



INTERACT EDUCATIONAL TOOL-KIT

ARCTIC INVASIONS!

WORKSHEET for STUDENTS



TASK 1. DIGGING DEEP

Use the internet critically to find the most correct answers. Along with your answer, give the source of the information. The more scientific and original source, the better.

Q1: How many invasive species are there in the Arctic?

Q2: Why do scientists believe more invasive species will invade the Arctic in the future?

Q3: How can invasive species be transported and released in new geographical regions?

Q4: What can YOU do to avoid the spread of invasive species?

Q5: What are some of the consequences of invasive species?



TASK 2. MATCH IT

Match the terms on the left to definitions on the right.

Terms

Definitions

Biodiversity

Is not native to the area

Invasion pathway

All the different kinds of life you'll find in one area

Food web

The means and routes by which invasive species get into new environments

Invasive species

Consists of all food chains in an ecosystem

Exotic species

Each and any species are part of multiple ...

Food chains

Is not native to the area, but still gets a dominant role



TASK 3. WORD SALAD

Below are some terms used in the lectures. Try to find them in the smiley!

ARCTIC
BROWN TROUT
ECOLOGY
KING CRAB
PEARL MUSSEL
SOIL

BALLAST WATER
CLIMATE CHANGE
GENETIC DIFFERENTIATION
MITES
PET TRADE
SPRINGTAILS

BIODIVERSITY
COMPETITION
INVASIVE
NEMATODES
PINK SALMON

S T N S P S C A S K
S S Y Y V B P B U F K F Z C Z M
T X N J H U Q G D I R A J E N P I J P I
Z A A L D W F M S G O X J K P P H D W I K P
L V Q U C Q A T I T J Y D O U E W Z D X O N D F L K
S C M C G R K G T I Y P H I P W F D R S Z L F Z H N I H
Q L R G L A B G E S Q N R K V C O M P E T I T I O N M X O K
Q I I S Z Y H R S P U S G C S E B L J V U Q Q G M I B I U N S P
Y E A U U T Z P U E H R H T V J H U M Y K V Q W
P U E T T P Y N V M P B S T E F G R B M J U V A X P
H M K M G K G Y T P M D V I Z Q E H R S J Z R H T N S Q
O J R Y N R Z R B E M R X T H A I J B V M F S M S O T X
M H R K Q I E T Q M A F M E Y O R W D M L P Y G V I I C O Y
F C D C Q R T O D X R Q P G K Q D R A B F Q N F Z A T W B W
T F Q X M P A F X O L D I N E L V W I C Z H T A E E A K Q U
A J Q O F Q S W P N J M O U A G J M P P W H R T P L K I F L T E
C H K C E C T T I X G U D Z I U Z O H G D K I N G C R A B K I B Y F A T D Q U T
O P O T C H T S N L H S G M W Z P R C W Z R R I J W G F K X I F K H O N B W O I
V E D R F B V A K X Q S N W Z A X S E H F D A V M K G E F P Q I Q R O E N Y R Z
K T M Z R H I L S V U E O V F N P P T A W G Q P T N E S S S Z G J Z C R G G T G
P T E E R A D L A L J L X L H Z R R A L Q O R I X D B Q M O R Q U B C E N O N P
K R M E K N H A L H A I J O R H U J M E C W X Z R K K H V Z L T K V X F U L W X
N A K S N L D B M D K Q G Q L W O S I T S K R A S I F C V W L C N T Y F Q O O N
L D Y E U M Y O P Y B L F V N O B L I O I E P V N U G I Q Y E A H I X C R D
Q E P V C Y U N A T Z D W O T Y P C P W H Y I S I Z J M M I Y Z K D D E B E
U H I K Y J K T E F J B V S Y F C G N K Y G P V U G Q C V Q C N G J
K A S V G N N G E W Q F Z F A Y L B O T G U M X I X C N I L G N
O D A K E C L L T C K K
K V T Z I W D S E G V
B N U R T F R T X L N O T
I F Q C H W U L N M I E W
P Y Z R O L K X V E Y E W G W
D R A M R R O A H I N T I F I A K W J M P M F X O P M B W O Z J
G I U M H D H W T A C W N C R C R B O Y D I P G A S G Q S K
S I Y A D H G D L Q U H L H R W J X P H W V T M R N U J
H X P U P Q G O T S T K F H W N B E R C O W H V Q V
M E I Q P L I V S W B P A E W U D K D P B E L S
K J L A D M P B E C T K X O Y E C R K T
B P N Y E Z G X J W J W S K M W
I C D R A W O G J X



TASK 4. OH' ALL THE CHOICES

Tick the correct answer(s). Sometimes there's more than one.

1. Why are invasive species so successful?

- ☐ They often have high reproduction rates
- ☐ People like them, bring them to the area and throw a nice party for them
- ☐ They are often generalists that can survive in a wide range of conditions
- ☐ All of the above.

2. How much of the global biodiversity is found in soil?

- ☐ 10%
- ☐ 25%
- ☐ 50%
- ☐ 75%

3. Why do we know so little about soil organisms?

- ☐ Few taxonomic experts able to identify soil species
- ☐ They hide very well
- ☐ Research focus has been on species aboveground
- ☐ They are too fast to be captured

4. What is an example of a social impact of invasive species?

- ☐ Local businesses have financial losses because tourists do not visit the area
- ☐ They are no longer liked and not invited to parties anymore.
- ☐ An invasive species can give increased income as they are seen as a delicacy.
- ☐ All of the above.

5. Some people feed goldfish in park ponds. What do you think about that?

- ☐ I think, this is a good idea. If we feed them, they will not compete for food sources with other species and therefore, even though they are invasive in many places, they will do no harm.
- ☐ I think this is a bad idea. Feeding them helps them survive and reproduce in areas where they are dangerous to the environment.
- ☐ Well, it can't hurt to feed them. They are cute and if people are enjoying them, then there is nothing wrong with a snack.
- ☐ I agree with both the first and the third statement.



TASK 5. DO YOU KNOW'EM?

We have discussed several invasive species that are found in northern regions and the Arctic. Can you identify them based on only the pictures below?





TASK 6. WANTED - DEAD OR ALIVE!

Here are some invasive species that we have not talked about in the lectures. Search the internet for clues and complete the missing species form.

WANTED

DEAD OR ALIVE

Species name:

Photo of the culprit



Crimes:

Features (morphology)

Last seen (origins and current distribution)

Originally native to subtropical & temperate South America, it has since been introduced primarily by fur farmers to North America, Europe, Africa, and Asia.

Suspected hideouts (habitats, bite marks, and tracks)

WANTED

DEAD OR ALIVE

Species name:

██████████ wort

Photo of the culprit!

Crimes:

It is a prolific achene producer and has a vigorous growth and contains pyrrolizidine alkaloids, which are toxic to livestock and other mammals.

Features (morphology)

Last seen (origins and current distribution)

Suspected hideouts (habitats, bite marks, and tracks)

WANTED

DEAD OR ALIVE

Species name:

Photo of the culprit!

Crimes:

Features (morphology)

Have reddish eyes, and their bills are grey with a conspicuous off-white cere. Look out for the red feet! They are masters of disguise because they can look very different in different geographical regions!

Last seen (origins and current distribution)

Suspected hideouts (habitats, bite marks, and tracks)

Wild nesting sites include caves, canyons, and sea cliffs. They will even live in the Sahara so long as an area has rocks, water, and some plant matter. They prefer to avoid dense vegetation. Feral [REDACTED] are usually unable to find these accommodations, so they must nest on building ledges, walls or statues. Their feces may damage these structures, as they over time corrodes masonry and metal.

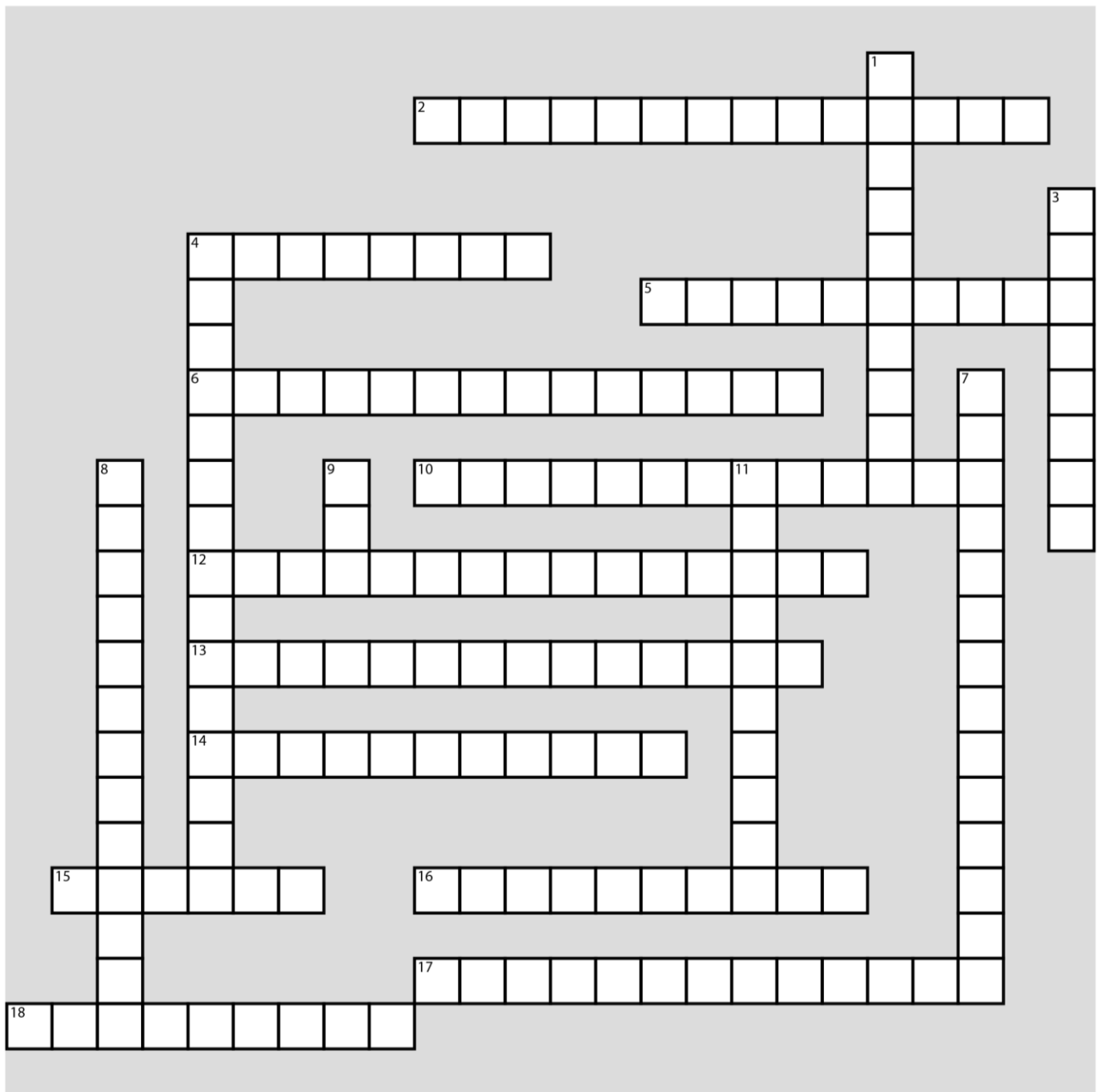


TASK 7. THE EARTH PUZZLE

Below your feet is a huge mysterious world, which plays a big role in the consequences of invasive species. Fill in the crossword the correct terms based on the definitions provided. Some terms consist of two words but in the crossword, these are written as one word to challenge you a bit extra.

- 1) Organisms that can eat very different food
- 2) The process in which energy from the sun and carbon dioxide from the air is used by green plants to generate carbohydrates (sugar)
- 3) The most abundant element in our atmosphere
- 4) (down) Consequence of invasive species in terms of number of species in the area
- 4) (across) The process by which substances, like nitrogen, are leaking from soil into aquatic systems or groundwater
- 5) Organisms that can eat only one or a few types of food
- 6) Using other microorganisms or tiny living creatures to eat and break down pollution to clean a polluted site
- 7) When microbes act on dead organic material, such as animal poo or decomposing plants or dead animals and convert its chemical components, like nitrogen, to a form that can be absorbed by plant roots to create new life
- 8) A very tiny living thing, like a bacterium or virus
- 9) Carrier of genetic/ hereditary information
- 10) Smelly algae (but not only bad)
- 11) Substances that contain nitrogen and hydrogen and are building blocks for creating cells, organs, muscles, and tissue
- 12) Organisms from another region that do not belong in their new environment, but still spread a lot
- 13) Excessive amount of nutrients (especially nitrogen) in a lake or other waters, which causes a dense growth of aquatic plantlife, such as algae
- 14) All the links indicating who eats whom or what in soil
- 15) Protein that can break down large and complex molecules into smaller and simpler molecules
- 16) An industrial or natural substance added to soil or land to increase its fertility
- 17) The breaking down of organic matter like dead leaves into soil
- 18) Interaction between two different organisms living in close physical association, typically to the advantage of both

The Earth Puzzle!





TASK 8. THE MULTIPLYING MUSKRAT

How fast can an invasive species population grow? Bring out your math brain if you have one to calculate and graph the growth rate of this muskrat population. If you don't have a math brain, don't worry, your brain has other qualities and life can be good anyways.

Basic level

Assuming no external forces (e.g., no hunting, predation, or extreme weather events) affect the muskrat population, calculate the population size over a period of three years and then prepare a graph showing the changes in population size and number of offspring.

Scenario: One female muskrat and one male muskrat were released in your neighbourhood. In year 1, this female will give birth to 6 surviving young in each of 3 litters. We assume that each litter has an equal number of females and males in it and that each females gives birth to the same number of young each time (this is not how it happens in nature, but for the exercise we must simplify a bit). We also assume that no muskrats die within the three years, and that there are no muskrats migrating into or out of the population.

Start with year 1.

1. What is the number of initial females?
2. Calculate the total number of muskrats born in year 1.
3. How many of those total young are female muskrats?

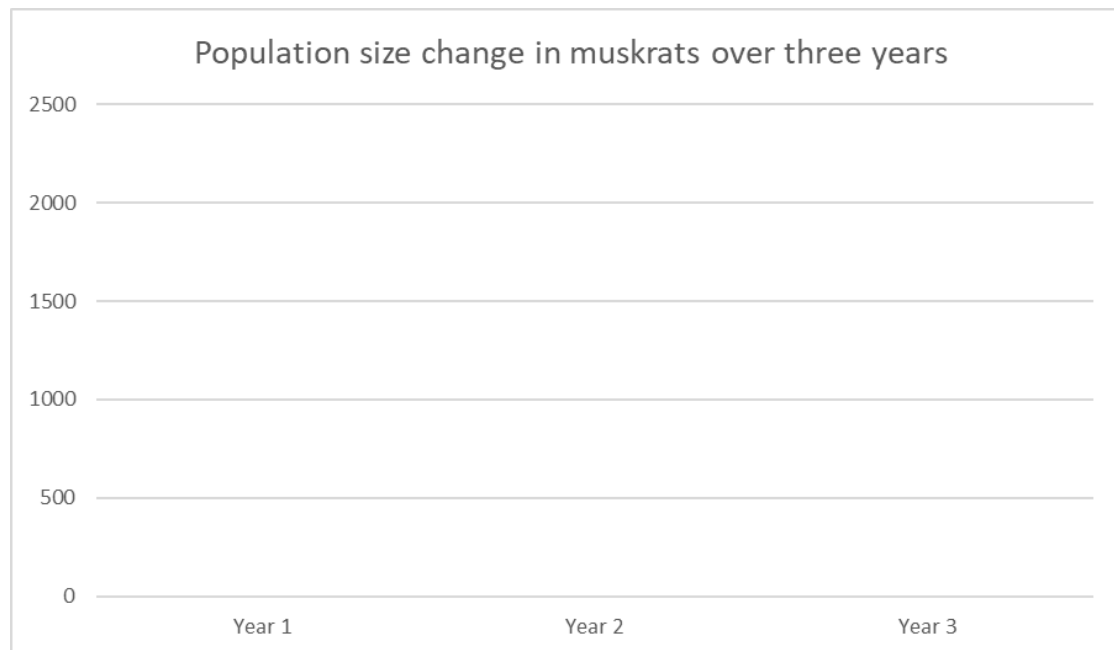
Move into year 2

4. Calculate the total number of female muskrats after year 1, keeping the initial female(s) in mind.
5. Females are 50% the muskrat population. How many muskrats are there in total after year 1?
6. What is the number of initial females in the second year?

With these calculations in mind, fill in the rest of the table.

	Year 1	Year 2	Year 3		
Initial females					
Total number of born					
Females born					
Total females					
Total number of muskrats					

Make your own graph or draw on the premade graph below.



Discussion questions (for both basic and advanced level)

1. Based on the information given in this exercise and the model assumptions as well as calculations - how realistic is this model?
2. How likely is it that the population will stay isolated (no immigration or emigration)?
3. What factors in addition to predation could limit population growth?

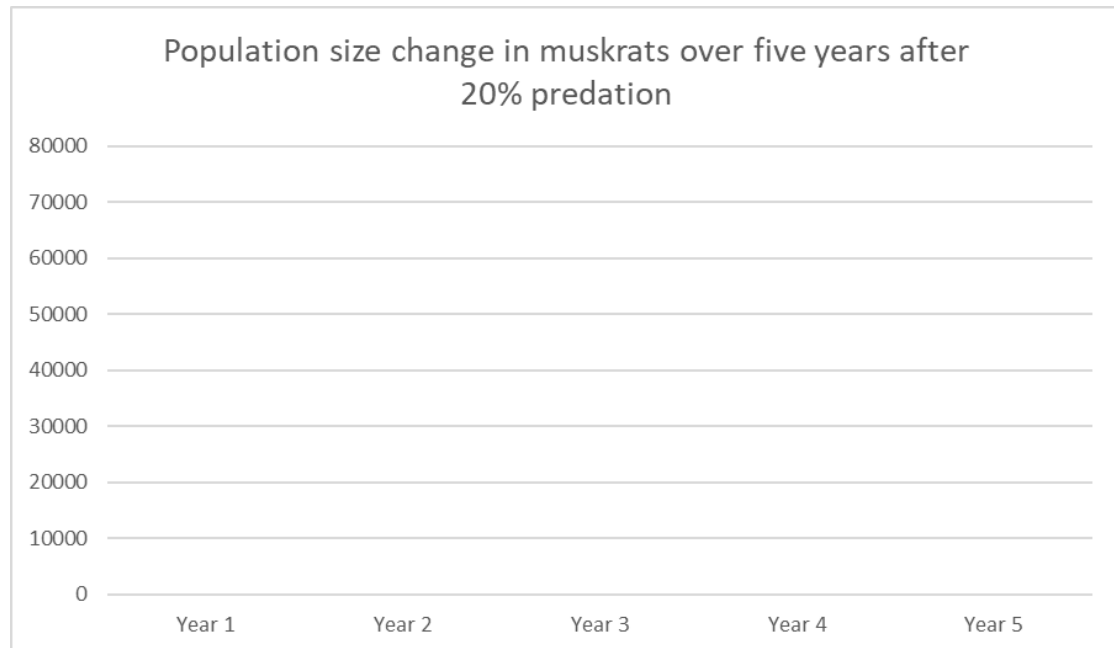
Advanced level

Now we expand to five years, and we assume that there is an annual predation rate of 20% in addition to the scenario described above. We also assume that the sex ratio is 1:1 among the muskrats that die from predation.

1. If we take a predation rate of 20% into account, how many muskrats survived year 1?
2. Repeat the calculations for the basic level, but take predation into account, and fill in all the empty rows in the table below. Note that you may have to round up or down numbers depending on the initial numbers. Muskrats don't come in halves or thirds :)

	Year 1	Year 2	Year 3	Year 4	Year 5
Initial females					
Total number of born					
Females born					
Total females					
Total number of muskrats					
Total surviving number of muskrats after predation					
Total surviving females					

Make your own graph or draw on the premade graph below.



Discussion questions (for both basic and advanced level)

1. Based on the information given in this exercise and the model assumptions as well as calculations - how realistic is this model?
2. How likely is it that the population will stay isolated (no immigration or emigration)?
3. What factors in addition to predation could limit population growth?