

Water Development in the West

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Introduction

The purpose of this exercise is to get students to do some critical thinking and ethical reasoning about engineering projects and water development. It is only through practice that they develop those skills.

This packet contains seven units. The first are based on some chapters in Mark Reisner's 1986 book Cadillac Desert. The sixth is based on a recent great documentary film. The last unit is inspired by a terrific chapter from John McPhee's 1971 Encounter with the Archdruid.

Although Reisner wrote Cadillac Desert in 1986, the lessons it presents are current today. Not much has changed really in the past three decades.

People still live in arid places where, perhaps, they should not live. Engineers still redesign nature to meet human needs, only to find out later that there are unintended consequences. About the only thing that has changed is that today we do not have the Bureau of Reclamation and other agencies spending megabucks to construct huge water projects. Almost insignificant by comparison, some restoration and dam removal projects have begun on a very limited scale.

The seven units are:

- 1 - The Great American Desert (based on the introduction to Cadillac Desert)
- 2 - A Country of Illusion (based on Chapter 1 of Cadillac Desert)
- 3 - First Causes (based on Chapter 3 of Cadillac Desert)
- 4 - The American Nile (based on Chapter 4 of Cadillac Desert)
- 5 - Go-go (based on Chapter 5 of Cadillac Desert)
- 6 - DamNation (based on the 2014 documentary called DamNation)
- 7 - Brower vs Dominy (based on Part 3 of Encounters with the Archdruid)

Instructors may wish to use some or all of the seven units. They pretty much stand alone - except that the last two sort of tie everything together and call for more thought by the students.

The first five units require students to read part of Cadillac Desert and to answer questions. If your students are like mine, you should remind them to provide more than superficial answers.

Supporting Films



They seem to have forgotten that the level was lower before the Hoover Dam was constructed!

In 1977, PBS produced a four-part documentary series called *Cadillac Desert* - it is based on Reisner's book and includes lots of great interviews with key people. It was issued as four separate VHS films, each about an hour long. The first three parts of the documentary are quite good but, perhaps, add up to video overload. You could show them all, but better I think is to have your students only watch the second part - titled *An American Nile* - it really adds to this exercise. Have them watch the film before they do anything else or, perhaps better, just before they start Unit 4 on the American Nile.

You may have a tough time tracking down an original VHS copy of *The American Nile* - and I do not think it was published in any other format. A used copy sometimes can be found for sale if you search the web, although it may be expensive. When we wrote this in April 2015, the film was available on YouTube (although it was in several pieces), and it was available on a BYU website at:

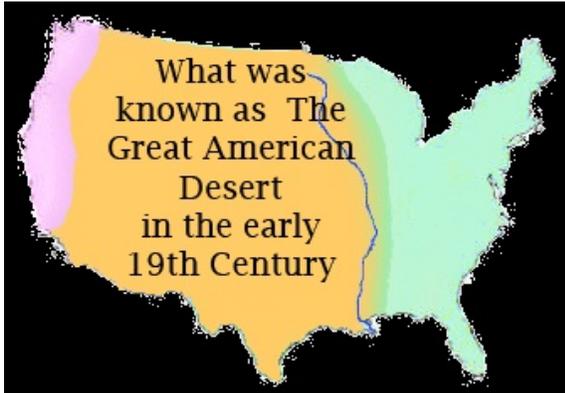
https://video.byui.edu/media/Cadillac+Desert+-+An+American+Nile/0_jy7e52rv

The other key video - the 2014 documentary *DamNation* - is quite good, fun and provocative. You can purchase it relatively inexpensively from Amazon.com or similar vendors.

Assignments

Below are seven assignment handouts - one for each of the seven modules in this packet.

1 - The Great American Desert



This map shows what was known as the *Great American Desert* in the early 1800s. It is not all desert, and it is not all great. But, it is all American.

1. What do you know about this region called the Great American Desert? Write a 2-page essay (without doing any research - just rely on what you know) that describes what is there. Be creative, pretend you are a prize winning author trying to get across the feelings and images you have.

Some questions to think about:

- If you travel around the region, what will you see?
- How does it vary from place to place?
- How many people live there, and where do they live?
- Do they live “well?”
- How do they make their livings?
- What about the flora and fauna? The natural plants and animals that live there. What is there? Is life precarious?
- A key question: Is the region pretty much the same as it was in the 1800s, or has it changed in significant ways? What ways?

After you write your 2-page essay, read the Introduction to Marc Reisner’s *Cadillac Desert* and then write answers to the following questions.

2. As Reisner describes it, what strikes you as the essential differences between the Eastern and Western parts of the United States?

3. Reisner’s introduction gives a high-speed tour through the often neglected story behind some of America’s most breathtaking engineering achievements.

a. Did you mention these projects in your essay describing what you know about the Great American Desert? Why or why not?

b. Some people argue that engineering has had a huge impact on the western United States. Others disagree? Who do you think is correct? Explain your answer.



The Central Arizona project carries Colorado River water 336 miles to the Phoenix and Tucson metro areas. More water evaporates than gets to the end of the canal.

2 - A Country of Illusion

Read Chapter One: *A Country of Illusion* in Marc Reisner's *Cadillac Desert*.

1. Consider Zebulon Montgomery Pike's proclamation about the arid west. What did he think of the region? Do you think he and the other pioneers would have predicted that the region would ever become farmlands?
2. The truth is that, except for a few very crowded cities, most of the Great American Desert is quite unpopulated. Judging from what you know, and what you have gleaned from Reisner's book, what would it take to further settle the inhospitable west and, perhaps, have significant numbers of people living there? Is it possible?

3. In the 1860s the area that is now Colorado, Utah, Arizona, New Mexico and Nevada was labeled "unexplored" on maps of the United States. Soon after that, settlers began to show up and, within a short time, there was little left unvisited. The graphs shown here trace population growth in the five states.

Speculate on answers to the following questions. ("I don't know" is not an answer - figure out a reason even if it might be incorrect.)

a. How hospitable is the land in these five states? That is, overall are they good places for people to live? Discuss why or why not. Your answer might be different for the different states, or for different parts of the states.

b. Which state was the fastest to start gaining population? Why? Which state was the slowest? Why?

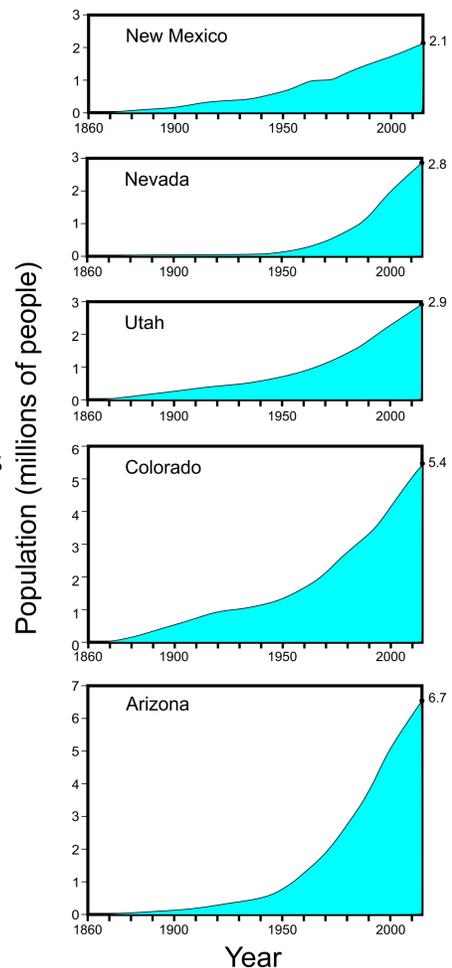
c. Which of the five states has the largest population today? Why?

d. New Mexico seems to have grown at a steady rate. The others seem to have taken off around 1950. Why?

e. The population of the United States is about 320 million people. What percent of the U.S. population lives in each of these five western states?

f. The most populated metropolitan areas in the five states are Phoenix (4.2 million), Denver (3.2 million), Salt Lake City (1.1 million), Las Vegas (1.4 million), and Albuquerque (900 thousand). Do those cities account for most of the people in their states? What

Population Growth in the Arid West
1860 - 2014



percents? Explain why people do not live in other parts of the states.

4. Between 1865 and 1875, Great Plains farmers accepted the idea that “the rain follows the plow.” What was the basis for this idea? Was it legitimate and did it have a scientific basis? What was the consequence of this widely accepted notion? Who benefitted most from this idea?

5. Which American corporations profited most from the rapid population growth in the arid west after the Civil War (after 1865)?

6. Congress passed the Homestead Act in 1862. How much land was allotted to individual farms after passage of the Act. How many head of cattle could be raised on that much land? Was it enough to support farmers and ranchers?



Rafting on the Colorado River today

7. John Wesley Powell was a key figure in western politics in the mid 19th century. He was known for strong views about western expansion. He was a U.S. soldier, a geologist, a college professor and an explorer of the American West best known for the Powell Geographic Expedition in 1869 - exploring the Grand Canyon during a three-month river trip down the Green and Colorado Rivers. Powell was very outspoken about how the western U.S. should be developed.

Powell argued that the Homestead Act was flawed because of the amount of land allotted to individual farmers. What did Powell argue was wrong with the Homestead Act’s arbitrary choice of a quarter section of land per farm?

And, what did he think about increasing productivity by irrigating the quarter section farms?

8. What was Powell’s advice about the rate at which population should grow, and land should be irrigated or developed in other ways, in the west?

9. So, what is the take-away message from this chapter of Reisner’s book? Summarize in a good paragraph or two.

3 - First Causes

Read Chapter Three: *First Causes* in Reisner's *Cadillac Desert*.

1. What natural events led to the popularity of Federal irrigation projects? List at least three events and tell when they occurred.

2. Francis G. Newlands, a Member of Congress from Nevada, was instrumental in passing the Newlands Reclamation Act, also called the Reclamation Act of 1902. For a long while, before 1902, there was resistance to passing such an Act. Why? What changed that made it essential, in the eyes of western politicians, to pass the act?

3. Newlands himself argued against the Reclamation Act. Why? Did he raise valid points?

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John Wesley Powell

Which President first sought to carry out John Wesley Powell's ideas for Federal irrigation projects?

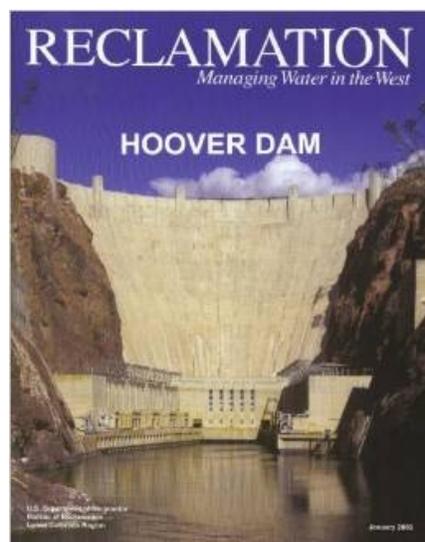
5. Shortly after the Reclamation Act passed, the Reclamation Service started lots of reclamation projects. Who paid for those projects? Who benefitted most from those projects?

6. What were some initial errors made by the first engineers working for the Reclamation service?

7. Did Congress heed Powell's guidance to adjust allotment size for climate and altitude? What was the consequence?

8. How did the economics of the Bureau of Reclamation's activities play out in the first decades of the 20th century? Did irrigation projects make money for the farmers they were supposed to help? Which people benefitted most from reclamation projects?

9. What was the reason that the Reclamation Service kept proposing and building ever more projects that had questionable or marginal economic value?



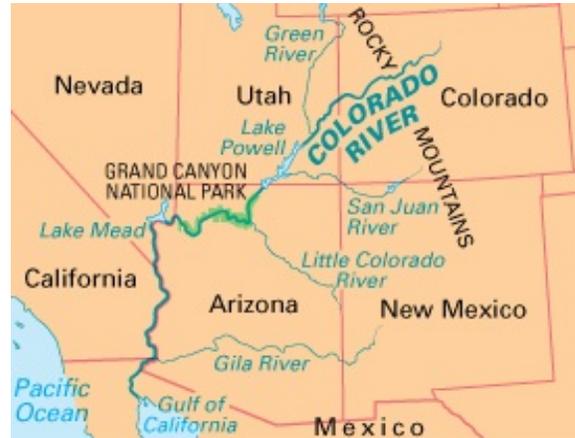
The Hoover Dam, near Las Vegas, is the largest dam built by the Bureau of Reclamation

4 - The American Nile

Read Chapter Four: *An American Nile (I)* in Reisner's *Cadillac Desert*.

1. The Boulder Dam (later renamed Hoover Dam) was constructed between 1931 and 1936. The project was significant and bodacious.

- a. List and briefly discuss four reasons why this project took place in the early 1930s. Why was it needed or wanted, etc.?
- b. Some people say that the dam was an engineering marvel. What do you think was new, unique, and most impressive about the project?



The Colorado River and its water are shared by six or seven states and two countries. There are 15 main dams on the river, including the Hoover Dam.

2. One problem with the dams on the Colorado River is that they stop sediment from moving downstream.

- a. Is the Colorado river's sediment load significant? That is, does it move a great deal of sediment?
- b. Why does the river occasionally divert to new channels?
- c. Is it troublesome/problematic that this sediment will be restricted by the dam? What will be the result above and below the dam?

3. Powell argued that, due to geology and topography, some parts of the west were more suited to irrigation than others.

- a. Explain how topography affects the various climatic regions across the American West. Give an example.
- b. How did Powell predict that topography would affect the cost and efficiency of irrigation?

4. The Colorado River Storage Project is a Bureau of Reclamation project involving water projects in the upper Colorado River basin. Started in 1956, the project provides hydroelectric power, flood control and water storage for Arizona, Utah, New Mexico, Colorado and Wyoming.

What inconsistencies did Illinois Senator Paul Douglas point out about the legislation that created the Colorado River Storage Project?

5. As Reisner points out, many Federally funded projects built by the Bureau of Reclamation will never be able to recoup their costs. And some critics argue that politicians and the Bureau of Reclamation rigged their accounting systems so that they could continue to build dams, although many or most of the dams were impractical or not needed.

- a. How was the accounting manipulated to create a semblance of being financially reasonable?
- b. What motivated the Bureau of Reclamation to continue to construct unnecessary projects?
- c. What are some unfortunate consequences of constructing the unneeded, or only marginally beneficial, projects?
- d. Can you justify the actions of the Bureau of Reclamation in their crusade to build dams for dams sake?



The Glen Canyon Dam, built by the Bureau of Reclamation in 1956 as part of the Colorado River Storage Project, blocks the Colorado River and creates Lake Powell.

6. Google the Colorado River Compact.

- a. What is the Colorado River Compact, and what is/was its purpose?
- b. How well is the Compact working today?
- c. What are some problems (political, economical, environmental) associated with the Compact? What should be done to address those problems? What do you think will be done to address those problems?

5 - The Go-Go Years

Read Chapter Five: *The Go-Go Years* in Marc Reisner's *Cadillac Desert*.

1. President Franklin Roosevelt (FDR) "said he wanted to be remembered as the greatest conservationist and the greatest developer of all time." He is not remembered that way. But, do you think it was even possible? Explain.

2. In 1933, FDR appointed Harold Ickes to run the Interior Department and the Public Works Administration. So, Ickes was in charge of the Bureau of Reclamation and many other agencies and programs.

a. What was the most obvious change made to the Bureau of Reclamation by FDR and Harold Ickes in the 1930s?

b. What did the "nineteen thousand-odd employees" of the Bureau actually do?

c. Ickes appointed Mike Straus as Commissioner of the Bureau of Reclamation. Why did Ickes think that Straus was the best person for the job, and what was his main role intended to be? How was his role different from previous Commissioners?

d. What hypothetical question does Mark Reisner suggest Mike Straus should have asked - but did not?

3. The American Dust Bowl began around 1934 and continued in places until 1940.

a. What events (natural and human - caused) combined to trigger the Dust Bowl?

b. How did the Dust Bowl, in some ways, lead to water development projects in California's Central Valley?

c. What was the purpose of the California Central Valley Project? How was it originally intended to be financed? What financial problems did it run into?

d. How did FDR rescue the project?

e. Did the project provide the promised employment for all the people who needed it?

4. The first major dam on the Columbia River was the Rock Island Dam, built by a private utility company in 1933. It was followed by the U.S. Army Corp's Bonneville Dam in 1937 and

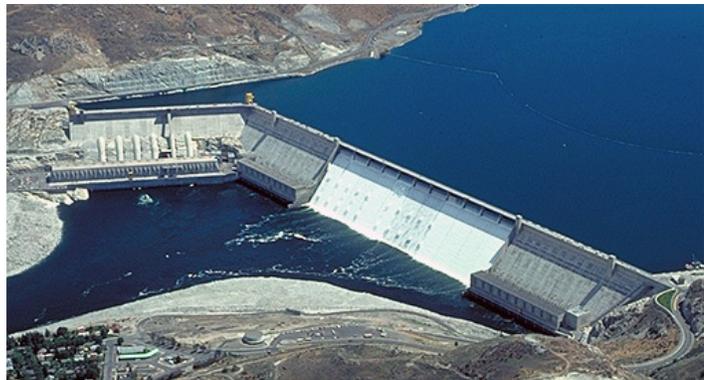


1937 dust storm in Kansas

then by the much larger Bureau of Reclamation Grand Coulee Dam in 1941. Depending on how you count, at least eight more large dams were built on the Columbia, the last being the John Day Dam in 1971.

- a. Why is the Columbia River ideal for building dams to generate hydroelectricity?
- b. The Bonneville Dam and the Rock Island Dam are low dams. What is the difference between a “high dam” and a “low dam?” Why did the Bureau of Reclamation want to build a high dam at Grand Coulee? What would a high dam let the Bureau do that a low dam would not? Why? And what other benefits would a high dam bring?
- c. What was the main problem that FDR faced regarding constructing a high dam at Grand Coulee? Who was opposed to it and why? How was the problem solved?

d. The Grand Coulee dam was completed in 1942. Although we think of the Grand Coulee as a very high dam, the Hoover Dam (built six years before the Grand Coulee) is much higher. And the highest dam in the U.S. is the Oroville Dam, built 25 years later. Use your Google skills: where are the Hoover Dam and the Oroville Dam, and how tall are they?



The Grand Coulee Dam in north central Washington

- e. Why were the Oroville Dam and the Hoover Dam built? What purpose do they serve, and who are the direct beneficiaries?
- f. What is a glaring ecological issue with a high dam on the Columbia River? Why is the problem absent or not as severe for low dams? And, do you suppose this same problem applies to the Hoover Dam? Does it apply to the Oroville Dam? Why or why not?

5. Hydro dams have both good and bad consequences.

- a. For example, what vital role/purpose did the Bonneville and Grand Coulee Dams play during World War II?
- b. What other positive contributions do hydro dams make - Reisner describes several in this and the previous chapter?
- c. What are the most significant problems associated with damming rivers? List at least three and discuss briefly.

6 - DamNation

Watch the film *DamNation* in class or at home and answer the questions below.

These questions are opinion questions, mostly with no specific correct answers.

1. After reading about the history of water development in the west, how did seeing footage of the results affect you? What was your impression of the imagery in this movie?

2. *DamNation* stresses the effect that dams have on salmon and other river fish. Do you think this is an important issue? Is it sufficient reason to remove more dams and restore rivers to their original natural state?

3. 2011 was the Year of the River and the beginning of the largest dam removal project in history - the Elwha Ecosystem Restoration project on the Olympic Peninsula of Washington. Starting in 2012, and finishing in 2014, the 108 ft tall Elwha Dam and the 210 ft tall Glines Canyon Dam were removed to restore stocks of Pacific Salmon and trout species to the Elwha River watershed. The removal of these blockades allows migratory salmon to travel past the dam sites and upriver, an event that has not occurred since the dams' creation in 1913.



The Elwha Dam before it was removed.

When asked about salmon migration, what do you think about the response from the Elwha's hydro-engineer? Do you agree or disagree with his views?

4. The salmon of the Elwha river have been migrating and spawning there for millennia. The dam was there for almost one hundred years. How do these two time-scales compare? Does this affect your ideas about dam construction and constructing "permanent structures" that alter nature? Explain.

5. How do you feel about the statements made by the hydro-engineer at the Grand Coulee Dam? What do you think he meant when he said "things [have] progressed?"

6. Many Native Americans have developed a way of life that takes advantage of the natural spawning and migration of salmon. Many Americans, however, seem to prefer to adjust nature and change natural environments to fit their needs. How do these ways of life conflict, especially regarding dams?

7. Floyd Dominy, Commissioner of the Bureau of Reclamation from 1959 to 1969, said that *people must control nature instead of letting nature control people*. What do you think of his perspective?

8. Dams provide traps for sediment.

- a. What is the source of the sediment?
- b. When you saw the amount of sediment trapped behind the Glines Canyon Dam, were you surprised?
- c. What would happen to the sediment if the dam was not there?
- d. Does river sediment play an important role in preserving river ecosystems? Explain. Give a few examples.

9. Dam removal involves removing outdated, dangerous, or ecologically damaging dams from river systems. There are thousands of outdated dams in the United States that were built in the 18th and 19th centuries. Many more recent ones have caused such great ecological damage that they are proposed for removal. Dam removal is a relatively new and experimental branch of engineering that is in demand because people want to restore rivers to their natural state.

Recent Dam Removal Projects in the U.S.

1973 - Lewiston Dam (39 ft), South Fork Clearwater River, Idaho
1997 - Marie Dorian Dam (8 ft), Walla Walla River, Oregon
1999 - Edwards Dam (24 ft), Kennebec River, Maine
2004 - Embrey Dam (22 ft), Rappahannock River, Virginia
2004 - Cuddebackville Dam, Neversink River, New York
2007 - Marmot Dam (50 ft), Sandy River, Oregon
2008 - Milltown Dam, Missoula, Montana
2009 - Savage Rapids Dam, Rogue River, Oregon
2011 - Condit Dam (123 ft), White Salmon River, Washington
2012 - Elwha (108 ft) and Glines Canyon (210 ft) Dams, Elwha River, Washington

- a. Have you encountered this type of engineering before?
- b. Can you think of any other kinds of engineering projects that have similar goals - putting things back they were before human engineering messed them up?
- c. If you had to choose, would you rather build dams, or be in charge of removing them?
- d. Dam removal is expensive. Is it worth it? Discuss.
- e. Look at the list of recent dam removals in the box. They are all small dams. Yet, arguably, large dams cause much worse problems. What do you think about the feasibility of removing large dams?

10. In *DamNation*, environmental activists did all sorts of “goofy” things.

- a. What was their motivation? Altruism? Or, something else? What do you think? Explain.
- b. What were their goals? Were their goals achievable?
- c. How effective do you think their tactics were?

d. They trespassed and broke other laws. What do you think about their acts of civil disobedience? Were they appropriate and justified?

e. Did they accomplish anything?

11. How did the film *DamNation* make you feel? Did it change your mind about anything, or strengthen your previously held convictions? Do you agree or disagree with the film's message?



Scissors added to the Matilija Dam (near Ventura, California) by ecowarriors

7 - Dominy and Brower

Read part 3 of John McPhee's Encounters with the Archdruid and answer the following questions.

1. Why does the book have the title it has? What person in the book is the archdruid? This is answered directly in several places in the book. Or, you can figure it out if you know what an "archdruid" is.

2. Write two ½ page essays that describe who Floyd Dominy and David Brower were professionally. Forget about what they believed and what they advocated - just describe their careers and the jobs they held.

3. Now, write two ½ page essays that describe what Floyd Dominy and David Brower believed. What fundamental beliefs did they have that were different and irreconcilable? What did they value and how were the values different for the two men?

4. Of course, at the end of the story, nothing has happened. The story simply recounts the arguing of two people as they floated down a river. Yet, this book is considered to have great importance. Why?

5. Who do you think won the argument, Dominy or Brower?

7. A book reviewer said: "Brower struggled to save the Glen Canyon from being flooded by the Glen Canyon Dam but failed and as the story progresses, he is increasingly marginalized in the environmental movement for his perceived militancy. Wendy Nelson Espeland, in *The Struggle for Water*, argues that the Bureau carries much of the blame (or credit) for 'radicalizing' Brower." Did you get this message when you read the book? Explain.

6. Another reviewer said: "So the real issues [in the book] relate to what is natural? How should lands be used? What role do humans have in using, caring for, being part of the land and can we do so responsibly?"

Is the above statement how you would summarize what you read?

7. Finally, how would you answer the questions:

- What is natural?



Floyd Dominy at Hoover Dam



David Brower at the Grand Canyon

- How should lands be used?
- What role do humans have in using, caring for, being part of the land and can we do so responsibly?”
- Check out http://en.wikipedia.org/wiki/Intrinsic_value_%28ethics%29 - and then answer this question: Does nature, and do natural systems, have intrinsic value?
- The 1964 Wilderness Act defines wilderness as: “*A wilderness, in contrast with those areas where man and his own works dominate the landscape, is hereby recognized as an area where the earth and its community of life are untrammelled by man, where man himself is a visitor who does not remain.*” What does “untrammelled” mean?
- Are there some natural, wild, pristine, or otherwise untrammelled places that should be left alone forever? Why or why not? If so, how can or should they be identified?