NOAA's West Coast Region

High school curriculum: Killer Whale Recovery

Recruiting teachers, Overview, Teacher Feedback and Curriculum Evaluation

Recruiting Teachers

NOAA's 9th-12th grade killer whale curriculum

Science: Biology, Marine Biology, Environmental Studies

- Life Science (Population dynamics and the science behind the recovery strategies)
- Inquiry (questioning, data analysis, formulating conclusions from evidence)
- Application (Science, technology, problem solving)

Social Studies and Classroom Based Assessment:

- Geography (habitat and range)
- Management and Policy (What level of protection do these whales have in the USA and Canada?)
- Economics (Stakeholders and how different levels of government regulate impacts)
- Government (local, state, federal, and international)
- Civics (stewardship: rights and responsibilities of citizens)

Aligns with **CBA: Humans and the Environment or International Relations**

Curriculum Overview

Lesson	Topic	Activity	Length of Time	Materials Needed	Assessment
1	Natural history and population parameters	Pre-Test Trading card activity to look at population dynamics	1-2 50 min. periods	Bottle with hole at base and water 10 posters Trading cards Student worksheet	Pre-Test Participation in trading card activity worksheet
2	Population comparison and demographics	Trading card activity, Part 2	50 min. period	Trading cards Student worksheet	participation in trading card activity worksheet
3	Threats, recovery goals, delisting criteria	Are the issues black and white? Calculating ideal population size	50 min. period	Student worksheet	participation worksheet
4	Stakeholders and governments	Quick write Facebook stakeholder profile	50 min. period	Student worksheet Internet access	participation in activity worksheet
5	**NOAA representative:** Science, Management and Stewardship	Problem solving: Use the delisting criteria for a recommendation on killer whale recovery. Data gaps/stewardship	50 min. period	Student worksheet	participation worksheet

Classroom based assessment: Humans and the Environment or International Relations
http://www.k12.wa.us/socialstudies/Assessments/HighSchool/HSGeo-HumansandtheEnvironment-CBA.pdf

To arrange a guest speaker email: **wcr.education@noaa.gov**

Teacher Feedback and curriculum evaluation **Classroom Background Information**			
Name: School: Class(s) you teach: Grade level:	NOAA Representative: Visit date:		
Lessons 1-4 Evaluation	**Yes**	**No**	**Comment**
Was there enough background information to complete the lessons?			
Were the instructions for the lessons easy to follow?			
Was the time estimated for each lesson appropriate?			
Did the worksheets support the activities?			
Was the information age-appropriate?			
Were the students successful accomplishing the lessons using the websites?			
Would you be interested in teaching this again?			
How did you adapt any these lessons to your students?			
How would you describe student engagement in these lessons?			
Lesson 5 Evaluation			
What did the NOAA representative do well?			
What advice might you give this person who might visit other classrooms?			

Thank you for your feedback. Your opinions are valuable and will help us transform these activities to be powerful tools for your students.

Please send to:
NOAA Fisheries, c/o Peggy Foreman, 7600 Sand Point Way NE, Bld. 1, Seattle, WA 98115 or email **wcr.education@noaa.gov**

NOAA's West Coast Region

NOAA's 9th-12th Grade Killer Whale Recovery

Aligned for Social Studies CBA: "Humans and the Environment" or "International Relations"

Pre-Visit Questionnaire

Your Name:	Teacher's Name:	
School/Groups Name:	Phone number:	
School location: Driving Directions:		
Class and Grade Level:	Periods & Time:	Class size: * *
Presentation Date:	Check in at office? Yes ☐ No ☐ Room #:	
What is the best time to set up:	Resources that you brought: # Distributed:	

Content background knowledge

- What background do your students have in policy and marine conservation efforts?
- Are there any vocabulary words or topics that you would like me to specifically address or connect to prior knowledge or concepts?

Class dynamics

- Do you have any special needs students?
  Do you have any tips that work best with these students?
- How do you involve them in group discussion? (raising hands?)
- What techniques do you use to get their attention? (clap, turn off lights, etc.) (more for elementary)

Equipment and Room Space

- Computer and LCD projector? Yes ☐ No ☐ Macintosh ☐ or PC ☐
- Recommendations? own laptop ☐ CD or flash drive ☐ TV/VCR Yes ☐ No ☐
  ☐ Make a pdf of your presentation to avoid inconsistencies in formatting/ font etc.
- Blackboard or dry erase board?
- Table if you have hands-on materials (baleen, salmon eggs, etc.)
- Open space if you are going to do an activity on the floor (sitting or able to move around)

Other ways to support your class?

Killer Whale Recovery

High School: Natural History and Population Parameters

Lesson 1: Trading Cards

	**Subject Area(s):** Killer whale natural history, classification, social structures, population parameters, analyze graphs and compare two similar population sizes.	**Duration:** one 50 minute period
	Key words: ecotypes, matrilines, pods, clans, community, birth and death rates, predation, prey requirements, habitat destruction, competition for resources, biological impacts vs. human impacts, carrying capacity, and population bottleneck (genetics)	
Materials:	Killer Whale Trading Cards or I.D. catalogue, plastic bottle with hole at bottom, worksheet, computers with internet access	
State Standards: WA, OR, and ID	WA: EALR 2, 9-12 INQH (citations for all ideas from research work) EALR 4, 9-12 LS3E (classification using similar and differences with physical characteristics) OR: H.2L.5 (explain how multiple lines of scientific evidence supports biological evolution) ID: 9-10.B.1.1.1 (explain the scientific meaning of systematic order and organization) 9-10.B.3.1.1 (use the theory of evolution to explain how species change over time)	
Focus Questions:	In order to protect, restore, and manage an endangered population, what factors influence population size? What questions drive scientists to study recovering populations?	
Learning Objectives:	At the end of this lesson students will be able to: • Organize natural history traits into categories • Differentiate how biological and human impacts might influence population size • Interpret graphs of two similar populations to find trends and patterns	
Engage and Encounter	Pre-Test Population demonstration, influence of births and deaths on population size	
Explore and Investigate	Distribute trading cards and have students organize them into natural history categories	
Reflect and Explain	Have students determine what potential biological or human impacts might influence population size http://www.whaleresearch.com/orca_ID_pods.html and analyze two graphs of similar population. Have students brainstorm why one is healthier than the other.	
Apply and Extend	To learn more about current research projects visit NOAA's website: www.nwfsc.noaa.gov/research/divisions/cb/ecosystem/marinemammal/index.cfm Sustainability is in your hands poster/website: test species I.D. within marine ecosystem. http://www.nmfs.noaa.gov/speciesid/Sustainability.html	
Background for teacher	Four levels of social structure have been identified among resident killer whales. The basic and most important social unit is the matriline, which is a highly stable hierarchical group of individuals linked by maternal descent (Baird 2000, Ford et al. 2000, Ford 2002, Ford and Ellis 2002). A matriline is usually composed of a female, her sons and daughters, and offspring of her daughters, and contains one to 17 (mean= 5.5) individuals spanning one to five (mean=3) generations. Members maintain extremely strong bonds and individuals seldom separate from the group for more than a few hours. Groups of related matrilines are known at pods (like J, K, and L pods). Matrilines within pods share a common maternal ancestor from the recent past, making them more closely related to one another than to those of other pods (Baird 2000, Ford et al. 2000). Currently there are about 85 whales in all three pods and are listed as endangered species. Clans are the next level of social structure and are composed of pods with similar vocal dialects and a common, but older maternal heritage (Ford 1991, Ford et al. 2000, Yurk et al. 2002). Pods (and clans) that regularly associate with one another are known as communities, which represent the highest level of social organization in resident killer whale societies (Ford et al. 2000, Ford 2002). In regards to factors that influence population size, have students think of birth and death rates, predation, habitat destruction, competition of resources, etc. Remind students that the carry capacity is not static and population sizes change due to many complex factors. Have them explore different scenarios and the outcomes and then have them generate questions and testable experiments to better understand what how some of these factors might be addressed to help protect the species or population. Longevity and mortality will be addressed in the next lesson and students will use the trading cards again to better understand the population.	
Contact NOAA	For a guest speaker in lesson 5 email: **wcr.education@noaa.gov**	

Lesson 1 Procedures

Natural History and Population Parameters: Trading Cards

I. Anticipatory Set: (10 minutes)

A. **Pre-Test:** Have students answer the 5 questions; turn in when done. Then use the same paper to hand back as a POST TEST in lesson 5 or when done.
   1. Describe the Southern Resident killer whale population and its status.
   2. What dietary challenges do these whales face?
   3. What factors of environmental contaminations most concern this population?
   4. How does anthropogenic noise effect their survival?
   5. Who studies and manages the Southern Resident population?

B. Have students pass up the quizzes and save for later; if they have lab books/notebooks you could have them save a page for the post test rather than collecting.

II. Direct Instruction: (35 minutes)

A. **Brainstorm:** In order to protect, restore, and manage an endangered population, what factors influence population size and which ones are priorities? Births and deaths.

B. **Demonstration:** Pour water into a plastic bottle that has a small hole near the bottom; highlighting that the input of water indicates birth rates and the output or loss from the bottle indicates death rate. Have half the class turn to their neighbor and ask what may cause the birth rate to increase or decrease and the other half focus on how death rate could increase or decrease.

C. **Trading Card Activity:** (Place 10 category signs around the room prior to class).
   1. Divide the approximately 80 cards evenly amongst students or table groups.
   2. Tell the students that there is a natural history fact about killer whales on each card. Challenge the students to organize them according the categories.
   3. Once all of the cards are distributed in the categories, have the students briefly summarize some of the characteristics of that group.
   4. Next, have the students determine which categories help describe population dynamics, size, or factors that could influence a population increase or decline. The three main threats to these animals are (prey availability, contaminants, and vessel effects and noise).
      a. Distribution, habitat and range (The habitat is unhealthy throughout range)
      b. Diet and foraging (salmon abundance is low and salmon may contain toxins)
      c. Vocalizations, sound, and other senses (vessel effects and noise affect communication which is vital to navigation, foraging, and socializing)
      d. Social organization (Small population size and tight social society, if a large scale catastrophe happened and all three pods was present, it could wipe out the whole population at once.)
   5. Hand out worksheet and have them be ready to share the next day.

III. Assessment:

A. Pre-Test to be compared with Post Test at the end.

B. Participation in trading card activity

C. **Homework:** Have students generate scenarios that support an increasing, decreasing, or stable population and then testable questions to address these factors.

IV. Apply and extend:

A. If students want to learn more about research on whales; share with them some reading sources such as the Northwest Fisheries Science Center Research Update. http://www.nwfsc.noaa.gov/research/divisions/cb/ecosystem/marinemammal/index.cfm

B. Have students test their knowledge of species I.D. using this website http://www.nmfs.noaa.gov/speciesid/Sustainability.html to see how killer whales are only one element of the marine food web.

Name:
Period:

NOAA's Killer Whale Recovery Pre and Post Test

1. Describe the Southern Resident killer whale population and its status.

2. What dietary challenges do these whales face?

3. What factors of environmental contaminations most concern this population?

4. How does anthropogenic noise effect their survival?

5. Who studies and manages the Southern Resident population?

****POST TEST: Have students use a different color of pen/pencil and make any changes to the Pre-Test.**

Comparison to other whales or animals

Vocalizations, sound, and other senses

Body plan and ID. features

Swimming, dive behaviors, surface active behaviors

Diet and foraging

Distribution, habitat, and range

Social organization

Identifying individuals, birth, and age expectancy

Status and human interactions/impacts

Conservation

Natural History Trading Card Categories- KEY

Comparison to other whales or animals(7 trading cards)		Vocalizations, sound and other senses (7 trading cards)	
K36	mammals	L103	vocalizations
J36	toothed whales	J32	calls
J37	dolphin	K27	echolocation
J39	size	L74	hearing
K16	size comparison to other whales	L54	ears
L7	look alikes	L41	smell
K22	similar to elephants	J41	tactile
Body plan and ID. features (12 trading cards)		Swimming, dive behaviors, surface active behaviors (17)	
L26	skeleton	L83	traveling
J31	brain	L72	porpoising
K35	mouth and teeth	L27	speed
L91	jaws	K33	dive depths
L5	melon	L88	dive times
L100	blow hole	J8	blows
L95	pectoral fin	J28	resting
K34	flukes	K13	spyhopping
J40	countershading	K14	lunge
J27	saddle patch	L84	cartwheel
J1	fin size	L82	breaching
L47	dorsal fin	L85	backdive
		L105	tail lob
		L55	fluke wave
		L106	kelping
		L53	play
		J26	greeting ceremony
Diet and foraging (5 trading cards)		Distribution, habitat, and range (4 trading cards)	
L12	food chain	K38	distribution
L77	salmon	L78	summer and winter
L79	hunting	K21	fall in Seattle
J17	beneath the surface	L73	viewing orcas
J33	predator/prey		
Social organization (9 trading cards)		Identifying individuals, birth, and age expectancy (9)	
K20	residents	L86	research names
L94	transients	L89	nick names
L87	offshores	J42	naming
K37	clan	J34	names
J35	pod	J2	longevity
J38	matrilines	J19	mom and baby
K12	extended families	J16	at birth
L2	new pods	L108	coloration at birth
K11	super pod	L110	nursing
Status and human interactions/impacts (5 trading cards)		Conservation (6 trading cards)	
L92	research	K25	watershed
L90	endangered	K40	rivers
L25	toxins	K26	watch from shore
L109	captures	A73	whale rescue
J14	First Nations	J30	Killer Whale Tales
		L22	Be Whale Wise

Factors that influence population size

How does the size of a population influence genetic diversity?

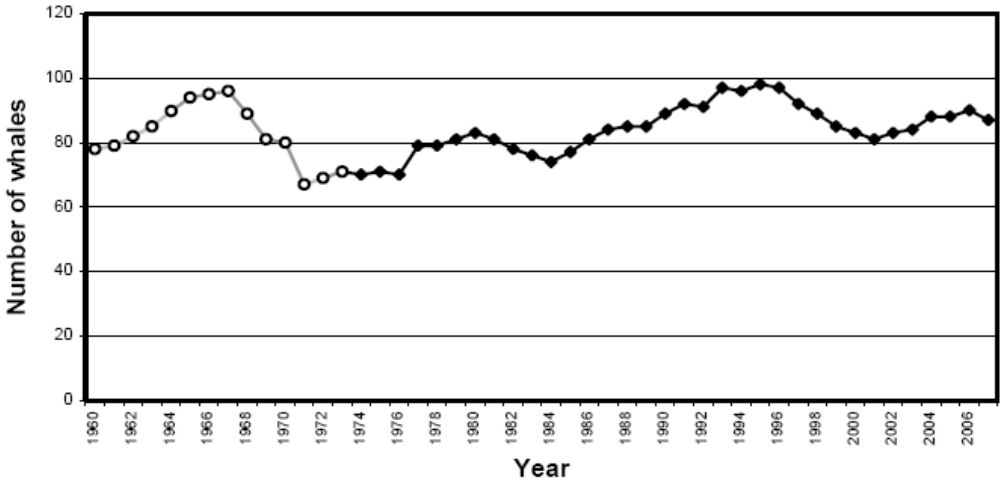
What factors might cause an increase in population?	What factors might cause a decrease in population?	What qualifies as a stable population?
• • • • +	• • • • –	• • • • +/–
What questions would you want to ask to better understand the above factors?	What questions would you want to ask to better understand the above factors?	What questions would you want to ask to better understand the above factors?

Describe the role of carrying capacity in managing populations?

What is a population bottleneck? What implications does this have for recovery?

Comparing Populations using Graphs

Graph 1: Population size and trend of Southern Resident killer whales, 1960-2007. Data from 1960-1973 (open circles, gray line) are number projections from the matrix model of Olesiuk et al. (1990a). Data from 1974-2007 (diamonds, black line) were obtained through photo-identification surveys of the 3 pods (J, K, and L) in this community and were provided by the Center for Whale Research (unpubl. data). Data for these years represent the number of whales present at the end of each calendar year except for 2007, when data extend only through October.



What is the maximum value (highest population size):

What is the minimum value?

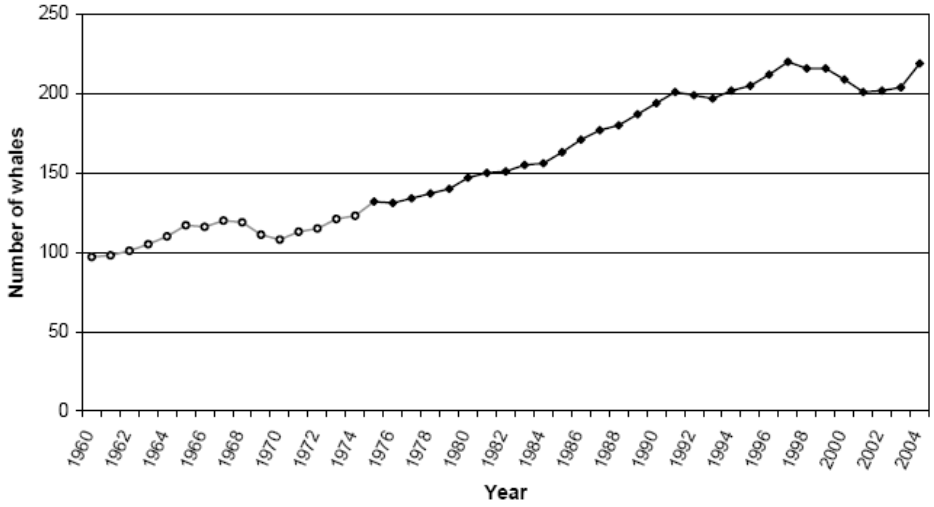
Range:

Average (eye ball this):

Trends over the years:

The capture periods in Puget Sound were in the late 60's and early 70's. Why do you suppose it took about 20 years for the population to increase to its estimated levels?

Graph 2: Population size and trend of Northern Resident killer whales, 1975-2004. Data from 1960-1974 (open circles, gray line) are number projections from the matrix model of Olesiuk et al. (1990a). Data from 1975-2004 (diamonds, black line) were obtained through photo-identification surveys of the 16 pods in this community and were provided by J. K. B. Ford (unpubl. data) and Olesiuk et al. (2005).



What is the maximum value (highest population size):

What is the minimum value?

Range:

Average (eye ball this):

Trends over the years:

How would you describe the health of this population? Why?

Killer Whale Recovery

High school: Population Comparison and demographics
Lesson 2: Trading Cards Part 2

	**Subject Area(s):** Look at factors or threats impacting population size and health of a population of whales	**Duration:** one 50 minute period
	Key words: longevity, mortality, reproductive age, post reproductive age, age classes	
Materials:	Worksheet Computers with internet access	
State Standards: WA, OR, and ID	WA: EALR 2, 9-12 INQA (generate questions and evaluate a question) EALR 3, 9-12 APPA (scientific ideas influenced society) EALR 3, 9-12 APPB (technological design, defining problem in terms of criteria) OR: H.2L.2 (explain how ecosystems change in response to disturbances) H.3S.5 (explain how technology problems and advances create a demand) ID: 9-10.B.1.6.1 (Identify questions and concepts that guide scientific investigations) 9-10.B.5.2.1 (explain how science advances technology) 9-10.B.5.2.2 (explain how technology advances science)	
Focus Questions:	Are population sizes changing? What factors influence increases, decreases or stable populations? How might one go about studying these changes?	
Learning Objectives:	At the end of this lesson students will be able to: • Explain how age classes and sex ratios are used to inform population dynamics. • Compare the Southern Resident killer whale population with the Northern Residents. • Formulate the current population status on the Southern Resident killer whales.	
Engage and Encounter	Review graphs from the Recovery Plan to interpret the issues facing the Southern Resident killer whales.	
Explore and Investigate	Trading card activity: Have students look at some of the population parameters such as abundance and demographics (age and sex ratios and distribution of individuals among different subpopulations).	
Reflect and Explain	Explore some of the issues impacting their decline, why are they important to recovery? What else do we still need to know to better understand these animals? Any data gaps?	
Apply and Extend	Connect with a math/statistics/computer teacher to continue to analyze graphs/statistics from worksheet in lesson 1.	
Background for teacher	***Longevity*** At birth, the average life expectancy of southern and northern resident killer whales is about 29 years for females and 17 years for males (Olesiuk et al. 1990a). However, for animals that survive their first six months, mean life expectancy increases to about 50-60 years for females and 29 years for males. Life expectancy at sexual maturity (about 15 years of age in both sexes) averages about 63 years for females and 36 years for males. Maximum life span is estimated to be 80-90 years for females and 50-60 years for males (Olesiuk et al. 1990a). Reasons for the shorter longevity of males are unknown, but are probably linked to sexual selection (Baird 2000). Among southern Alaska residents, females reaching 6 months of age have a shorter life expectancy of 39 years and a maximum life span of 60-70 years (Matkin et al. 2003).Mortality curves are U-shaped for both sexes, although the curve is narrower for males (Olesiuk et al. 1990a). ***Mortality*** is extremely high during the first six months of life, when 37-50% of all calves die (Bain 1990, Olesiuk et al. 1990a). Annual death rates for juveniles decline steadily thereafter, falling to 0.5% for both sexes from 10.5 to 14.5 years of age, and an estimated 77% of viable calves reach maturity. Death rates remain low among females of reproductive age, averaging just 0-1.7% per year between 15.5 and 44.5 years (Olesiuk et al. 1990a). Mortality increases dramatically among older females, especially those beyond 65 years of age. After reaching sexual maturity, death rates for males increase throughout life, reaching 7.1% annually among individuals older than 30 years. Life history tables for both of these resident populations are presented in Olesiuk et al. (1990a).	
Contact NOAA	For a guest speaker in lesson 5 email: wcr.education@noaa.gov	

Lesson 2 Procedures

Population comparison and demographics

I. Anticipatory Set: (15 minutes)

A. What defines a healthy population or a long-term sustainable population? In the case of the Southern Resident killer whales in order to be delisted there must be a positive population growth (i.e., more individuals entering the population than being removed) over a certain time frame and an adequate number of individuals of both sex classes and mixed ages, distributed among the three pods, to make it unlikely the population will fall below a threshold at which it is in danger of extinction.

B. To gauge whether the above biological parameters were realistic, NOAA Fisheries used Northern Resident population data to help guide their delisting criteria. Ask students to pull out their homework regarding graphing and go over together.

II. Direct Instruction: (35 minutes)

A. **Comparing Populations using Graphs:** Have the students share what they learned from the graphing activity for homework last night. What trends did they see? What might have caused some of those changes? How are their habitats different? NRKW population is over 200 whales and appears to be increasing, SRKW population is about 87 whales and has fluctuated and less than half the size. Live captures in the '60-'70s, urban watersheds, and increased vessel impacts.

B. **Trading Cards Part 2:** Hand out the trading cards again, same groups would be easiest (by matraline) or to have the students learn about a new matraline would be fine too.

1. **Part 1:** Have students answer the questions on their worksheets just about their matriline. This would be a great time to verify that all students know what matriarchal means and have them explore the number of generations, oldest female and male, etc.
2. **Part 2:** When matrilines are done, have pods get together and tally information.
3. **Part 3:** Do as a whole class. Have students share their pod data and look at the whole population. Address the last question, what does this information tell us about recovery? Are we there yet? Does it look promising? Have them look at what the color of the cards mean. Ask them what color or decade of whales is the oldest and the average life span for a female is about 50-60 years and males about 29 years.

III. Assessment:

A. Class participation in activity.

B. Homework: Finish worksheet and have students ask their loved ones about what they know about the status of this population. Have them be thinking of what advocacy or stewardship action they could participate in to help protect this population.

IV. Apply and extend:

A. Look at other graphs from the recovery plan. Connect with a math/statistics/computer teacher and go in more depth on the tables, graphs, statistics, or techniques how to graph from the Recovery Plan.

B. Learn more about what scientists are studying http://www.nwfsc.noaa.gov/research/divisions/cb/ecosystem/marinemammal/index.cfm

Killer Whale Trading Card Activity Part 2

Population demographics

_____pod

Part 1: Matriline Data How many generations of whales are in this matriline? Divide your matriline into males and females, then by age classes.	**Part 2: Pod Data** Tally this information for the whole pod.
1 How many juveniles (3-14 years old)? Total:	How many juveniles (3-14 years old) in the whole pod? Total:
2 How many females do you have? • Who is the oldest female or matriarch in your group? • How old is this whale? • How does the age compare to longevity for the species? • How old was the mother when she had her calves? • What are the intervals between calves (gestation is about 16 months) • **# of reproductive females (15-45 years old)?** • **# of post-reproductive females (46 years and older)?**	How many reproductive females (15-45 years old)? Total: How many post-reproductive females (46 years and older)? Total:
3 # of adult males (15 years and older): • Who is this the oldest male? • What is the age of this whale? • His relationship to the matriarch?	How many adult males (15 years and older)? Total:
4 Total number of whales in your matraline?	How many whales in this pod?

Killer Whale Trading Card Activity Part 2

Population demographics

For extra support, visit http://whalemuseum.org/collections/meet-the-whales

Part 3: Southern resident population data (whole class)

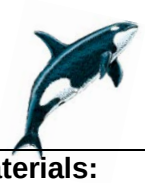
Quantitative measures for population parameters include:

Do you have representation from at least three pods?	Yes	No	Why is this critical?				
Are there more than two reproductive age males in each pod or information that fewer males are sufficient?	Yes	No	Why is this critical?				
Find the current population size of the Southern Resident killer whales (you will use this below)	J	K	L	Total population:			
A ratio of the following in comparison to Northern Resident population:	Total Number currently	Total population	% Currently	Target	Are we close to the target? Yes	Are we close to the target? No	Too high Too low
Number of juveniles (3-14 years old)				47%			
# of reproductive females (15-45 years old):				24%			
# of post-reproductive females (46 years and older)				11%			
# of adult males (15 years old and older)				18%			

What does this information tell us about recovery?

Killer Whale Recovery

High school: Threats, Recovery Goals, and Delisting Criteria
Lesson 3: Are the Issues Black and White?

	**Subject Area(s):** Look at factors or threats impacting population size and calculate ideal population size	**Duration:** one – two 50 minute period(s)
	Key words: bioaccumulation, biomagnifications, PCBs, PBDEs, persistent organic chemicals, immune disruptors, acoustic impacts exponential growth, delisting criteria, inter-birth intervals, exponential functions, recruitment	
Materials:	worksheet computer access with internet	
State Standards: WA, OR, and ID	WA: EALR 2, 9-12 INQC (explain or draw conclusions supported by evidence) EALR 2, 9-12 INQD (communicate clearly) EALR 3, 9-12 APPD (solve problems with math, computers, probes, or data) OR: H.2E.4 (evaluate the impact of human activities on environmental quality) H.4D.6 (evaluate ways how ethics, public opinion, and government policy influence the work of engineers and scientists) ID: SS.9-12.E.3.2.2 (explain and illustrate the impact of economic policies and decisions made by governments, businesses, and individuals)	
Focus Questions:	Salmon are endangered (main diet of the Southern residents, so not abundant and not healthy due to toxins), and noise might be interfering with their ability to find food…how do these issues get resolved? How could multiple threats interact or have cumulative effects?	
Learning Objectives:	At the end of this lesson students will be able to: • Discuss how the three threats together are interrelated • Calculate a growth rate using an algebraic equation to see what target population size is considered healthy enough to delist the currently endangered orcas of the PNW • Explain that a recovery plan lays out goals, objectives, and criteria to follow and problem solve the issues	
Engage and Encounter	Analyzing population declines, what questions can we generate to help understand the population and the effect of threats on these animals?	
Explore and Investigate	Look at three threats (prey, toxins, and vessel effects or noise)	
Reflect and Explain	Work on the biological delisting criteria to see what the population of the Southern Residents is now and what the target number they are striving for in order to remove from the endangered species list.	
Apply and Extend	Have students analyze the following questions in their journals/notebooks: Is it realistic that a population would have the same growth rate every year? Why might it change from year to year? How does one measure population growth for species where you do not know every single individual? Like fish in the ocean?	
Background for teacher	When a species is listed as threatened or endangered under the ESA, one of the three specific statutory requirements is that each recovery plan incorporate objective measurable criteria which when met would result in a determination, in accordance with the provisions of this section, that the species be removed from the list. The ultimate goal is to achieve the recovery of the Southern Resident killer whale distinct population segment and its ecosystem to a level sufficient to warrant its removal from the Federal List of Endangered and Threatened Wildlife and Plants under the ESA. The intermediate goal is to reclassify this population from endangered to threatened. To accomplish these goals population abundance and demographic parameters, along with addressing the threats. In this lesson, students will use the biological criteria to see where we are at and what ideal population would be needed to delist. In lesson 5, students will problem solve and suggest recommendations of how to address the threats.	
Contact NOAA	For a guest speaker in lesson 5 email: **wcr.education@noaa.gov**	

Lesson 3 Procedures

Threats, Recovery Goals, and Delisting Criteria

I. Anticipatory Set: (20 minutes)

A. **Brainstorm:** The top three issues facing this small population: Prey, Toxins, and Noise. What questions can help us understand the effect of threats on these animals? Prey: what is the abundance of available food; is the food healthy; diet specific (will they change prey if salmon is not available), etc. Toxins: what kinds of chemicals, where do they come from, etc. Noise: what is making the most noise, loudest noise, duration, frequency, etc.

B. **Worksheet:** Are the Issues Black and White; do this side with the students and help them make connections.

1. Prey availability and quality (What do we know…Salmon and other fishes are the preferred prey of these whales; endangered salmon in particular, preferably Chinook salmon. What does it mean for the whales…not enough food to eat and the health of that food is questionable, due to potential harmful chemicals.
2. Environmental Contaminants/oil spills (What do we know…there are high levels of PCB's, PBDE's, Persistent organic pollutants (POPs), mercury, heavy metals, etc. in the ecosystem and food chain. What does it mean for killer whales…it biomagnifies up the food chain and toxins are stored in fatty tissues, blubber and milk. Mother whales off load toxins to their calves; the first-born calf often receives the highest concentrations. These high toxin levels can cause immune and reproductive problems in animals.
3. Vessel effects and sound (What do we know…boats make sound and there are a lot of boats around the whales in the summer months when the Chinook salmon are abundant. What does it mean for killer whales…noise impacts their ability to navigate, find food, and communicate with their pod.
4. What does it mean, "Are the issues black and white?" Not necessarily. Could there be confounding effects and why is this important to recovery? Possibly, how might one study this?

II. Direct Instruction: (30 minutes)

A. **Review:** Northern resident population to the Southern resident population. Why do you think these populations are so different? Today they will calculate what the TARGET population size would be in order to downlist to threatened status and delist this species off of the Endangered Species Act list. Have students take out their calculators, while you hand out the worksheet.

B. **Recovery Activity:** Read the recovery goals and objective at the top. Tell them if they have ever done a compound interest or other algebraic problems dealing often with money, then this should be a review.

C. Get the current population either from lesson 1 or The Center for Whale Research website.

D. When finished they can think back to lesson 2's worksheet of the other parameters like:
-number of juveniles ~47% how many whales would that approximately be (<50%)?
-number of reproductive females ~24% how many whales (1/4) would that be?
-number of post reproductive females ~11% how many whales (10%) would that be?
-number of adult males ~18% how many whales (20%)

III. Assessment:

A. Classroom participation

B. Worksheet

IV. Apply and extend:

A. Is it realistic that a population would have the same growth rate every year? Why might it change from year to year?

B. How does one measure population growth for species where you do not know every single individual? Like fish in the ocean?

Are the Issues Black and White?

Background on threats: Recovery Plan section II-71 (Prey Availability= II-75; Environmental Contaminants= II-87; Vessel Effects and Sound=II-103)
www.westcoast.fisheries.noaa.gov/publications/protected_species/marine_mammals/cetaceans/killer_whales/esa_status/srkw-recov-plan.pdf

TOP three threats facing the Southern Resident killer whale population		
	Prey availability:	What do we know about salmon… What does it mean for the whales?
	Environmental contaminants:	What do we know… What does it mean for the whales?
	Vessel effects and sound:	What do we know… What does it mean for the whales?

The above threats are just some of the issues facing these animals; do scientists know what factor is the most important? What do you think?

Why is this important to recovery?

Do you think there are any gaps in the data collection, what research question or strategy would you propose?

Recovery Goals, Objectives, and Criteria

Recovery Plan section IV-1 through 11
Biological delisting criteria: Recovery Plan section IV-4

Goal: Remove from Endangered Species List or delist them from endangered to threatened as a first step.
Objectives: How are you going to do it? What actions will be established to address the biological and threats criteria.

DOWNLIST from Endangered status to Threatened status: If the Southern Resident DPS can exhibit an increasing population trend at an average growth rate of 2.3% per year for 14 years…then these animals would no longer be endangered but listed as threatened. 1. Current population number right now: N_o = _____ 2. What would the population need to be to downlist: N= _____ 3. How many more whales is that from now? _____	Use the following formula to address the growth rate over the 14 years. $N=N_o(1+r)^t$ N=population requirement to downlist N_o=current population r= rate of growth (2.3% convert to a decimal first) t= time period (days, weeks, years, etc.) Make sure you round to a whole number.
REMOVE from Endangered Species List: If the Southern Resident DPS can exhibit an increasing population trend at an average growth rate of 2.3% per year for 28 years…then it can be delisted. 4. Current population number right now: N_o = _____ 5. What would the population need to be to delist: N= _____ 6. How many more whales is that from now? _____	Use the following formula to address the growth rate over the 28 years. $N=N_o(1+r)^t$ N=population requirement to delist N_o=current population r= rate of growth (2.3% convert to a decimal first) t= time period (days, weeks, years, etc.) Make sure you round to a whole number.

Besides these target numbers, what other parameters are needed for evaluating the status of this species?

Killer Whale Recovery

High school: Government, Policy, and Management
Lesson 4: Facebook stakeholder's profile

	**Subject Area(s):** Government, policy, management, stakeholders	**Duration:** one 50 minute period
	Key words: National Marine Fisheries Service (NMFS) also known as NOAA Fisheries, Department of Fisheries and Oceans (DFO), conflict resolution, stakeholders, anthropogenic noise, necropsy, stranding network, and hydrophones	
Materials:	worksheet computers with internet access	
State Standards: WA, OR, and ID	WA: EALR 3, 9-12 APPC (choose best solution involves comparing alternatives) EALR 4, 9-11 LS2C (population growth limited by resources, size of environment, competition/predators) Social Studies EALR 1.2.3 (evaluates impacts of various forms of gov't on people) Social Studies EALR 3.2.1 (evaluates human impacts on the environment) Social Studies EALR 5.11 (analyzes consequences of an issue) OR: SS.HS.SA.04 (analyze an event, issue, problem from varied or opposed perspectives) ID: SS.9-12.E.3.2.1 (define scarcity and explain its implications in decision making)	
Focus Questions:	Now that you know the biological criteria for delisting, what actions or measures can be done to eliminate, slow down, or address the issues? And who is involved in this recovery action? What role does science, management, and community play in decision making? What economic value do killer whales provide business owners in the PNW?	
Learning Objectives:	At the end of this lesson students will be able to: • Construct understanding of conflict resolution in problem solving • Use scientific evidence and multiple perspectives to help make informed decisions and recommendations • Evaluate stakeholder's opinions and apply how public opinion matters to managers	
Engage and Encounter	Quick write on the stakeholders involved in killer whale recovery	
Explore and Investigate	Introduce the stakeholder's mock Facebook page and emphasize that this activity is intended to highlight issues, beliefs, and values that different stakeholders might have in regards to the Southern Resident killer whale population.	
Reflect and Explain	Students should be prepared to know their stakeholder and what role they play in SRKW recovery. Formulate a list of question that might be addressed to NOAA representative in lesson 5	
Apply and Extend	Compare Canada's SARA with our ESA Recovery Plan, are they aligned? Investigate organizations, academic programs, internships to further their knowledge and interest.	
Background for teacher	Due to the fact that killer whales are top predators in this marine ecosystem; this important sentinel species reflects the ocean's health. Ecosystem management addresses the target species, but also on habitat, prey, human impacts. Understanding who makes the decisions and how one gets involved is vital to establishing interconnections between humans and the environment. Resource Management in regards to how endangered species are monitored and protected are important points for the community to be aware of and potentially opportunities for stewardship actions. Understanding human impacts and problem solving with diverse constituent groups can be difficult for students if they don't research what factors influence their beliefs and values. Allowing students to familiarize themselves with killer whale recovery strategies will help them analyze and evaluate the different stakeholders in this lesson.	
Contact NOAA	For a guest speaker in lesson 5 email: **wcr.education@noaa.gov**	

Lesson 4 Procedures

SRKW Facebook stakeholder's profile: Government, Policy, Management

I. Anticipatory Set (10 minutes)

A. **Quick write:** Have the students do a brainstorming strategy known as a quick write to generate **"Who is at the table?" or "Who are the stakeholders involved in killer whale recovery? "** This might be done in a notebook or on scratch paper; a quick write challenges students to write down their ideas that first pop into their minds. Have them generate details, topics, or tap into past experiences and not focus on spelling, punctuation, or grammar. Give the students 1.5 minutes only. Topics: fishermen, whale watch boats, kayakers, biologists, managers, Federal, State, International representatives, anyone who profits from the season influx of killer whale sightings into their community (like hotels, restaurants, etc.)

B. Once done, ask the students to share their lists with a neighbor. Encourage them to develop their list (add new ones, add specificity, etc.) Share one or two groups with the whole class.

C. What economic value do killer whales provide business owners in the PNW?

II. Direct Instruction: (40 minutes)

A. **Part one:** Introduce the Facebook profile page of one of the stakeholders. Tell the students that you want to get all of the stakeholders together to discuss what policy or management strategies need to be prioritized. Ask them to imagine what these people would be like? Who would lead? What is the hierarchy in the management system and who would be present?

B. Have the students research their assigned stakeholder (use internet if possible), each one is based off a real person. Encourage the students to figure out their role in killer whale recovery. Then start filling in a "mock" Facebook page focusing on what that person does and their opinion on the threats. (25 minutes up to this point)

C. **Part two:** Next have them mingle and discover who else is at the table. Have the students find 4 "stakeholder friends" or colleague who might have similar professions or similar beliefs. Continue to emphasize how these professions are connected to recovery efforts. (10 minutes)

D. Another tip, encourage them to write fictional name AND profession (will help in lesson 5)

E. **Part three:** Tell students a little about lesson 5. The students will be in groups of three; a manager who will be in charge and then a scientist and a stakeholder. The manager will listen to both members of their group and will ultimately take that information and come up with recovery actions according to the theme they were assigned, like salmon.

F. Also encourage the students to generate a list of questions they might want to ask the NOAA representative for tomorrow. (5 minutes)

IV. Assessment:

A. Participation in class

B. Worksheet provided: SRKW Facebook Page

V. Apply/Extend:

A. Compare Canada's Species at Risk Act (SARA) with our ESA Recovery Plan to see the similarities and differences in management strategies.

http://www.westcoast.fisheries.noaa.gov/publications/protected_species/marine_mammals/cetaceans/killer_whales/esa_status/srkw-recov-plan.pdf

http://www.sararegistry.gc.ca/default_e.cfm

B. Learn more about places, organizations, or academic programs/internships to further their knowledge base and interest.

Stakeholders in Killer Whale Recovery

The Southern Resident killer whales reside in international waters, so it is paramount that the recovery efforts of this population be aligned and cooperative.

Management	Science	Community	L5
1. Canadian Department of Fisheries and Oceans manager who listed the SRKW under the Species at Risk Act (SARA).	2. NOAA scientist studying prey of killer whales (scat/poop, scales, or prey specifically)	3. Salmon sports fisherman	A
4. NOAA Fisheries manager and marine mammal specialist in charge of listing the SRKW under the Endangered Species Act(ESA)	5. Department of Fisheries and Oceans scientist studying toxins in blubber/tissue samples	6. A young college student who is allergic to fragrances and most household chemical products	B
7. The coordinator for Soundwatch (an on-the-water education program) enforcing “Be Whale Wise” guidelines	8. Scientist using underwater hydrophones to passively monitor acoustic activity or presence of whales.	9. Owner of a kayak company on San Juan Island	C
10. A San Juan Island Marine Resource Committee member who wants to increase killer whale protection	11. Canadian biologist using suction cup tags: Time, Depth Recorders (TDRs) to monitor dive profiles	12. Oil Tanker captain that navigates through Haro Strait and often sees the whales in the summer	D
13. Washington Department of Fish and Wildlife-manager who wrote the state regulations/status report	14. Biologist from the Washington Department of Fish and Wildlife who gave recommendations on the Recovery Plan	15. Seattle Aquarium worker educating patrons on top predators and sentinel species and what they can do to help	E
16. NOAA’s Salmon Recovery Manager specializing in hatchery fish	17. NOAA’s Northwest Fisheries Science Center, salmon biologist working on hydropower and salmon habitat	18. Salmon commercial fisherman	F
19. Elected official allocating money to research on southern resident killer whales	20. Canadian researcher studying genetic relations	21. A Port Supervisor who wants super fund sites in the Puget Sound addressed	G
22. NOAA or State law enforcement officer on the water monitoring vessel interactions	23. U.W. graduate student studying acoustics and impacts from anthropogenic noise on SRKW	24. Concerned citizen about the Navy’s use of sonar in the habitat and range of an endangered species	H
25. Canadian Department of Fisheries and Ocean manager who agreed to work with the US to relocate Springer, A73 to her native waters	26. Sea World’s Veterinarian who monitored Springer’s vitals (blood, blow hole culture for bacteria and ketones, urine and fecal samples for parasites	27. A child who read about Springer, A73, and has adopted a southern resident killer whale	I
28. Puget Sound Partnership member defining action items to address	29. Center for Whale Research scientist photographing whales for population census	30. Whale Museum educating its patrons on killer whale issues, research, and stewardship.	J
31. NOAA’s stranding network coordinator setting priorities to responses this upcoming year	32. NOAA’s Alaska Fisheries Science Center scientist studying the tissues, blubber, and immune system from a necropsy case	33. Land-based naturalist educating guests at a State Park about the individuals in this population	K
34. EPA official in charge of ocean and human health issues	35. Veterinarian from Wildlife Health Center studying potential infectious disease threats on resident orcas	36. Member of a Non-governmental organization interested in killer whale recovery and Puget Sound Conservation	L

****L5= You will use these letters in lesson 5 with NOAA representative**

SRKW Facebook

Home | Profile | Friends | Inbox

Stakeholder's Profile

Information

My Name:

Location:

My occupation:

Which theme on the matrix most applies to your profession?

Friends

My Wall

6 comments you might suggest for killer whale recovery

What part of the Action Plan can I do…

Killer Whale Recovery

High school: Cooperative management and Stewardship
Lesson 5: NOAA Representative: Action Plan and Stewardship

	**Subject Area(s):** management, government, community support, and stewardship	**Duration:** one 50 minute period
	Key words: debating strategies, mitigate, conflict resolution, advocate, campaign message, stewardship	
Materials:	worksheet Post Test (re-use the Pre-Test and have them add to it)	
State Standards: WA, OR, and ID	WA: EALR 1, 9-12 SYSD (systems can be changing or in equilibrium) *math connection *b A1-8B (select and apply strategies to solve problem) EALR 4, 9-11 LS2F (sustainable development) EALR 2, 9-12 INQC (explain or draw conclusions supported by evidence) OR: H.2E.4 (evaluate the impact of human activities on environmental quality) SS.HS.GE.06.01 (evaluate the consequences of economic, cultural, and environmental changes on a given population) ID: 9-10.B.1.6.2 (utilize the components of scientific problem solving to design an investigation) 9-12.G.5.1.2 (discuss the mutual impacts of ideas, issues, and policies among nations)	
Focus Questions:	In order to protect, restore, and manage…what has to happen? Once those threats are identified, how does one prioritize them in order to address recovery? How can individuals participate in killer whale recovery? Why is it important to involve different levels of governments in recovery efforts?	
Learning Objectives:	At the end of this lesson students will be able to: • Prioritize actions that could reduce human impacts and help promote recovery of this species. • Distinguish how stewardship can be individual acts or large scale community efforts	
Engage and Encounter	A NOAA scientist or manager will introduce themselves and explain their role in killer whale recovery	
Explore and Investigate	Problem solve in groups actions that could address the threats criteria of the recovery plan and make recommendations	
Reflect and Explain	Summarize this whole curriculum and emphasize how individuals and community groups, science, and managers can work together.	
Apply and Extend	Stewardship Challenge: Create a campaign, get involved in a stewardship activity, and share what you accomplished.	
Background for teacher	The oceans and humans are inextricably interconnected; humans affect the ocean in a variety of ways. Laws, regulations, and resource management affect what is taken out and put into the ocean. This lesson is intended to empower the community to participate in the decision making process and having a voice is vital to the success of conservation and recovery of endangered and threatened species. We believe that people of any age and in any geographic region can make a positive impact on the marine environment. We hope to strengthen the link between scientific knowledge, resource management and being active stewards in their environment.	
NOAA and Teacher	Thank the teacher for piloting. Remind or give another copy of evaluation to the teacher; collect or photo copy both the Pre-Post Test and Lesson 5 if possible. Please send back Pre/Post tests if possible and evaluation to **wcr.education@noaa.gov**	

Lesson 5 Procedures:

NOAA Representative: Stewardship and Problem Solving using Delisting Criteria

I. Anticipatory Set: (10 minutes)

A. Introduce yourself and share what role you play in killer whale recovery.
B. Ask if there are any questions that arose from prior lessons that might be addressed before today's activity on recovery strategies.

II. Direct Instruction: (40 minutes)

A. **Share the logistics of how this activity works:** Tell students that they will be working in groups of three today, their letter group. In that group, there will be a manager, a scientist, and a community member.
B. The student who is the manager in their letter group will be guiding today's activity. This student will pick up their groups' delisting criteria from the NOAA representative and be in charge of writing down all of the comments and suggestions their group comes up with. Both the scientist and the community member can propose what actions they want to address in recovery efforts, but ultimately the final decision or solution will come down to the manager.
C. Students will have 7-8 minutes to work on the Action Plan to propose solutions, evaluate the options, and make recommendations based on scientific evidence or sound practices. On worksheet, if students use fictional names, encourage titles too.
D. Supervise and walk around the room to prompt ideas, give minor suggestions if you see them struggling. This would be a good time to hand out any brochures to help the stakeholders or provide more insight on who these stakeholders are.
E. Remind the managers to be thoughtful listeners, problem solvers, and to use negotiating strategies when necessary. Students might need to compromise, but most importantly keep the whales health the top priority.
F. Present recommendations from each team, less than 45 sec each (12 min total)
G. Wrap up (15 minutes)
   Ask students how education and stewardship can play a vital role in recovery. Take them back through each lesson and highlight what they've learned and be open to any questions.
   1. Lesson 1: social organization, longevity, mortality
   2. Lesson 2: comparison between NRKW and SRKW
   3. Lesson 3: Issues (comment on their thoughtful recovery recommendations from today's lesson was evident of how they understand the issues) Ask them what the population is currently and what it needs to be to delist if the population increases at a rate of 2.3% for the next 28 years.
   4. Lesson 4 and 5: Emphasize that all of us can make a difference.
H. Lastly, emphasize stewardship and how NOAA would like to promote your efforts within our watershed.

III. Assessment:

A. Participation in class activity
B. Worksheet provided
C. Post-Test (go back to Pre-Test and have students answer the questions again)

IV. Apply/Extend:

A. **Stewardship Challenge:** There is a stewardship action on each Killer Whale Trading Card, have students reflect or brainstorm other ways to share what they have learned about this endangered population of whales.
B. Again, NOAA would like to celebrate your stewardship efforts toward killer whale recovery. Let us know what you have accomplished.

<table>
<tr><td> 
Killer Whale Action Plan
Recovery Plan section IV-1 through 11
Threats delisting criteria: Recovery Plan section IV-3, IV-6-8</td><td>Group letter:

Manager’s title:
Scientist title:
Community member:</td></tr>
<tr><td colspan="2">Goal: Remove from Endangered Species List or delist them from endangered to threatened as a first step.
Objectives: How are you going to do it? What actions will be established to address the biological and threats criteria.
Threats delisting criteria:</td></tr>
<tr><td rowspan="2">1st solution:</td><td>Pros</td></tr>
<tr><td>Cons</td></tr>
<tr><td rowspan="2">2nd solution:</td><td>Pros</td></tr>
<tr><td>Cons</td></tr>
<tr><td rowspan="2">3rd solution:</td><td>Pros</td></tr>
<tr><td>Cons</td></tr>
<tr><td>Prioritize them and then choose one solution:</td><td>Make a plan of how this will be accomplished: Recommendation

Who is going to do this task(s)?</td></tr>
<tr><td>When will you evaluate or monitor the progress:

How long will it take?</td><td>What adjustments could be made:</td></tr>
</table>

Stewardship Challenge: How can you inspire others to make a difference?
Ocean Literacy Principle: The oceans and humans are inextricably interconnected

On each of the killer whale trading cards there is a stewardship action. How many of those actions do you think you already do or might consider trying?	**Your challenge** is three-fold. The first is to come up with a campaign message, a way to promote one or more of the stewardship actions on a larger scale. You will want to raise awareness about the health of our watersheds and inspire others to take care of it. The second challenge is to participate in a large scale stewardship action or event and the third challenge is to share what you did to help recover killer whales and their habitat and inspire others to participate.
Challenge #1 *"Create a Campaign"* 65 points total	1. Categorize the stewardship actions from the trading cards or come up with your own. 2. Sort the trading cards by scale: what can be done at home; projects that your school could participate in, and community projects. Decide as a class how you can cover most of the topics. Work in groups of 2-3 to produce a campaign message that raises awareness, educates, or motivates action to promote killer whale recovery. 3. Evaluate how your campaign worked and show evidence of your original goal.
Challenge #2 *"Participate in or organize a stewardship event"* 25 points total	How can you and your classmates participate in a large scale stewardship action or event that promotes healthy watersheds (rivers, streams, Puget Sound), salmon, or killer whales. You could partner with organizations that might be doing something within your community. Or you can organize an event that encourages your community to help or support your efforts. If there are school clubs or events that the school already participates in this might be a perfect opportunity to partner with; or recruit people to partake in an activity or help out; or create a challenge for your community or neighboring high school to participate in an event or activity.
Challenge #3 *"Share your Stewardship Efforts"* 10 points total	The third challenge is to share what you did to help recover killer whales and/or their habitat and inspire others to take these challenges. When highlighting your success share how your campaign influenced your target audience and your stewardship actions. NOAA would like to hear how your efforts help support killer whale recovery and want to celebrate your efforts.

Team members: _____ Period: _____

Stewardship Challenge #2 and #3

Ocean Literacy Principle: The oceans and humans are inextricably interconnected

Challenge 1

Phase 1: **10 points**	Phase 2: **10 points**	Phase 3: **25 points**	Phase 4: **10 points**	Phase 5: **10 points**	Challenge 1 **Total points**
Have teacher approve your goal, objectives, and target audience. Due:	Draft message, mascot, format, and distribution. Due:	Final product (video, cartoon to be placed by garbage/recycling bins, etc.) Due:	Plan for how you will follow up or evaluate that your campaign worked. Due:	Proof or evidence that your campaign raised awareness or produced stewardship actions that will ultimately protect the marine environment and orcas. Due:	/65

Challenge 2: Summarize what activity you organized or participated in.

	Challenge 2 **Total points**
X _____ signature of activity coordinator	/25

Challenge 3: Who did you share your success with?

	Challenge 3 **Total points**
Attach evidence that you shared your work with others (email, photos, etc.)	/10

Killer Whale Recovery Action Items (cut by row and hand to appropriate group of three)

Group Letter: A Management: Canadian manager (#1) Science: NOAA salmon scientist (#2) Community: Salmon sports fisherman (#3)	Read the Goal and objectives of the Action Plan and fill in the worksheet with the following information. Threats delisting criteria: Rebuild depleted population of **salmon** (largest historical Chinook stock) in regards to **harvest**
Group Letter: B Management: NOAA manager listed ESA (#4) Science: DFO toxins in blubber scientist (#5) Community: Allergic college student (#6)	Read the Goal and objectives of the Action Plan and fill in the worksheet with the following information. Threats delisting criteria: Minimize pollution and **chemical** contamination
Group Letter: C Management: Soundwatch coordinator (#7) Science: Acoustics scientist (#8) Community: Kayak company owner (#9)	Read the Goal and objectives of the Action Plan and fill in the worksheet with the following information. Threats delisting criteria: Minimize disturbances from **vessels**
Group Letter: D Management: San Juan Island Marine Resource Committee member (#10) Science: Canadian biologist TDRs (#11) Community: Oil Tank captain (#12)	Read the Goal and objectives of the Action Plan and fill in the worksheet with the following information. Threats delisting criteria: Minimize the risk of **oil spills**
Group Letter: E Management: WA Dept. of Fish & Wildlife manager (#13) Science: Biologist with WDFW (#14) Community: Seattle Aquarium educator (#15)	Read the Goal and objectives of the Action Plan and fill in the worksheet with the following information. Threats delisting criteria: Develop **educational or outreach tools** to increase awareness
Group Letter: F Management: NOAA recovery manager (#16) Science: NOAA salmon biologist/dams (#17) Community: Commercial salmon fisherman (#18)	Read the Goal and objectives of the Action Plan and fill in the worksheet with the following information. Threats delisting criteria: Rebuild depleted populations of **salmon** in regards to **habitat** (fresh and salt water ecosystems)
Group Letter: G Management: Elected official allocating $ (#19) Science: Canadian genetic researcher(#20) Community: Port Supervisor-superfund site (#21)	Read the Goal and objectives of the Action Plan and fill in the worksheet with the following information. Threats delisting criteria: Minimize pollution and **chemical** contamination in marine sediments

Group Letter: H Management: Enforcement officer/vessels(#22) Science: UW grad student/acoustics (#23) Community: Concerned citizen use of sonar/ seismic surveys on habitat (#24)	Read the Goal and objectives of the Action Plan and fill in the worksheet with the following information. Threats delisting criteria: Minimize **sound** from all sources
Group Letter: I Management: Canadian manager- A73 (#25) Science: Sea World Vet/Springer (#26) Community: Child who read about Springer (#27)	Read the Goal and objectives of the Action Plan and fill in the worksheet with the following information. Threats delisting criteria: **Transboundary** and Interagency coordination and cooperation in recovery efforts
Group Letter: J Management: Puget Sound Partnership (#28) Science: Center for Whale Research (#29) Community: Whale Museum (#30)	Read the Goal and objectives of the Action Plan and fill in the worksheet with the following information. Threats delisting criteria: Develop public information and **education** programs
Group Letter: K Management: NOAA stranding network (#31) Science: NOAA's necropsy scientist: (#32) tissue, blubber, immune system Community: Naturalist educating public (#33)	Read the Goal and objectives of the Action Plan and fill in the worksheet with the following information. Threats delisting criteria: Respond to **stranded,** sick, injured, isolated, and possible threat to public
Group Letter: L Management: EPA official (#34) Science: Veterinarian (#35) Community: Non-Governmental organization (NGO) member killer whale recovery (#36)	Read the Goal and objectives of the Action Plan and fill in the worksheet with the following information. Threats delisting criteria: Monitor and minimize the risk of **infectious diseases**

HINT: If you have a group of two, join that group. If you have a group of one, add them to another group. You might not have 36 students in your class, but these are written in order of importance, so start with A. If you have more than 36 students, double up to accommodate.