# 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

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

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

<table>
<thead>
<tr>
<th>Name:</th>
<th>NOAA Representative:</th>
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<tr>
<td>School:</td>
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<td>Class(s) you teach:</td>
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<tr>
<td>Grade level:</td>
<td>Visit date:</td>
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## Lessons 1-4 Evaluation

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Was there enough background information to complete the lessons?</td>
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<tr>
<td>Were the instructions for the lessons easy to follow?</td>
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<td>Was the time estimated for each lesson appropriate?</td>
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<tr>
<td>Did the worksheets support the activities?</td>
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<td>Was the information age-appropriate?</td>
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<tr>
<td>Were the students successful accomplishing the lessons using the websites?</td>
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<tr>
<td>Would you be interested in teaching this again?</td>
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<tr>
<td>How did you adapt any these lessons to your students?</td>
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<tr>
<td>How would you describe student engagement in these lessons?</td>
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## Lesson 5 Evaluation

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<tr>
<th>Question</th>
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<tbody>
<tr>
<td>What did the NOAA representative do well?</td>
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<tr>
<td>What advice might you give this person who might visit other classrooms?</td>
<td></td>
</tr>
</tbody>
</table>

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
### 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: 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.

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).

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.nwfs.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.
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

<table>
<thead>
<tr>
<th>Comparison to other whales or animals (7 trading cards)</th>
<th>Vocalizations, sound and other senses (7 trading cards)</th>
</tr>
</thead>
<tbody>
<tr>
<td>K36 mammals</td>
<td>L103 vocalizations</td>
</tr>
<tr>
<td>J36 toothed whales</td>
<td>J32 calls</td>
</tr>
<tr>
<td>J37 dolphin</td>
<td>K27 echolocation</td>
</tr>
<tr>
<td>J39 size</td>
<td>L74 hearing</td>
</tr>
<tr>
<td>K16 size comparison to other whales</td>
<td>L54 ears</td>
</tr>
<tr>
<td>L7 look alikes</td>
<td>L41 smell</td>
</tr>
<tr>
<td>K22 similar to elephants</td>
<td>J41 tactile</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Body plan and ID. features (12 trading cards)</th>
<th>Swimming, dive behaviors, surface active behaviors (17)</th>
</tr>
</thead>
<tbody>
<tr>
<td>L26 skeleton</td>
<td>L83 traveling</td>
</tr>
<tr>
<td>J31 brain</td>
<td>L72 porpoising</td>
</tr>
<tr>
<td>K35 mouth and teeth</td>
<td>L27 speed</td>
</tr>
<tr>
<td>L91 jaws</td>
<td>K33 dive depths</td>
</tr>
<tr>
<td>L5 melon</td>
<td>L88 dive times</td>
</tr>
<tr>
<td>L100 blow hole</td>
<td>J8 blows</td>
</tr>
<tr>
<td>L95 pectoral fin</td>
<td>J28 resting</td>
</tr>
<tr>
<td>K34 flukes</td>
<td>K13 spying</td>
</tr>
<tr>
<td>J40 countershading</td>
<td>K14 lunge</td>
</tr>
<tr>
<td>J27 saddle patch</td>
<td>L84 cartwheel</td>
</tr>
<tr>
<td>J1 fin size</td>
<td>L82 breaching</td>
</tr>
<tr>
<td>L47 dorsal fin</td>
<td>L85 backdive</td>
</tr>
<tr>
<td></td>
<td>L105 tail lob</td>
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<td></td>
<td>L55 fluke wave</td>
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<tr>
<td></td>
<td>L106 kelping</td>
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<tr>
<td></td>
<td>L53 play</td>
</tr>
<tr>
<td></td>
<td>J26 greeting ceremony</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Diet and foraging (5 trading cards)</th>
<th>Distribution, habitat, and range (4 trading cards)</th>
</tr>
</thead>
<tbody>
<tr>
<td>L12 food chain</td>
<td>K38 distribution</td>
</tr>
<tr>
<td>L77 salmon</td>
<td>L78 summer and winter</td>
</tr>
<tr>
<td>L79 hunting</td>
<td>K21 fall in Seattle</td>
</tr>
<tr>
<td>J17 beneath the surface</td>
<td>L73 viewing orcas</td>
</tr>
<tr>
<td>J33 predator/prey</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Social organization (9 trading cards)</th>
<th>Identifying individuals, birth, and age expectancy (9)</th>
</tr>
</thead>
<tbody>
<tr>
<td>K20 residents</td>
<td>L66 research names</td>
</tr>
<tr>
<td>L94 transients</td>
<td>L89 nick names</td>
</tr>
<tr>
<td>L87 offshores</td>
<td>J42 naming</td>
</tr>
<tr>
<td>K37 clan</td>
<td>J34 names</td>
</tr>
<tr>
<td>J35 pod</td>
<td>J2 longevity</td>
</tr>
<tr>
<td>J38 matrilines</td>
<td>J19 mom and baby</td>
</tr>
<tr>
<td>K12 extended families</td>
<td>J16 at birth</td>
</tr>
<tr>
<td>L2 new pods</td>
<td>L108 coloration at birth</td>
</tr>
<tr>
<td>K11 super pod</td>
<td>L110 nursing</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Status and human interactions/impacts (5 trading cards)</th>
<th>Conservation (6 trading cards)</th>
</tr>
</thead>
<tbody>
<tr>
<td>L92 research</td>
<td>K25 watershed</td>
</tr>
<tr>
<td>L90 endangered</td>
<td>K40 rivers</td>
</tr>
<tr>
<td>L25 toxins</td>
<td>K26 watch from shore</td>
</tr>
<tr>
<td>L109 captures</td>
<td>A73 whale rescue</td>
</tr>
<tr>
<td>J14 First Nations</td>
<td>J30 Killer Whale Tales</td>
</tr>
<tr>
<td></td>
<td>L22 Be Whale Wise</td>
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</tbody>
</table>
Factors that influence population size
How does the size of a population influence genetic diversity?

<table>
<thead>
<tr>
<th>What factors might cause an increase in population?</th>
<th>What factors might cause a decrease in population?</th>
<th>What qualifies as a stable population?</th>
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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.

**Graph 1**

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).

**Graph 2**

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?
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 0.1-1.7% 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 matriline) or to have the students learn about a new matriline 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.nwfsoc.noaa.gov/research/divisions/cb/ecosystem/marinemammal/index.cfm
# Killer Whale Trading Card Activity Part 2

## Population demographics

### Part 1: Matriline Data

How many generations of whales are in this matriline?

Divide your matriline into males and females, then by age classes.

1. **How many juveniles (3-14 years old)?**
   - 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)?

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?

4. **Total number of whales in your matriline?**

### Part 2: Pod Data

Tally this information for the whole pod.

1. **How many juveniles (3-14 years old) in the whole pod?**
   - Total:

2. **How many reproductive females (15-45 years old)?**
   - Total:

3. **How many post-reproductive females (46 years and older)?**
   - Total:

4. **How many adult males (15 years and older)?**
   - Total:

5. **How many whales in this pod?**
### Part 3: Southern resident population data (whole class)
Quantitative measures for population parameters include:

<table>
<thead>
<tr>
<th>Do you have representation from at least three pods?</th>
<th>Yes</th>
<th>No</th>
<th>Why is this critical?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Are there more than two reproductive age males in each pod or information that fewer males are sufficient?</td>
<td>Yes</td>
<td>No</td>
<td>Why is this critical?</td>
</tr>
<tr>
<td>Find the current population size of the Southern Resident killer whales (you will use this below)</td>
<td>J</td>
<td>K</td>
<td>L</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>A ratio of the following in comparison to Northern Resident population:</th>
<th>Total Number currently</th>
<th>Total population</th>
<th>% Currently</th>
<th>Target</th>
<th>Are we close to the target?</th>
<th>Too high</th>
<th>Too low</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of juveniles (3-14 years old)</td>
<td></td>
<td></td>
<td></td>
<td>47%</td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td># of reproductive females (15-45 years old):</td>
<td></td>
<td></td>
<td></td>
<td>24%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td># of post-reproductive females (46 years and older)</td>
<td></td>
<td></td>
<td></td>
<td>11%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td># of adult males (15 years old and older)</td>
<td></td>
<td></td>
<td></td>
<td>18%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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?**

<table>
<thead>
<tr>
<th>Subject Area(s):</th>
<th>Look at factors or threats impacting population size and calculate ideal population size</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Duration:</strong></td>
<td>one – two 50 minute period(s)</td>
</tr>
<tr>
<td><strong>Key words:</strong></td>
<td>bioaccumulation, biomagnifications, PCBs, PBDEs, persistent organic chemicals, immune disruptors, acoustic impacts exponential growth, delisting criteria, inter-birth intervals, exponential functions, recruitment</td>
</tr>
</tbody>
</table>

| **Materials:**    | worksheet, computer access with internet |

| **State Standards:** | 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) |
| **WA, OR, and ID:** | |

| **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? |

<table>
<thead>
<tr>
<th><strong>Learning Objectives:</strong></th>
<th>At the end of this lesson students will be able to:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Discuss how the three threats together are interrelated</td>
</tr>
<tr>
<td></td>
<td>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</td>
</tr>
<tr>
<td></td>
<td>Explain that a recovery plan lays out goals, objectives, and criteria to follow and problem solve the issues</td>
</tr>
</tbody>
</table>

| **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)


### TOP three threats facing the Southern Resident killer whale population

<table>
<thead>
<tr>
<th>Threat</th>
<th>Information</th>
<th>Impact on Whales</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prey availability</td>
<td>What do we know about salmon...</td>
<td>What does it mean for the whales?</td>
</tr>
<tr>
<td>Environmental contaminants</td>
<td>What do we know...</td>
<td>What does it mean for the whales?</td>
</tr>
<tr>
<td>Vessel effects and sound</td>
<td>What do we know...</td>
<td>What does it mean for the whales?</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>DOWNLIST from Endangered status to Threatened status:</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
</tr>
<tr>
<td>1. Current population number right now: ( N_0 = ) ____________</td>
</tr>
<tr>
<td>2. What would the population need to be to downlist: ( N = ) _____</td>
</tr>
<tr>
<td>3. How many more whales is that from now? ____________</td>
</tr>
</tbody>
</table>

**Use the following formula to address the growth rate over the 14 years.**

\[
N = N_0(1+r)^t
\]

- \( N \)=population requirement to downlist  
- \( N_0 \)=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.

<table>
<thead>
<tr>
<th>REMOVE from Endangered Species List:</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
</tr>
<tr>
<td>4. Current population number right now: ( N_0 = ) ____________</td>
</tr>
<tr>
<td>5. What would the population need to be to delist: ( N = ) _____</td>
</tr>
<tr>
<td>6. How many more whales is that from now? ____________</td>
</tr>
</tbody>
</table>

**Use the following formula to address the growth rate over the 28 years.**

\[
N = N_0(1+r)^t
\]

- \( N \)=population requirement to delist  
- \( N_0 \)=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

<table>
<thead>
<tr>
<th>Subject Area(s):</th>
<th>Government, policy, management, stakeholders</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Duration:</strong></td>
<td>one 50 minute period</td>
</tr>
<tr>
<td><strong>Key words:</strong></td>
<td>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</td>
</tr>
</tbody>
</table>

**Materials:**
worksheet  
computers with internet access

**State Standards:**
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.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.

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

**L5= You will use these letters in lesson 5 with NOAA representative**
What part of the Action Plan can I do...

My Wall
6 comments you might suggest for killer whale recovery
# Killer Whale Recovery

**High school: Cooperative management and Stewardship**

**Lesson 5: NOAA Representative: Action Plan and Stewardship**

<table>
<thead>
<tr>
<th><strong>Subject Area(s):</strong></th>
<th>management, government, community support, and stewardship</th>
<th><strong>Duration:</strong> one 50 minute period</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Key words:</strong></td>
<td>debating strategies, mitigate, conflict resolution, advocate, campaign message, stewardship</td>
<td></td>
</tr>
</tbody>
</table>

**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

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**Lesson 5 Procedures:**

High school killer whales

NOAA WCR: Lesson 5

Page 1 of 2
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.
### Killer Whale Action Plan

**Recovery Plan section IV-1 through 11**

**Threats delisting criteria:**  Recovery Plan section IV-3, IV-6-8

| **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:**

<table>
<thead>
<tr>
<th>Solution</th>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>1&lt;sup&gt;st&lt;/sup&gt; solution:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2&lt;sup&gt;nd&lt;/sup&gt; solution:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3&lt;sup&gt;rd&lt;/sup&gt; solution:</td>
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</tbody>
</table>

Prioritize them and then choose one solution:

Make a plan of how this will be accomplished: **Recommendation**

Who is going to do this task(s)?

When will you evaluate or monitor the progress:

What adjustments could be made:

How long will it take?
**Stewardship Challenge:** How can you inspire others to make a difference?

**Ocean Literacy Principle:** The oceans and humans are inextricably interconnected

<table>
<thead>
<tr>
<th>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?</th>
<th><strong>Your challenge</strong> 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.</th>
</tr>
</thead>
</table>
| **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. |
<table>
<thead>
<tr>
<th>Challenge 1</th>
<th>Challenge 2</th>
<th>Challenge 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Phase 1:</strong></td>
<td><strong>Challenge 2:</strong> Summarize what activity you organized or participated in.</td>
<td><strong>Challenge 3:</strong> Who did you share your success with?</td>
</tr>
<tr>
<td>10 points</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Have teacher approve your goal, objectives, and target audience.</td>
<td></td>
<td>Attach evidence that you shared your work with others (email, photos, etc.)</td>
</tr>
<tr>
<td>Due:</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Phase 2:</strong></td>
<td></td>
<td></td>
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<tr>
<td>10 points</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Draft message, mascot, format, and distribution.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Due:</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Phase 3:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25 points</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Final product (video, cartoon to be placed by garbage/recycling bins, etc.)</td>
<td></td>
<td></td>
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<tr>
<td>Due:</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Phase 4:</strong></td>
<td></td>
<td></td>
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<tr>
<td>10 points</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plan for how you will follow up or evaluate that your campaign worked.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Due:</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Phase 5:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 points</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proof or evidence that your campaign raised awareness or produced stewardship actions that will ultimately protect the marine environment and orcas.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Due:</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Challenge 1 Total points</strong></td>
<td><strong>Challenge 2 Total points</strong></td>
<td><strong>Challenge 3 Total points</strong></td>
</tr>
<tr>
<td>/65</td>
<td>/25</td>
<td>/10</td>
</tr>
</tbody>
</table>

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

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

**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.