



Lesson Plan: **Trail Engineering Activity**

How can we improve a trail while also having a minimal impact on wildlife?

Alignment with STEM Framework

Inventor  **Tinkerer**  **Investigator**  **Designer** 
Altruist 

Overview

Parks can be enhanced for hikers and the animals living there, such improvements can be made by focusing on runoff, trail designs, and conservation/habitat protection. In this activity, youth will identify problems such as slope, erosion, gulleying, pooling/puddling, uneven spots, leaf debris push and come up with solutions.

Practice Goals

- Asking questions and defining problems
- Developing and using models
- Planning and Carrying Out Investigations
- Constructing Explanations and Designing Solutions
- Obtaining, Evaluating, and Communicating Information

Content Goals

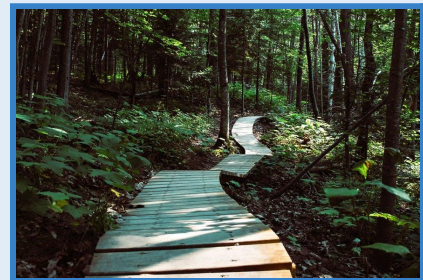
- How can I spot problems/solutions for the trail design?
- How can I recognize the best management practices?
- How can I re-engineer the trail to minimize runoff, improve walkability, and minimize impact on wildlife?

Purpose

Trail maintenance and management helps parks sustain their health and biodiversity. Recognizing the best management practices will give youth the experience they need to make the connection between trails and water drainage systems.. The materials used to form a trail (e.g. pavement, cobbles, sand) will all increase or decrease the velocity of stormwater runoff after a heavy rainfall. Mitigating this water erosion can preserve the trail and the park so the needs of future generations can be met.

Teacher Background Information

Poorly designed trails can further erosion problems. “This may mean planning a longer route that minimizes the impact to environmentally sensitive areas, as well as reducing the need for future remedial actions. Trail design should always ensure that runoff water and drainage from the trail is collected in a stabilized area or sediment basin. Natural drainage patterns should not be disrupted or moved, as the runoff water and surface water may be providing moisture to wetlands downslope or downstream. The design of these drainage ways ensures that runoff volume and velocity is handled without risk of erosion or sedimentation. Surveying the trail during wet months will help determine drainage patterns.”



Affinity Goals



I can act like an **Altruist** by cooperating with my small group and contributing to group discussions.



I can act like a **Designer** by creating trails that mitigate erosion and conserve the natural environment.



I can act like a **Tinkerer** by engineering models that improve longevity and stability of the trail.



I can act like an **Investigator** by identifying uneven spots, erosion, gulleying, pooling/puddling, and leaf debris.



I can act like an **Inventor** by imagining a trail structure that is beneficial to visitors and the surrounding organisms.

Materials

- BMP cards
- Laminated poster with a criteria and BMPs on one side, and problem spots and BMPs on the other
- Dry erase markers
- Shovels
- Rakes
- Surveyors stakes
- Hand-held mallets
- Saws for the adults
- 2 of each color flag - orange, white, red, green flag (These flags will be placed along the trail ahead of time.)
- 3 set of flags (pink), five flags in each set, numbered 1 - 5
- 12 small whiteboards and dry erase markers for planning
- Recording sheet *For every problem there is a solution*

All building materials are scavenged by youth from the woodlands in order to maintain the integrity of the natural space.

Time Needed

3 hours & 30 Minutes

Instructional Sequence

Exploring Best Management Practices (BMP) - 30 minutes

- Youth will get into small groups of three or four.
- Youth teams will be given a chart with 5 rows listing criteria for an excellent trail and the BMP photos at the top of each column.
 - Walkability
 - Habitat friendly
 - Uses natural or biodegradable materials
 - Minimizes erosion
 - Minimizes flooding potential
- Youth will check the criteria that are met by the BMP.

For instance: in the column for swail students might put a check next to walkability, habitat friendly and minimizes flooding.

Thinking about problem spots

- On the reverse side of the poster is a similar chart. This one correlates BMPs with problem spots.
- The rows are labeled with photos of problem spots, the columns are BMPs.
- Youth will work in their small teams to discuss and determine which BMPs might solve which type of problem.
- Youth will rank the BMPs with 1 being the most suitable. If a BMP is not right for the problem they can put an X and not include it in the BMPs for that problem.

For instance: a problem photo might show a small creek cutting through a trail. Youth might rank the columns for *corduroy* - 1, *puncheon* - 3, *culvert*-4 and *or/ water bar* - 2. The remaining BMPs such as a swail would receive an X because it does not address the problem.

Activity introduction - 15 minutes

- Teachers will inform youth that they now have the opportunity to put their understanding of BMPs and problem spaces into practice. They will be helping the park in a very real way by enhancing a footpath and working on turning parts of it into useful trail for future visitors.
- Teachers and youth will walk the footpath down to the work areas.
- Teachers will let youth know where the work area boundaries are. We are working the trail from the Cabin 10 trail head, down slope, across the creek bed and up the hill. The end of the trail is marked with orange tape.
- Youth and teachers will return to the top of the trail head outside of the Cabins.
- Teacher will introduce the challenge cards. There are seven different challenges:
 - For every problem there is a solution - This challenge asks youth to seek out problem spots and determine BMPs for each spot. This challenge focuses on design and does not involve building.
 - Saving salamanders - This challenge seeks out a BMP to be built addressing erosion that endangers a salamander spawning habitat.
 - Spare the rare - This challenge focuses on preserving the integrity of the growing space around the trail to save a rare plant. Youth will need to think through water runoff and absorbability in addition to the impact of your materials on the soil.
 - Helping hikers - No one likes getting poison ivy! This engineering challenge targets improving the trail so that people out enjoying the trail are not in danger of getting poison ivy.
 - Downhill danger - This challenge is focused on a very steep part of the trail that is very difficult for many people to traverse.
 - What is this? - This challenge is a choice for youth who are less interested in the building part of trail engineering and more interested in understanding the environment the trail is transgressing. This choice asks youth to identify and research plants and animal habitats that might be of interest to park visitors. Youth create trail markers to inform other visitors about the area along the trail.
 - What do you think? - This is an open ended design challenge. Youth identify a need on the trail for visitors or the wildlife and create a solution. For instance, instead of trail work, youth might feel that an area needs a bench for visitors to just sit and observe.

- Teachers will familiarize youth with the *Materials Market*. Most materials are to be found by the youth, but rakes, shovels, hand held tools and stakes are located at the trailhead.
- Teachers will share with the youth the amount of work time they will have and that they will get a heads up 30 minutes prior to the finish time (see clean-up).

Youth Work Time- 1 Hour and 45 Minutes

- Youth are free to work in small teams of their choice or as a larger group.
- Youth will select challenge cards that interest them. They may work on one the whole time or do several.

Debrief- 30 Minutes

- Youth and teachers will reassemble at the meeting spot at the top of the trail outside of Cabin 10.
- As a whole group the youth will walk to the farthest project on the trail.
- As the group walks back towards the trail head, each project team will share their engineering project as the whole group comes up to it. This is a time for youth to share their designs, drawings, thinking, actual trail and receive feedback from the rest of the group.

Cleanup

- Teacher will give youth a 30 minute heads up to put finishing touches on projects *before debrief*. Teacher will call time 15 minutes *before the debrief*. Youth are responsible for carrying their tools and unused materials back to the Materials market and returning them when time is called.