LID Design Challenge

Key Topics: Human Impact, Stormwater, Runoff, Erosion, Rain (Tank/Capture), Drought Tolerance, Groundwater Recharge, Low Impact Development (LID), Native Habitat, Rain Garden, Impermeable, Permeable

Grade Levels: K, 2-8

Inside and Outside

Lesson Overview:

In this lesson series, students learn about stormwater runoff, identify challenge areas on the school site, and design solutions and present designs to master Low Impact Development (LID) concepts to landscape management.

Activities:

LID Design Challenge (1 hour 20 minutes- 15 minutes review + 45 minutes to design + 20 minutes to present design drafts)

Suggested Activities and Learning Objectives by Grade Level:

- K: Tour Campus or Use pre-cutouts to do LID Design Challenge
  - K-ESS3-3 How can people help support the environment?
- 2:
  - 2-ESS2-1 What are methods of preventing erosion?
  - 2-ESS2-2 How does water shape the land?
- 3:
  - 3-ESS3-1 How can we reduce erosion?
  - 3-LS4-4 What are ways that we can prevent erosion while increasing habitat?
- 4:
  - 4-ESS2-1 Find examples of how water has caused erosion on campus.
  - 4-ESS3-2 Compare different methods of preventing erosion.
- 5:
  - 5-ESS3-1 How can our campus protect the environment?
- MS:
  - MS-ESS2-2 Design a method to prevent erosion.
  - MS-ESS2-4 How does water cycle through the Earth's systems?
  - MS-ESS3-3 Compare different solutions to preventing erosion.

Essential Question(s) that Connect CCCs and SEPs:

- How does this landscape currently work? Is there a problem present? How can I design a system to solve this problem? (Systems; Asking Questions & Defining Problems)
- What is causing the problem? What is the desired effect? What is the evidence that the cause leads to the effect? (Cause & Effect; Engage in Argument from Evidence)

- How can we model how the structure created with the landscape works? (Structure & Function; Developing & Using Models)
- What is the system I am observing or designing? How can I explain why this system changes or remains stable? Have we made the system more stable? Does the system respond to change the way we want it to? (Stability & Change; Construct Explanations & Design Solutions)
- How can I use the patterns learned (ex erosion, flooding, percolation, drought, impermeable surfaces) to tell me if the solution (ex. water wise, capturing stormwater, healthy plants, no erosion or puddling) works? (Patterns; Construct Explanations & Design Solutions)

Materials:

- Review landscape in Slideshow
- Graph paper and regular copy paper
- Colored pencils, rulers, compass
- Legend or key template drawn on the board for them to create their own
- Example of a landscape design and elevation from a licensed contractor and architect

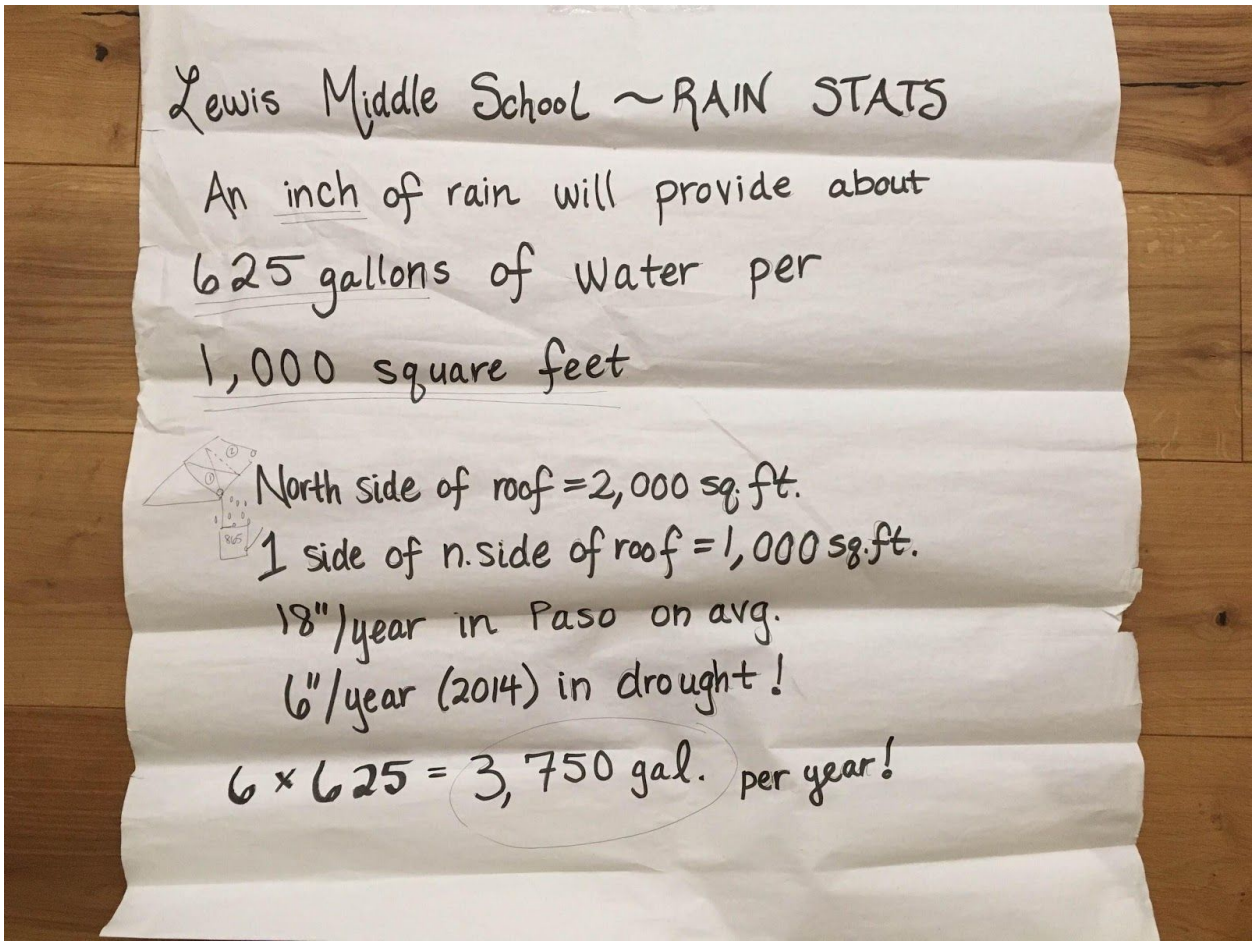
EG Team Support Needed:

- Facilities & Maintenance communications
- Access to native plants (to show live examples during design challenge perhaps)

Prep:

You may decide to review design areas and review ideas outside with students and then return inside for drafting. You could opt for reviewing outside instead of slideshow. Pictures may be good to show if you captured rainy days. If you decide to do all outdoors, please have proper clipboards, design drafting materials, and space for students to feel comfortable drawing and sketching.

- Walk the campus before touring and starting this lesson so you as an instructor can predetermine what route you will take for the Rainy Day Hike
- Take pictures of the areas during rain and during lesson choose who will take photos so it does not become a last minute distraction
- Upload photos for Part 2 and customize the PowerPoint
- Discuss with teacher what materials they have versus what you need to bring for Part 3
- Review Low Impact Development and use this local resource as a guide for your own professional development: https://www.centralcoastlidi.org/ and Ocean Friendly Gardens too at: https://slo.surfrider.org/programs/clean-water/ocean-friendly-gardens/
- Calculation guide for measuring stormwater runoff on impermeable surfaces; below is a picture of “Rain Catchment LID Math” done with 7th grade students.
    - An inch of rain will provide about 625 gallons of water per 1,000 square feet
    - You can estimate the size of a roof by pacing or measuring the ground parallel to side of roof and for an A-framed roof maybe use Google Earth to grab the surface area or estimate by adding square footage or use formulas
    - You could also use this to measure size of capture for permeable pavement and how much rainwater/stormwater could be captured instead of running off impermeable concrete and flushing down storm drain or piped to wastewater treatment plants



- Pre-extension (20 minute video) that may be appropriate for your teachers to share BEFORE you start your lesson: Cycles of Insanity Video
  - Highly encouraged because the concept of an aquifer is complicated if it is the first time students are hearing about it.
- Play some songs for students while they work inside on design...
  - Banana Slug String Band's Albums and Select one on Water
  - Not recommended as background music... but for a treat after lessons or as a before bell rings to watch later.... Mr. Eco gets kids excited! Save Some for the Fishes, Plastic Surgery,

Activity Procedure:

Engage:

Have students take out their model and sketch something if they lost it. Also, to take out their handouts. Preview the tour we went on again for the Rainy Day Hike. Take out the handouts too. What does "Low Impact Development" mean?

Comprehension Check

Let's break it down... Walk through each word and ask them to talk about the benefits after they have got the gist of it.

Explore:

What patterns did you notice on our rainy day hike? Write some of them or circle them on the handouts again. What elements did we go over in the second activity, Just Passing Through, that are considered Low Impact Development? What does it aim to do?

Explain:

PDF from LIDI: "As our communities develop, the amount of impervious surfaces –roads, parking lots,sidewalks, and rooftops –increases, and a greater percentage of rainfall flows off the landscapeas stormwater runoff, rather than seeping into the ground. Stormwater runoff picks up pollutants–including car oil, lawn fertilizers, pesticides, pet waste, and trash–and carries these pollutants to our waterways and ocean. The increased volume and velocity of runoff flowing off of impervious surfaces can also erode our creeks and rivers. LID is gaining popularity as a better approach to stormwater management that seeks to control stormwater at the source, using small-scale integrated site design and management practices to mimic the site's natural hydrology. LID techniques include using permeable pavements, rain gardens, rain barrels, grassy swales, soil amendments, and native plants. Reducing impervious surfaces, preserving natural vegetation and natural drainage patterns are also important LID tools. The use of LID requires a reexamination of the use and sizing of traditional urban infrastructure (e.g., streets, parking lots, detention ponds), which are often inadequate to meet natural resource protection objectives. LID techniques can help development meet stormwater management requirements, and in the broader context, support a variety of watershed and community goals by mitigating development impacts to land, water, and air."

Extend:

Tell students they are going to become designers today who are exploring new ways of decreasing stormwater pollution, increasing groundwater retention, capturing stormwater and using it positively, and beautifying the campus.

- They will have to choose an area identified in the Rainy Day Hike and site the #/name of which you call it.
- Then, they will have to choose what to call their redesign… with a category to choose from between: 1- native garden, 2- rain garden, 3- permeable pavement, 4- bioswale, 5- miscellaneous (if you think of one that is a category many want to do)
- What is the problem? Identify it with their team (discuss with teacher how you will split them up or have them do it)
- What are pieces you can include that will alleviate the problem? Remember, not all solutions are appropriate for each site.
- Have them use the post-evaluation below and tell them they will be presenting on their design (if time allows and teacher wants this extension)

Evaluation:

Do a group share out of each group's design. Ask them to include the following in their presentations.

Write on your graphic organizer:

The _____ (describe the site area, tell them to get as specific as they can with measurement and description of land with any buildings attached or not) functions the way it does because of the interrelated parts, _____, _____, and _____.

_____ caused _____. My evidence is _____.

I will redesign the system by _____ based on my understanding that _____ is a low impact development technique. Not every solution fits for the problem, but this is best suited for this system because _____.

Also, refer back to the Learning Objectives for your grade level and ensure that they have been met by asking the given learning objective question.

Extension Activities:

Part 4: Design Challenge Continued (two 45 minute sessions)

- Reserve Chromebooks or time in the computer lab for at least one of the sessions
- SLO County has an LID Guide to use for site mapping and design ideas

Part 5: Design Construction (timing can vary)

- Recommend outsourcing difficult logistics (drainage, irrigation, rainwater catchment) to Facilities & Maintenance and leaving menial tasks (digging, moving soil, etc.) and meaningful experiences (planting, mulching, etc.) for students to accomplish.
- Varying infrastructure items and equipment needed to prep/amend the site
- Examples: Signage, Native and Water Wise Plants, Rain Tank, DG, etc.

Tips and Caveats:

- Track the weather patterns closely during rain season and come up with a back date in case you get no rain and are too early to schedule. You may also get a day after a hard rain to see the same effects.
- Be prepared and make sure your teacher and students are prepared. You may purchase or use rain panchos for them. You may also decide to send home a letter with the teachers help and guidance if you should do so to inform them of our outing. Bringing rainy day clothes, umbrellas, and boots is a good idea.
- Guest speakers are a great extension to prepare students for their design challenge and/or people to watch and give feedback during the design challenge share outs. Example of them include: facilities and maintenance leads, landscape architect students, licensed green architects, etc. One Cool Earth is a member of the Central Coast Green Building Council and their Green Schools Committee. This is a great resource. Also, the Cal Poly City & Regional Planning and Architect Departments.
- You may get support from Ocean Friendly Gardens program as well. Greener Environments is a business that supports our work and has helped install rain gardens pro-bono. Ocean View Elementary is one of them.
- Be patient and realize that even if there is no infrastructure change that gets made because of your butterfly/rain/LID garden.... It is a success that students are advocating and learning about them. It sends a message to the district and community that students are critically thinking and yearning to take ownership with project and place based learning.

Adaptations for K-2

K-2 will follow the same Part 1 & 2 of the series.

For Part 3, instead of each student designing their own system, have it become a group activity where you have them work in teams of 4-5

Make precut items for them to glue onto their landscape (ex: plants, trees, pea gravel, rain tank, etc)

On each landscape, predraw the problem areas (ex: dry hard as rock soil, puddling, etc) to clue them to what to fix

Cited Curriculum:

- Project WET: Rainy Day Hike
- Project WET: Just Passing Through