# Wolves of the Greater Yellowstone Ecosystem
## Background Information for Teachers

**History of Wolf Management in North America:**

The gray wolves (*Canis lupis)* have lived in the North America for thousands of years. There were an estimated 400,000 wolves in North America when European settlers arrived. State and federal governments set up bounties and predator control tactics throughout the 1600s-1800s to eliminate wolves. In Yellowstone, predator control (including poisoning) was routinely practiced during the late 1800s and early 1900s. In 1926, the last wolf pack was removed from Yellowstone National Park, although sightings of lone wolves continued throughout the park and Wyoming. In the 1960s, wolf populations were at an all time low. Except for a small population in northeastern Minnesota, wolves were virtually exterminated from the lower 48 states.

In 1974, the wolf was listed as an Endangered Species, and by law, a recovery plan was required. The US Fish and Wildlife Service proposed the reintroduction of an 'experimental population' of wolves into Yellowstone National Park. Under this classification, wolves were considered to be a "non-essential species" which allowed agencies more flexibility in how they managed the wolves in the region. Meanwhile, a breeding pack began to reestablish naturally in northwestern Montana, and in 1994, there were approximately 50-60 wolves in northwestern Montana.

In 1995 and 1996, a total of 31 wolves were captured in western Canada and released in Yellowstone National Park. Scientists monitored these animals closely using radio collars. The wolves established themselves in several locations in Yellowstone and formed packs that still exist today (refer to video *Wolves of Yellowstone National Park* for more information about the reintroduction). The release of the wolves in Yellowstone National Park marked the end of a long battle that scientists fought to reintroduce the species, but there were many more battles to come. Managing wolves to co-exist with humans, cattle, and other wildlife in the Greater Yellowstone region has been a challenge, and scientists have learned more about their overall effect on the ecosystem.

*Time Line:*

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| 1600s | Approximately 400,000 wolves inhabit North America. |
| 1600s-1800s | State and Federal governments set up bounties to eliminate wolves. |
| 1800s-early 1900s | Predator control (including poisoning) was routinely practiced in Yellowstone National Park (YNP). |
| 1926 | Last wolf pack was removed from YNP although sightings of lone wolves continued throughout the Greater Yellowstone Ecosystem. |

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|---|---|
| 1960s | Wolf populations hit an all time low. Except for a small population in Minnesota, wolves are eliminated from the lower 48-states. |
| 1973 | Endangered Species Act passed. |
| 1974 | Gray wolf listed as an Endangered Species - recovery is mandated. |
| 1987 | U.S. Fish and Wildlife Service proposes the reintroduction of an "experimental population" into YNP. |
| 1991 | Congress provides funds for an Environmental Impact Statement (EIS) for the restoration of wolves in YNP and central Idaho. |
| 1994 | EIS is completed and more than 16,000 public comments are received.<br><br>Fifty to sixty wolves naturally re-colonize in northwestern Montana. |
| 1995-1996 | Thirty-one gray wolves from Canada are relocated to Yellowstone National Park. |
| 1997 | District judge orders the removal of reintroduced wolves to Yellowstone but immediately stays his judgment pending appeal. |
| 2000 | Court decision is reversed. |
| 2002 | Montana, Idaho, and Wyoming begin process to remove wolves from the Endangered Species List. |
| 2004 | U.S. Fish and Wildlife's recovery objectives are met: 332 wolves live in the Greater Yellowstone area; 31 packs include at least 25 breeding pairs. |
| 2006 | Ten year anniversary of the reintroduction. Delisting of the gray wolf is pending (Montana and Idaho wolf management plans are accepted by U.S. Fish and Wildlife, but Wyoming's plan is not accepted). |

The management of the wolves of the Greater Yellowstone Ecosystem has arguably been the most scrutinized project in the history of the natural resource management. There are many reasons why the reintroduction and management is so controversial:

1. Wolves kill livestock which directly affects the livelihood of ranchers.
2. Wolves eat large game animals which may affect the populations of elk, moose, and deer and therefore affect the livelihood of outfitters, and subsistence hunters.
3. Many people are afraid of wolves.
4. Many people are wary of federal government intervention.

On the other hand, numerous people have strong opinions that wolf re-introduction was right and necessary. They feel that their absence in the ecosystem over the last 100 years has created a predator-prey imbalance, and in order for nature to run its natural course, wolves need to be present. Furthermore, some wildlife viewers and recreationists would like the opportunity to observe, hunt, or trap these animals in the wild.

The controversy is complex and it challenges many of our values and attitudes towards the natural world. The following curriculum is designed to help you and your students understand the issue more completely, so that we can make the best management decisions possible in our future.

**What have scientists learned?**

The reintroduction of wolves into Yellowstone allowed scientists the rare opportunity to study wolves in a protected, yet natural setting. Scientists have learned about the behavior of wolves and how they interact with one another, as well their overall influence on the ecosystem. Wolves have been described as a *keystone species*, because there are relatively few of them, yet they have an enormous effect on other animals and plants in the ecosystem. As a result, researchers are still uncovering the influences of wolves. Below is a summary of a few of the ecological lessons researchers have learned over the last 10 years. For more information, refer to *Ten Years of Yellowstone Wolves 1995-2005 (Yellowstone Science Winter, 2005).*

*Wolves and Their Prey*

Elk make up most of the Yellowstone wolves' diet. Wolves primarily eat the elk calves, because they are the most vulnerable. Wolves also feed on older females and weakened bulls. Elk populations have declined by about 50% in the northern section of the park since the reintroduction of the wolf. It is possible that this decline is also due to the drought that has affected the region since 1998.

Bison made up about 2% of a wolf's diet during the last 10 years, but this percentage has increased recently. Wolves may begin relying on bison more if elk numbers continue to decline. Wolves will hunt moose as well, but there are only 33 documented cases of moose being killed by wolves in Yellowstone in the last 10 years. Mule deer and pronghorn make up only a small percentage of a wolf's diet because most of these animals migrate out of the park in the winter.

In the summer, smaller animals, such as rabbits, ground squirrels, and beaver also contribute to the diet of wolves. It has been difficult for scientists to track wolves in the summer, because there is no snow to follow their movements, and they hunt in smaller groups. As a result less is known about wolf behavior in the summer. Researchers think that wolves eat about 30% less in the summer than in the winter.

*Wolves and the Scavengers*

Wolves kill many large animals but since they cannot eat the entire carcass, many other animals benefit from the leftover meat after a kill. The animals that eat these carcasses are called scavengers. There are about 12 different scavengers that use and

benefit from the kills, including ravens, magpies, bald and golden eagles, coyotes, bear, and potentially wolverines.

While wolves were absent from the ecosystem, the coyote populations increased. Since they often compete for similar food sources, wolves will kill coyotes if they are too close. As a result, coyote populations have declined in the last few years. Generally all other populations of scavengers are thriving with the reintroduction of wolves to the ecosystem.

*Wolves and the Ripple Effect*

Since wolves are considered keystone species, they affect many other species around them. Scientists are just learning some of the indirect ways that wolves are influencing other plants and animals in the ecosystem. For example, if elk population and/or behavior changes with the reintroduction of wolves how will the plants that the elk eat change? Furthermore, how will a change in the plant structure affect the other animals within the park? As you can see the reintroduction of the wolf has opened a whole chapter of new concepts that scientists have yet to learn.

**Wolf Curriculum**

5th grade through 8th grade

The following curriculum is designed to take the class through a unit on wolves. The first lessons help students become familiar with the basic physiology of the wolves and their adaptations for survival. Then they progress towards more complex ecological concepts and discussions on management. Please feel free to use any or all of the lessons. Additional lessons and activities can be found in *Gray Wolves Gray Matter* curriculum which was developed by the International Wolf Center. We hope you enjoy the material!

**Part I: Wolf Basics**

*Activity: Wolf Jeopardy (approx 30 min)*

Teachers and students will be able to assess their prior knowledge of wolves in this fun and interactive activity. Wolf jeopardy can also be used as an assessment tool at the end of the wolf unit.

*Activity: Create-a-critter (approx 45 min)*

Students will create an imaginary creature with adaptations that will help it survive. They will then explore the adaptations of wolves and how they survive in the wild.

*Activity: Home is where the food is (approx 2 hours)*

Students chart wolf travels on a map to glean wolf territorial behavior.

*Activity: Wolf Packs of Wyoming (approx 45 min)*

Students will learn about wolf packs and their social behavior. They will also read maps and tables to deduce the size and range of Wyoming's wolf packs in 2006.

**Part II: Wolves and the Food Chain**

*Activity: Oh Deer, what about Elk?! (approx 1 hour)*

Students become elk and wolves and mimic how their populations fluctuate depending on the availability of food, water and shelter.

*Activity: Ripple Effect? (approx 1 hour)*

Students draw a conclusion about the wolf's effect on the ecosystem by building a logical argument.

**Part III: Wolf Management and the Human factor**

*Activity: Wolf Management Mediation (approx 2 hours)*

Part 1:

# Wolf Basics

# Wolf Jeopardy

Teachers and students will be able to assess their prior knowledge of wolves in this fun and interactive activity. Wolf jeopardy can also be used as an assessment tool at the end of the wolf unit.

** Note This activity was taken from the International Wolf Center's *Gray Wolves Gray Matter* curriculum **

**Student Objectives:**
At the completion of the lesson, students will be able to:

1. Assess what they know or do not know about wolves.
2. Extrapolate the important topics related to wolf management.

**Materials:**

- Game Questions
- Resource books and fact sheets

**Procedure:**

See enclosed activity description.

# Create – A - Critter

Students will create an imaginary creature with adaptations that will help it survive. They will then explore the adaptations of wolves and how they survive in the wild.

**Student Objectives:**
At the completion of the lesson, students will be able to:

1. Define 'adaptation'
2. List 3 or 4 adaptations that wolves have to help them survive
3. Become familiar with the track, skull, and pelt of a wolf

**Materials**:

- Drawing paper
- Colored pencils
- Skull, pelt and track casts

**Teacher Background Information:**

*Camouflaged Fur:* The fur of the gray wolf is specially designed to keep the animal both warm and dry. The outer fur is long and course and is angled to shed water off the body. The under-fur or down fur is softer and thicker, designed to keep the wolf warm during cold months. Wolves will shed fur in the summer to stay cooler and grow more fur in the winter to stay warm. Wolves can be many different shades from light gray to black, and most often get lighter in color over their lifetime.

*Long Legs and Big Feet:* Note the long legs and large feet of the wolf. The long legs help the wolf travel long distances with low energy exertion. They are also very fast and can attain speeds of 30-35 mph for short periods during a hunt. Typically, wolves travel 10-30 miles a day in search of food, but have been known to move 550 miles a day in search of a new mate! That is farther than walking from Yellowstone, NP to the Canadian border in one day. The large feet also assist the wolf in running. They act like snow shoes in the winter keeping the animal on top of the snow.

*Endurance/ Lung capacity*: Their cardiovascular system is well adapted for endurance, going long distances at a moderate speed. They are built like middle distance runners not like sprinters.

*Sense of smell* (smell receptors line their nose and back of mouth)*:* Notice the large nasal opening on the wolf skull, and the delicate bones inside. These support the moist membranes of the nose, which help the wolf smell. Wolves have an excellent sense of smell, and rely on scent more than any other sense. They can smell something approximately 1 mile away!

*Eyesight*: Though sharp, the eyes of the wolf are not the most sophisticated of its senses. They are located on the front of the skull to help the predator with its depth perception which is beneficial in capturing its prey.

*Acute Hearing:* Towards the back of the skull on the underside, notice the large, egg shaped bones called auditory bullae. These hold the inner ear of the animal and the size reflects the relative importance of the hearing compared to other senses. In general dogs have good hearing. They can hear other wolves howling several miles away. By rotating their ears around, wolves are able to pinpoint the exact direction of the sound.

*Sharp Teeth/ Strong Jaw:* Wolves have very strong jaws. The strong muscle which gives the jaws their power attach to the sagittal crest (the prominent ridge on the top of the skull) and the lower jaw. The jaws are so powerful they can bite through the femur of a moose in about 6-8 bites. Their teeth are also designed to help them process food efficiently. The front narrow incisors pick meat off the bones; the large pointy canines are used to pierce and grip prey; and the scissor-like premolars and molars cut through the meat.

**Procedure**:

1. On a blank piece of paper ask students to draw an imaginary "critter" that could survive in the water pipes of the school. Ask the students to indicate special features that the "critter" would have to enable its survival. How does it eat? How does it move? What is the shape of its body? Be creative and have fun! After the students have created their critters have them explain the "sophisticated" features that their critters have developed. These features are called ADAPTATIONS.
2. Define adaptation for your students- *An adaptation is a physiological or behavior characteristic that enables an organism to survive in its environment.*

3. Lay out the wolf pelt, the skull, and the track casts of the wolf. Encourage students to observe these items closely. Ask the students- What adaptations do wolves have that help them survive?
4. Discuss some of the adaptations mentioned above with the students.

# Home is where the food is

Students chart wolf travels on a map to glean wolf territorial behavior.

** Note This activity was taken from the International Wolf Center's *Gray Wolves Gray Matter* curriculum **

**Student Objectives:**
At the completion of the lesson, students will be able to:

1. Describe how researchers determine wolf pack territory size.
2. Use a map to estimate the range of a wolf pack territory size in Minnesota.
3. Hypothesize why wolves disperse.

**Materials**:

- Copies of Tracking Map
- Copies of hypothetical telemetry data for 2004 and 2005
- Different colored pens

**Procedure:**
See enclosed activity description.

# Wolf Packs of Wyoming

Students will learn about wolf packs and their social behavior. They will also read maps and tables to deduce the size and range of Wyoming's wolf packs in 2006.

**Students Objectives:**

At the completion of the lesson, students will be able to:

1) Outline the typical structure of a pack
2) Read a map which outlines wolf pack territories in the Greater Yellowstone Recovery Area
3) Hypothesize which wolf packs pose the greatest threat to area ranches.

**Teacher Background Information:**

- Wolf packs are the basic social unit of a wolf community. They are usually a family group that is led by the parent wolves- alpha male and alpha female. The other members of the pack are typically the offspring of the alpha pair ranging in age from pups to two-to-three-year-olds.
- A pack size is determined by the amount of food available in the territory. In Yellowstone the average pack size is about 10 wolves (Yellowstone Wolf Project Annual Report, 2006). This number has decreased over the last 10 years as Yellowstone reaches its carrying capacity of wolves. In other words, the population within the park seems to be stabilizing because there is a limit on the amount of food available.

**Procedure:**

1. Introduce students to the structure of a wolf pack by having them read International Wolf Center's *Basic Wolf Information: Communication.*
   Possible Discussion Questions:
   a. Why do wolves need to communicate with one another?
   b. Why are wolves territorial?
   c. What are some advantages to living in packs?
2. Review (from the previous activity) why some territories are large and why some are small.

3. Orient students to Figure 3, Table 2, and the livestock distribution map. Have them fill out the "wolf pack worksheet" to help them synthesize the information in the tables.

Part 2:

# Wolves and the Food Chain

# Oh Deer, what about Elk?!

Students become elk and wolves and mimic how their populations fluctuate depending on the availability of food, water and shelter.

** Note: This activity is similar to Project WILD's Oh Deer, but has been modified to show the relationship between wolf and elk.**

**Student Objectives:**
At the completion of the lesson, students will be able to:

1. Identify food, water and shelter as three essential components of habitat.
2. Define limiting factors and give examples of each
3. Recognize that fluctuations in wildlife populations are natural as ecological systems undergo constant change.

**Materials:**

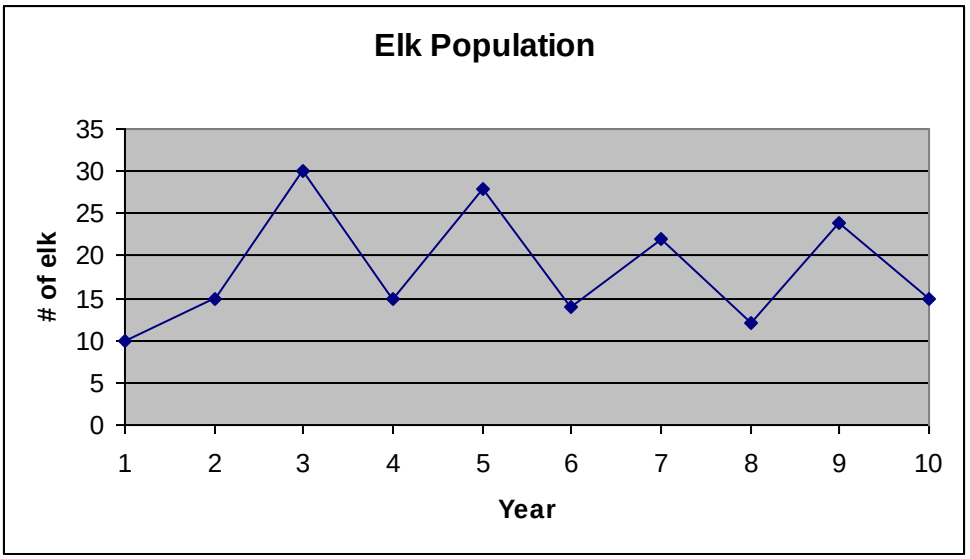
- Gym or playfield large enough for students to run
- White board or graph paper
- Writing utensils

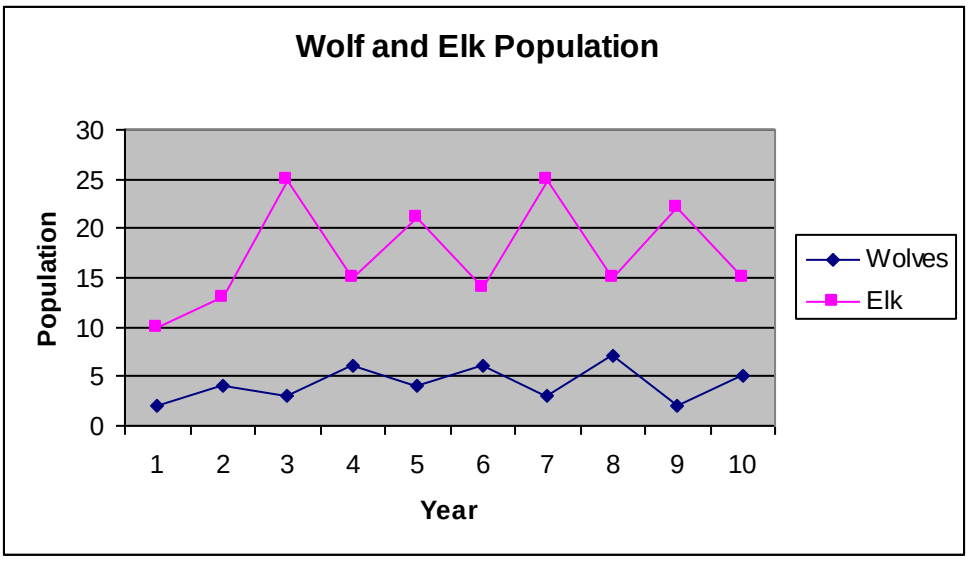
**Procedure:**

1. Explain that the essential components of a habitat are food, water, shelter and space. Plants and animals need all of these in order to survive. In this activity we will be exploring how three of those four components: food, water and shelter, affect populations.
2. Assign $\frac{1}{4}$ of your students to be the elk. These students should remain at one end of the play area.
3. The rest of the students should go to the opposite end of the play area. These students are the essential components of habitat: Food, Water and Shelter.
4. Explain again that all elk need food, water and shelter to survive. If an elk is looking for food, it should put its hands over its stomach; if an elk is looking for water, it should put its hands over its mouth; if it is looking for shelter, it should put its hands together over its head. An elk can choose to look for any of these needs during each round of play. The deer CANNOT change what it is looking for during any one round. It can change what it is looking for during the next round if it survives.

5. The rest of the students are the components of habitat (water, food, shelter). Each student chooses what component he or she will be at the beginning of each round. The students depict what they are the same way the elk show what they are looking for (ie hands over mouth, stomach or head)
6. The activity starts with students lined up on their respective sides. With their backs turned, they choose their signs.
7. When the teacher says go, the students turn around and display their signs clearly. The elk look for the habitat component that they need. When they find one, they run to it. Each deer must hold the sign of what it is looking for until it reaches the habitat component with the same sign. Each elk that successfully reaches a "food", "water" or "shelter" takes that person back to the elk side of the play area. This represents the elk successfully finding its habitat need, and successfully reproducing as a result.
8. Any elk that do not find their food, water or shelter die and become part of the habitat team.
9. As the facilitator, the teacher should keep track of the number of elk during each round of play.
10. Continue the activity for 8-10 rounds. Keep the pace brisk and the students will have a lot of fun!
11. At the end of the segment, call the group together to discuss what they saw and noticed about the elk population. Use the white board or graph paper to graph the elk population for each round (year). Ask the students what some of the "limiting factors" were for the survival of the elk. (see graphic example below)
12. Now add a predator (wolf) into the mix. The predator starts in the designated "rendezvous site" off to the side. The wolves (because they are not as fast as elk) must speed walk to tag the elk. They can only tag elk that are on their way out to the habitat components. Once an elk is tagged, the predator escorts the elk back to the "rendezvous site". This simulates the time it takes to eat. The eaten elk is now a predator. Predators that fail to tag an elk die and become habitat components and join the habitat team.
13. Teachers should now keep track of elk populations *and* wolf populations after each round.
14. After 10 more rounds, call students together, and have them graph the elk and wolf populations on their own. (see example below)
15. Discussion Questions:

- If we continued several more rounds of this activity, what would your graph look like?
- How is the wolf population affected by the elk population? When is the wolf population at its highest? Why?
- Are the predators controlling the prey populations? or Are the prey controlling the predator populations?
- If you started this activity with an artificially high elk population due to many years of no predators (say half elk and half habitat). How would a small wolf population do? Approximately how long would it take for the graph to stabilize like the ones you just created?



# Ripple Effect?

Students draw a conclusion about the wolf's effect on its ecosystem by building a logical argument.

** Note: This activity was taken from the International Wolf Center's *Gray Wolves Gray Matter* curriculum **

**Student Objectives:**
At the end of the lesson, the students will be able to:

1. Construct pieces of biological evidence into a logical sequence to build a defensible conclusion.

2. Infer the wolf's influence on biodiversity.

**Materials:**

- A set of evidence cards for each student or group of students.

**Procedure**:
See enclosed activity description

Part 3:

# Wolf Management and the Human Factor

# Wolf Management Mediation

**Student Objectives:**

At the completion of this lesson students will:

4. Understand how complex the human-wolf issue is in the Greater Yellowstone Region
5. Explain three or four viewpoints associated with wolf management
6. Develop a management plan for the region that incorporates the viewpoint of the various stakeholders

**Mediation Procedure:**

1. Assign a role to each member of the class (see attached role cards)
2. Hand out articles and fact sheets to each of the students and have them fill out the form entitled: My Position
    a. Articles range in length and difficulty. Teacher will need to assess the difficulty of the article in relation to their own students.
    b. Articles can be handed out as a homework assignment
    c. If time is limited or articles are too difficult, this activity will still work if students just read their role cards and draw on information previously learned during class time.
3. Outline the ground rules for the mediation (this can be done by the teacher or a student-mediator)
4. Pose the question/problem to be resolved during this mediation: *How should wolves be managed once they are removed from the Endangered Species List?*
5. Allow each stakeholder group 1 minute to state their position.
6. After each group has stated their position, give the groups 5 minutes to develop questions that they would like to ask other stakeholder groups.
7. Each group poses one question to another group. That group then has 1 minute to respond.
8. When each group has had the opportunity to ask one question, decide whether you would like another round of questions or whether you feel like you can move on to the management solution phase of the mediation.
9. Allow each stake-holder group 30 seconds to summarize their argument.

**Developing the Management Plan:**

1. The teacher or student-mediator continues to guide the meeting.
2. To start, have students develop a Vision Statement: focus on the common vision rather than the opposing views. It is best to have the students develop the elements of this vision statement, but this is an example of what they might develop: ex) We would like to develop a plan where humans and wolves can co-exist in the Greater Yellowstone Ecosystem while ensuring economic stability, natural resource protection and cultural identity.
3. While still in character, have the students brainstorm 3 to 5 management alternatives.
4. Discuss as a group which management alternative best matches the vision statement.
5. Have the students vote on which management alternative they would prefer.

**Debrief:**

1. Have students step out of character and let them reflect on the process.
    a. How did it feel to represent a character whose views you may not agree with?
    b. Do you have a better understanding of someone else's viewpoint after this activity?
    c. Are you happy with the management plan that you developed?

**Extension**

1. Students may be interested and writing to their local congressman outlining the details of their management plan.
2. Students may be interested in writing a letter to the editor explaining the activity and what they learned from the process.