Designing for Extreme Events

Objectives:

Students will be able to

▪identify problems, actions taken, and outcomes of those actions in two different case studies presented.

▪create an impact map indicating cause and effect relationships between actions and impacts.

▪identify unintended consequences of actions and whether they areas 'desirable' or 'undesirable' for people and for other living things.

Time:

50 minutes

Grade Level:

6-12

Author:

Ecology Explorer Education Team

Standards

Background:

We are faced with problems every day and our solutions will have some type of impact. Some of the consequences will be what we intended, while other impacts may be unintended. For example, you might be hungry and your solution is to pick an orange from a tree to eat. You will have solved your initial hunger problem, but let's say the orange was so juicy that you now have orange juice staining your clothes. One impact of eating the orange was an intended consequence of your action, while the other was an unintended consequence. City planners address problems in cities by building different types of infrastructure. Infrastructure is a term that describes the components that have to be in place to be able to provide a service to people. Infrastructure can be completely designed, built and managed by people, or may involve some naturally occurring elements and processes in order to function. Understanding the interaction between nature and human built infrastructure can help us reach good solutions, but there might also be some unintended consequences as well.

Vocabulary

infrastructure - the basic structure of an organization or system which is necessary for its operation, esp. public water, energy, and systems for communication and transport

Advanced Preparation:

Review impact map example

Materials

Student worksheets

Slide presentation

Large Paper & Markers

Engage:

1) Think back to a typical monsoon storm here in Arizona, which usually falls in July, August, and early September. How long did it last? Did your house get rain but not your best friend's house or vice versa? Can you remember the record-shattering storm in September 2014, which flooded the I-10 highway and made national news? How long did it last? Was there flooding in lawns and parking lots? Sudden and large amounts of water create a very powerful force along the pathway of the flow. Thinking through how to best plan for this powerful force continues to be a challenge for city planners.

2) Explain to the students that they will look at two cases with different approaches to handling monsoon flooding events in Arizona. The students will be asked to analyze and compare these two cases.

3) Have students individually read Section 1 of the Student Worksheet, then answer the Section 1 questions as a group.

Explore:

4) Students continue to individually read the article portion in Section 2 of the Stu-

dent Worksheet, and as a group answer the Section 2 questions.

5) Students continue to individually read the article portion in Section 3.

Explain:

6) Sometimes a solution can have outcomes that are unintended. Some of the unintended consequences could be positive, while other might be negative. Sometimes the solution might loop back to the original problem (referred to as a 'feedback loop'), in some instances even making the problem worse. Ask if students can think of any examples of this.

7) In small groups have students complete the impact cards and create an impact map (see page 3, or slide 1) for an example) as described in Section 4.

Expand:

8) Watch the 7 minute video: https://www.youtube.com/watch?v=UDE5ffsKwQw and in groups answer the questions and table in Section 5. As an additional option, students can identify direct and indirect outcome.

Evaluation:

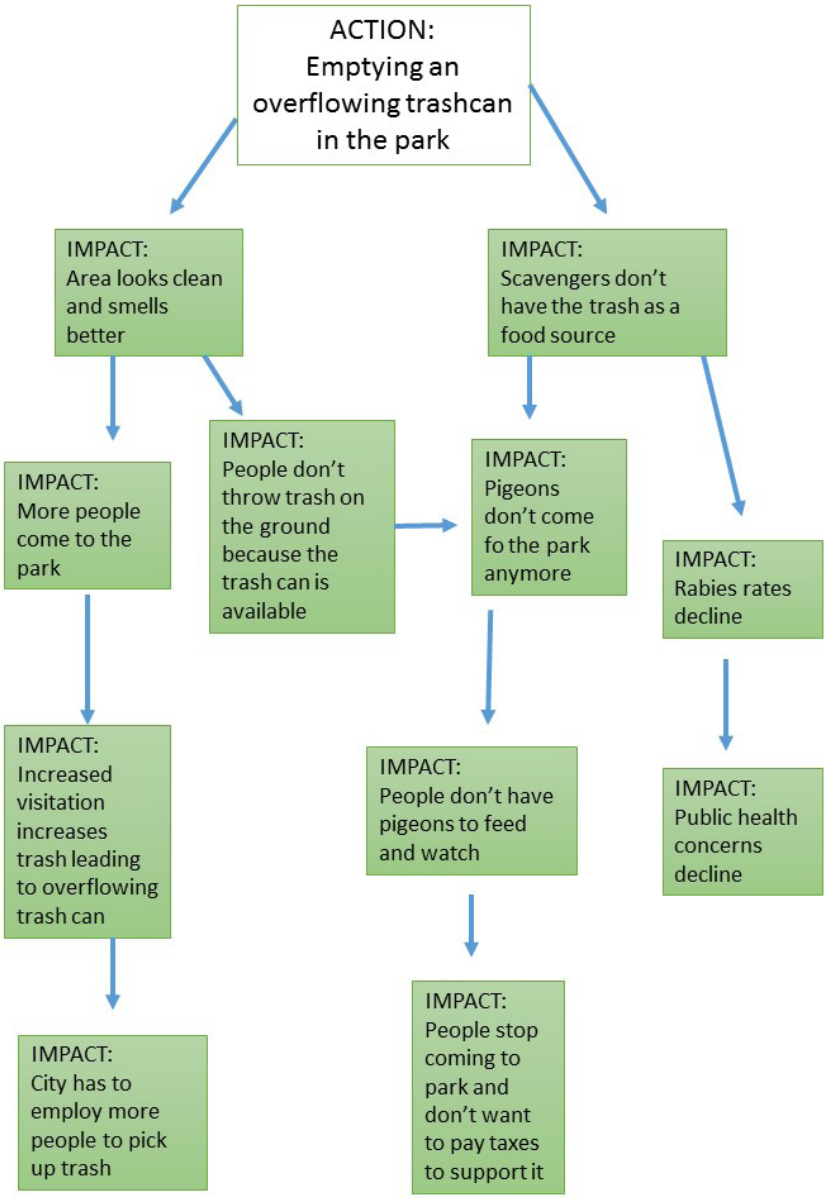
(9) A neighborhood approach to solving the problem of excess water in neighborhoods in Phoenix and Tucson is to create retention basins (see slide 2) which capture water draining from neighborhoods. Some of these basins are so large that they have soccer fields in them, some are smaller (slide 2). Create an impact map with some possible consequences of creating neighborhood retention basins.

Extension:

Seeing Extreme Events: What do the Data Say?

Standards:

Desinging for Extreme Events
Impact Map Example



Adapted from: How Big is Your Backyard? . 2001. Institute for Global Ethics

Student Worksheet 1
Designing for Extreme Events

Name: _____

Section 1

1) Individually, read this portion of an article from the Arizona Daily Sun, October 31, 2015:

> Soil cement has been used in Tucson since the late 1970s, after major floods struck the Santa Cruz and Rillito rivers. It continued in 1982 when the city of Tucson put in a massive downtown flood control project in hopes it would allow development with little flood risk. Soil cement prevents floodwaters from eroding otherwise barren streambanks. The use of soil cement accelerated after a huge flood in October 1983 sent homes, trailers, condominiums and an office building into the Rillito and other washes when raging floodwaters undercut and ate away the riverbanks that held up the structures.
>
> Since then, Pima County has lined about 80 miles of rivers and washes with soil cement, at a total cost of about $170 million. Soil cement lines parts or all of most major washes in the urban area including the Cañada del Oro, the Pantano and the Julian as well as the Rillito and Santa Cruz. They have become a symbol of better flood protection, and county officials note that most flood damage since 1983 has struck homes and other structures built in older areas developed without soil cement protection.

2) Answer these questions as a group:

A) Soil cement is being used to try to solve what problem? _____

B) List at least two examples of problems caused by flood waters that affected people _____

_____

C) How might flooding be a problem for other living things?

_____

_____

_____

Section 2

1) Individually, continue reading from this same article:

> Tamarisk and mesquite trees, grasses and shrubs jut out 10 to 15 feet from both banks of the Santa Cruz River through downtown Tucson. It's a scenic view, conjuring memories of what the river looked like decades ago.
>
> Soils and other sediment have now built up across the entire river bottom. The trees growing along the river banks allow even more sediment to build up. In some places the sediment and vegetation have grown almost as high as the soil cement-lined river banks.

2) As a group address this question:

A) What impact has the soil cement had on living things along the Santa Cruz in downtown Tucson? _____

_____

_____

Student Worksheet 2
Designing for Extreme Events

Name:_____

Section 3

1) Individually, continue reading from this same article:

Sediment has built up all across the river channel, and trees have grown as high as 30 to 40 feet near the edges. The sediment is brought in every year by smaller flows that occur during normal storms. The result: The river has less room to carry water, raising the possibility of floodwaters overtopping the banks, says professor Victor Baker, who has been studying floods in Tucson and around the world for nearly 50 years.

Now, with the channel constricted by sediment, trees and shrubs, "we don't know for sure how much water it can carry, but it will be a lot less than what the channel was originally designed for," Baker said. That raises the risk of water flooding over the edges, he said.

Baker worries that the now-artificial river can no longer handle the amount of flooding the soil cement cover was originally designed to carry. "If the flood is large enough, it will spill out of the channel into adjacent areas," said Baker, a professor of hydrology and water resources, and of geosciences.

Baker also said he's concerned about potential flood impacts on the Santa Cruz's West Branch, a tributary that merges with the river north of Irvington Road and is choked with grasses and other vegetation. The West Branch is lined with homes close to the river on both sides.

"We have big trouble here," he said.

El Nino may pose Santa Cruz flood risk to downtown Tucson, Arizona Daily Sun, October 31, 2015, by Tony Davis

Section 4: Creating an Impact Map

As a group, complete the impact cards and impact map as described below:

On the top of a large sheet of butcher or easel pad paper, write: 'Problem – Tucson flooding'.

On one index card, write: 'Action – Soil cement installed along streambeds'. Place this card near the top of the paper.

On another index cards, write: 'Impacts' and then list a resulting impact of installing soil cement. In pencil, draw an arrow from the action to the outcome, indicating cause-effect. You can now complete this cause-effect statement using your cards:

To solve the problem of Tucson flooding, soil cement was installed. Because soil cement was installed, a resulting impact was _____.

Try to determine if there are additional impact by substituting the first impact card into the sentence:

Because _____(impact listed on index card)_____, an additional impact was _____.

List this impact on an index card and add it to your map, using pencil to indicate cause-effect.

Continue to identify as many impacts as possible, and continue to show relationship arrows. You may find that some things overlap in causes and effects, and some things lead back to the problem. You might consider color-coding "human impacts" differently from "environmental impacts"

Student Worksheet 3
Designing for Extreme Events

Name: _____

Section 5

1) As a group view : https://www.youtube.com/watch?v=UDE5ffsKwQw

2) Describe the problem in Scottsdale that needed to be addressed: _____

3)) What was the original idea to solve the flooding problems in Scottsdale?_____

4) After discussion with the community, it was decided the City of Scottsdale would develop Indian Bend Wash. List at least 5 impacts that have resulted from the development of Indian Bend Wash: _____

_____

_____

5) Compare the impacts resulting from the Santa Cruz River development to the outcomes resulting from development of the Indian Bend Wash area in terms of desirability for people and for other living things.

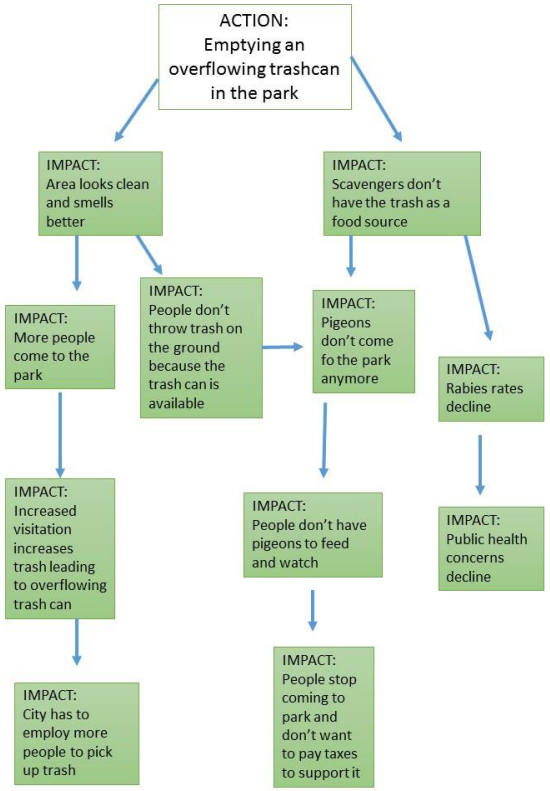
Case	Impacts	Desirable for people?	Desirable for other living things
Santa Cruz River			
Indian Bend Wash			

Student Worksheet 4
Designing for Extreme Events

Name:

A neighborhood approach to solving the problem of excess water in neighborhoods in Phoenix and Tucson is to create retention basins which capture water draining from neighborhoods. Some of these basins are so large that they have soccer fields in them. Create an impact map with some possible consequences of creating neighborhood retention basins.

Impact Map Example



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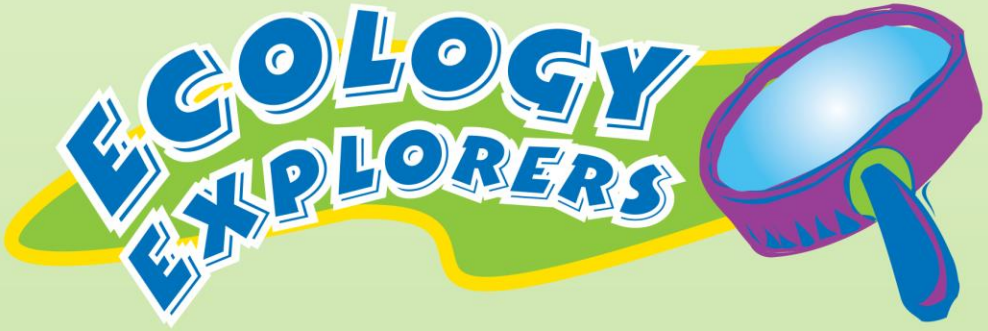

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