Activity 4:
Mystery of the disappearing sea star

Created by:

Brittany Bennett
Holland Elder
Jake Weissman
Jesse McNichol
Nicole Ratib
Suzana Leles
Trang Nguyen

Sea stars are disappearing...

Due to climate change, marine species are adapting to dramatic changes in temperature, salinity and pH. These environmental stresses can make organisms more susceptible to disease. In 2012, we noticed that sea stars began to disappear, and it appeared to be a disease.

What changes do you notice in the image on the right?

Possible answers: no sea stars, more barnacles and mussels, more shells, more clams, no bare rock

What do you notice about the rocks below the sea stars in the image on the left?

Possible answers: They are bare, they have fewer shells, they have fewer mussels, barnacles, or clams

Why do the sea stars keep the rocks bare? What does that tell you about the sea stars?

Possible answers: The sea stars eat the mussels, clams, or barnacles

If the sea stars are gone what happens to the tide pools?

Possible answers: They get covered in barnacles or mussels

What other organisms are missing in the image on the right?

Anemones, snails, crabs (tie back to biodiversity). Without the sea stars, barnacles and mussels take over more of the tide pool and crowd out other organisms

Sea stars are disappearing...

What do you notice about the sea star on the left?

Regular color, no lesions, or open sores.

What do you notice about its skin? How is it different from the sea star on the right? There are big white patches, which are open sores and lesions.

What do you notice about these sea stars?

Possible answers: Missing arms, Arms falling off, deflating, melting, disintegrating, arm crawling away

Why do you think the sea stars look like they are melting or falling apart?

Possible Answers: they might be sick. This correct, but we have also had them respond saying they were being eaten. Guide them towards being sick.

Could we be looking at a sickness or illness?

Yes What causes sickness or illness? viruses

Sea stars are disappearing...

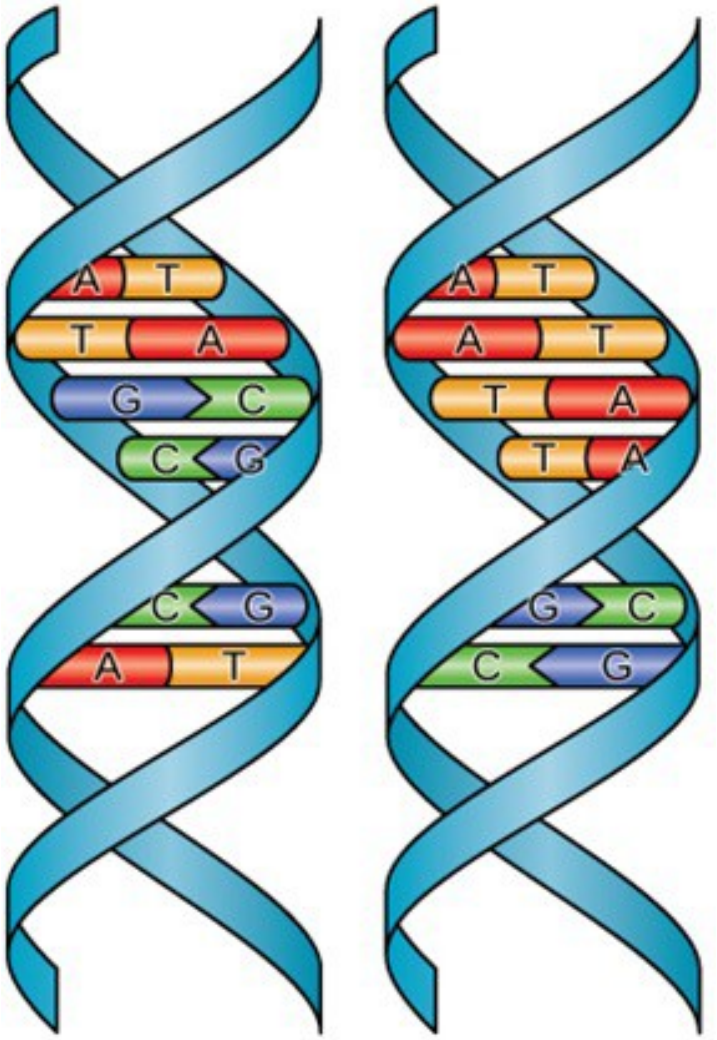
One way scientists identify disease causing pathogens (often viruses or bacteria) is by sequencing their DNA.

Each organism has its own unique sequence of DNA

To the right is a picture of DNA. How would you describe its shape?

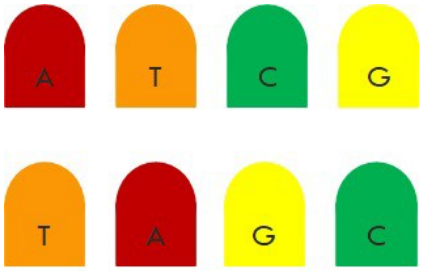
Complementary base pairing contributes to this structure. Each DNA molecule has a **complementary pair.**

A always pairs with T.
C always pairs with G.
These are
Complementary pairs.



Activity 1: Building model DNA

Color Key:



What you will need:

- 1 box of DOTS gumdrops
- 30 toothpicks
- 1 Plate

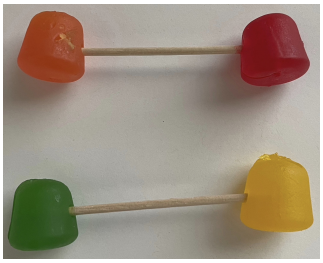
Step 1:

We're going to build a DNA model of the sequence: A T T C G T A C G C A A

Write the complimentary base pairs below the sequence _TAAGCATGCGTT_____

Step 2:

Use the color key above to connect the complimentary base pairs of the sequence. Similar to the picture on the right.



Step 3:

After all complimentary base pairs have been connected, use toothpicks to build the sequences.

Step 4:

Twist the DNA to form the double helix

Let's talk a bit more about how we can use the structure of DNA to solve biological mysteries.

And how we are going to design an experiment to find the cause of the sea star sickness.

Activity 2: Matching DNA sequences

Food for thought:

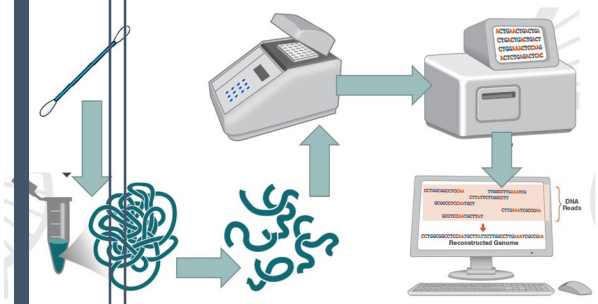
We leave clues of our presence by leaving DNA behind. Your hair, skin, fingernails and all parts of you contain DNA or the instructions to make you. Other organisms also leave DNA behind too and we can detect it.

What you will need:

- ☐ 6 sequence cut outs (1 unknown & 5 known)

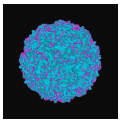
Steps to sequence DNA:

1. Take DNA samples
2. Isolate DNA
3. Sequence
4. Compare DNA sequences



The Unknown sequence you have was found to be much more numerous in and on sick sea stars than healthy sea stars. We want to find out who the Unknown sequence belongs to because that organism could be the cause of the sickness. We will compare sequences and we will record which ones match and which ones don't.

Step 1: Try pairing the unknown sequence with the 5 known sequences. Record the number matches and mismatches in the table below.

Organism	Matches	Mismatches
 Pacific Purple Sea Urchin	2	10
 Giant Green Anemone	4	8
 California Mussel	3	9
 Giant Kelp	4	8
 Densovirus	12	0

Summary and final thoughts

From today's activities, you learned about:

Sea star wasting disease
DNA structure
Identifying pathogens using DNA sequences

We learned about the structure of DNA: molecules (A, T, C, and G), complimentary pairing, double helix

We learned the structure of DNA allows us the compare sequences between organisms.

We also learned that we can detect organisms in an environment because they leave DNA behind.

We solved the mystery of the sea star wasting disease and found the cause, a denso virus.

Outlook on sea star populations today:

Today we know the virus is not a problem for sea stars and their populations are recovering, but we also know that as the climate warms it could become a problem again. Check this website (https://marine.ucsc.edu/data-products/sea-star-wasting/#id-guides) for a place to record your citizen science observations of sea star health. This helps sea stars by keeping track of sea star wasting disease.