How does this connect to data collection? (write in journal)
   b. Arthropod drawing activity: Have students draw what they think an arthropod is. Ask: *What are key features? What do you think of when you hear the word "arthropod"?*

- Characteristics of an arthropod (use visual aid to depict these):
  - Jointed appendages
  - Segmented bodies
  - Exoskeleton
  - Multiple pairs of legs
- Type of arthropods:
  - Insects
    - 3 body parts
    - 6 legs
    - Variable mouth parts
  - Bugs
    - 3 body parts
    - 6 legs
    - Sharp straw like mouth
    - All bugs are insects but not all insects are bugs!
  - Arachnids
    - 2 body parts
    - 8 legs




- Ask: *How are plants and arthropods connected?* (K-LS1-1) Plants need nutrients and sunlight to survive. Arthropods need plants to survive (for shelter, food, etc). Both need water and a suitable habitat.

c. Collecting pitfall traps - Ask: *What do you think we'll find today?* Have students set up a table in their journal like the one below. Split into groups and go collect arthropods by dumping each cup into a ziploc bag.

| **Type of Arthropod** | **How many?** |
|---|---|
| Roly Polies | |
| Beetles | |
| Ants | |
| Crickets and Grasshoppers | |
| Spiders | |
| Centipedes | |
| Millipedes | |
| Other: _____ | |

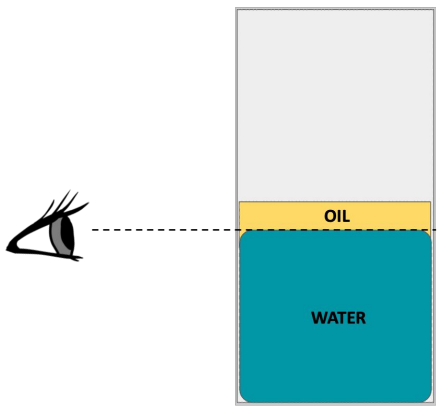
Ask: *What does your set up location say about what's in the cups?* Ex. bare ground vs lots of leaves. Connect the presence of plants and/or moisture to the presence of arthropods. Bring students together as a group and go through each bag. Tally on a whiteboard or easel pad as a group. Have students fill out the table in their journal as they go. Release the arthropods near where they were trapped.

3. Reflection: What does this data tell us mean about the ecosystem? Ex. Low diversity could be because the ecosystem is unhealthy or it could be seasonal, less arthropods are found in the winter.
   a. Have students draw a diagram of what a healthy ecosystem needs (i.e. sun, water, plants/animals interacting, high biodiversity) (K-ESS3-1).
   b. OR Have students use materials in nature to create a diagram of what a healthy ecosystem needs. For example they can stick cottonwood leaves in the ground to represent trees or different colored rocks to represent different animals in the ecosystem. (K-ESS3-1).

## SESSION THREE: Litterfall & Precipitation

**(At least one week and up to four weeks after session one)**

1. Review of what you've done the last two days - Ask: *Are there any questions that have come up for you in the last couple days?*
2. What we're doing today: Collecting litterfall and precipitation data and making observations.
   a. Nature journaling: Space out students (at least arms length apart) and have them respond to the prompt "It reminds me of" in their journals for five minutes. Connect "I notice" and "I wonder" to it reminds me of. Have students write what their previous observations remind them of. Ask: *Why did we do these journaling activities? What is the importance of it?* It's own form of data collection. *What kind of data would you like to collect by doing this again?*
   b. Using field guides: Hand out BEMP field guides or plant field guides. Look at field guides and make observations on how the organisms are grouped together. Ask: *What kind of information do these field guides provide?* (Name, scientific name, description, pictures, measurements, etc.) *What does it mean to be native or exotic?* Define these terms. Go over why scientists use scientific names.
      - What do you need to look at when you are sorting plants to put them into field guides, etc? Go over and define: Leaf design, shape, margin, venation.
      - Give students two leaves and have them cut them in half (they can do these in pairs). Tape these into their journals and have them draw the other half paying attention what makes these leaves unique.
      - Students should write the leaf's name, scientific name, and four descriptive words that include the shape, margin, venation, and one other characteristic they can observe (color, texture, etc.).
      - If time permits, give them 5 minutes to explore the area and look to see if they can find anything on the BEMP/plant guides. Check back. What did they find? Ask: *Do you think any of the plants you identified will be in your litterfall tubs?*
   c. Record precipitation: As a group record precipitation data in their journals with the date and time (if they get any). Make sure the students read the second line of liquid and don't count the oil toward the total.



Rain Gauge

d. Collect tubs: Create a table like the one below. Have students grab and carefully carry back tubs. Be careful not to dump out data! Write down what they have in their tub - no need to collect them in a bag since we'll be right there.

| **Type of leaf, seed, flower, fruit, etc** | **How many?** |
|---|---|
| Ex. Willow seed pod | 3 |
| | |
| | |
| | |

- What should they do if they don't know what plant it is? Use their guide or look around them to see what trees are there are or categorize it using descriptive words. Similar to their "it reminds me of" prompt. If they don't know what it is, and they know what it reminds them of, then that can be their categorization.
- Ask: *What did you find in your tub? If you found a lot of things, what do you think contributed to that? If you didn't find a lot of things, what do you think contributed to that?*
- Total data together on whiteboard/easel paper while students fill in tables in their journals. *What was the most abundant? Was it exotic or native? What can this tell you about our ecosystem?* Ex: Lots of exotics is not great, trees dropping leaves too early or late can be a sign of stress, data can show us which species are doing well and which aren't.
- Finish by dumping the tubs near where the data was collected.

3. Conclusions for the day/week. Summarize the following:
   - What did we do last Monday (part 1)?
   - What did we do on Wednesday (part 2)?
   - What did we do today (part 3)?

a. Middle School: *What did you learn about the ecosystem?* (MS-LS2-5, MS-ESS3-3) End by journaling possible solutions to increase biodiversity or increasing ecosystem services (MS-LS2-5) and how to minimize human impact (MS-ESS3-3). Ex. invasive species management, releasing native species, managing water resources for native species, organizing trash collection etc.

b. Elementary School: *Did you notice anything you didn't before?* End with I notice one more time in journals.

c. Optional if time: *What was your favorite thing we did in the past week?*