Activities related to the theme ‘DNA’

wetenschapsknooppunt
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Overview

Occasionally during this chapter, references are made to video material. These specific fragments of the DNA project are only available in Dutch.

LICENSE TERMS

Photos

Introduction game

Activity 1: Everyone is unique

Goal: The first activity is an introductory game through which the uniqueness of every person is illustrated.

What do you need?

- Space where children can move freely
- Questions about traits of students

Duration: 20 minutes, discuss in class

Game:
All children stand up. After that, the teacher names a couple of characteristics. If a child has a certain characteristic, they will separate themselves from the group. Eventually, all children stand in a separate area. In short: every human has a unique set of characteristics.

Overview of possible questions for the teacher:

1. Are you a boy or a girl?
    - Example assignment: all girls go left.
2. Are you left- or right-handed?
3. Can you roll your tongue? Yes or no?
4. Are your ear lobes attached to your head or partially loose?
5. Do you have curls or straight hair (naturally)?
6. Do you have dimples in your cheeks?
7. Cross your arms. Which arm is folded over the other? Right or left?
8. Can you make a V with your fingers (demonstrate)?
9. Does your hairline converge to a point on your forehead in the shape of a V?
10. Do you have a dimple in your chin? Yes or no?
11. Embrace your hands. Which thumb is on top? The left thumb or the right?
12. What is your original hair color? Light or dark?

Follow-up activity: Group discussions
Through the game *'Everyone is unique'* a group discussion can take place. The central question is: What does this game say about us? It can happen that children, despite the questions, still stand together. In the group discussion, it can be discussed further. How can it be that these children kept on standing together? What does that say about their characteristics? What characteristics do they not have in common?

Do you want to see an example of the activity? [Only available in Dutch] Go to: https://www.wetenschapdeklasin.nl/activiteiten/dna, click on '*Introductieactiviteit: Iedereen is uniek'* and watch video 203.

Exploratory activities

Activity 2: Who do you resemble the most?

Goal: The children discover that certain characteristics occur more often in the family in comparison to other characteristics.

What do you need?

- Worksheet 1 – Unique characteristics
- Worksheet 2 – Who do you resemble the most?

Duration: 30 minutes, the children finish the worksheet at home

Activity:

Do you resemble your neighbor or your family?

If you look around you or if you played the game 'Everyone is unique', then you will realize how different you are compared to your friends when paying attention to just a few characteristics: you are unique!

Yet we all say sometimes: 'I've got that from my father or my grandmother.' You probably resemble your family more than your neighbor.

Strange family?

Below is a list with several characteristics. We will investigate whether these characteristics frequently occur in your family. Once filled in, you will see who of our family you resemble the most. In the first table, you will find an explanation of the characteristics.

Execution:

- Choose at least 5 characteristics (possibly think of a characteristic of which you want to find out if it can be found in your family) and try to fill in as many characteristics of your brothers, sisters, grandpas, grandmas, and if you like, even your uncles, aunts, cousins' characteristics. If needed, use pictures, call them, or send an e-mail. It's not bad if you miss some information, but the more, the more fun.
- Fill in the second table for yourself and the rest of the family. This way you get a complete list of who has which characteristics or not.
- Circle everyone's characteristic that is the same as yours (for instance: if you have black hair, then everyone with black hair gets a circle around the word 'black') and count the number of circled traits of every family member: the one with the most circles, resembles you the most.
- Who do you resemble most? _____

Worksheet 1 – Unique characteristics

Characteristic		Explanation
Rolling the tongue		If you can roll your tongue, you are a 'tongue roller'
Eye color		If you have blue eyes, you miss the pigment from the outside layer of your iris
Pointy hairline		Check your hairline or hair implant: Does your hairline converge to a point on your forehead in the shape of a V?
Hair color		Is your hair (naturally) black or blonde?
Hair shape		Do you naturally have curls or straight hair?
Attached ear lobes		Check your ear lobes: Are the ear lobes attached to your head or partially loose?
Bend little finger		Lay your hand with closed fingers before you: Does the above phalanx of your little finger bend towards your ring finger?
Outstanding thumb/lift thumb		Make a fist and raise your thumb, you have a lift thumb if your above phalanx clearly sticks backwards
Hair growth on the middle phalanx		Each of your fingers has 3 parts called phalanges: Does hair grow on the middle one?
Left- or right-handed		Do you write or do you throw with your left or right hand?
Size of teeth		Check if your teeth are really big
Dimple in your chin		A dimple in your chin becomes deeper if you laugh

Worksheet 2 – Who do you resemble most?

Characteristic		You								
Rolling the tongue?										
Eye color (brown/green=brown, blue/grey=blue)										
Pointy hairline?										
Hair color (Light or dark)										
Hair shape (curly or straight)										
Attached ear lobes?										
Left- or right-handed?										
Dimple in your chin?										

Activity 3: Making your own DNA

Goal: The child gets insight into the structure of DNA.

What do you need?
- Strips of paper
- Stickers in the colors green, red, blue, yellow
- Worksheet 3 - Unique characteristics with color code

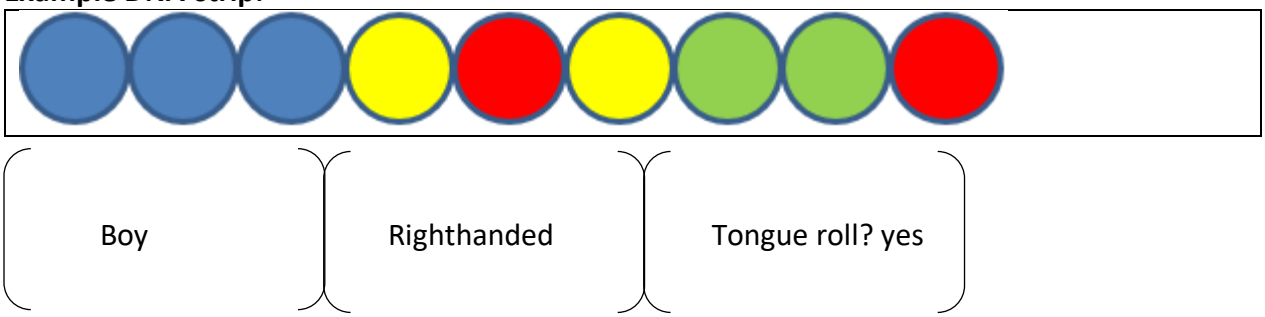
Duration: 30 minutes

Activity:
To better understand how mistakes can occur during the copying of DNA, we will first see what the coding of information exactly looks like. For that purpose, we build a piece of our DNA on a stroke of paper, where the nucleotides are represented by four colors, in the form of stickers or circles.

We now give each characteristic from the introductory activity '*Everyone is unique'* its own color code. For instance, left-handedness is green-red-blue. On the worksheet, you see what code belongs to which characteristic. This way you make the strip of DNA complete with your twelve characteristics from worksheet 2. Everyone makes their own unique array of 12 x 3 = 36 colored stickers like this.

Differentiation tip: You can choose to add new characteristics, but you can also let the children add their chosen characteristics from the activity *'Who do you resemble most?*'.

Example DNA-strip:



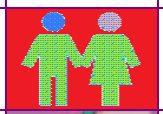
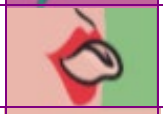
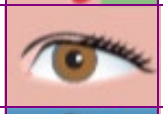
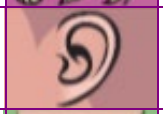
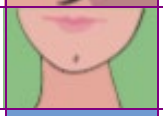
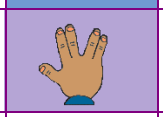
Do you want to see an example of the exercise? [Only available in Dutch]
Go to https://www.wetenschapdeklasin.nl/activiteiten/dna, click on '*Activiteit 2: Maak je eigen DNA'* and watch video 209.

Background information for this activity

It was a conscious choice to convert the characteristics into a set of three colored stickers. The bases (A, T, C, G) of the DNA serve as code for the build of proteins. The order of all those A's, C's, T's, and G's can form a code for the order in which amino acids in the cell can be strung into proteins.

Francis Crick and Sydney Brenner cracked the *genetic* code together. Every possible combination of three bases forms the code for one certain amino acid. Francis Crick and Sydney Brenner reasoned as follows. The DNA code only has four letters: A, T, C and G. So, if one letter would form the code for one amino acid, only one protein can be made which is made up of four different amino acids. That is too few because in proteins there are twenty different amino acids. Even with two bases – AT or GC – there are not enough combinations to make a code for each of the twenty amino acids. But with three bases you can create more than enough codes for the different amino acids.

Worksheet 3 – Unique characteristics with color code

Characteristic		Explanation	Code:
Boy/girl		Are you a boy or a girl?	Girl: Boy:
Left- or right-handed		Do you write or throw with your left or right hand?	Right: Left:
Rolling tongue		If you can roll your tongue into a tube, you're a so-called 'tongue roller'	Yes: No:
Eye color		If you have blue eyes, you miss the pigment from the outside layer of your iris	Blue: Brown:
Pointy hair line		Check your hairline: Does your hairline converge to a point on your forehead in the shape of a V?	Yes: No:
Hair color		Do you have dark or light hair?	Dark: Light:
Hair shape		Do you have curls or straight hair (naturally)?	Curls: Straight:
Attached ear lobes		Check your ear lobes: Are your ear lobes attached to your head or partially loose?	Attached: Loose:
Dimple in the chin		A dimple in your chin becomes deeper if you laugh	Yes: No:
Which thumb is on top?		Embrace your hands. Which thumb is on top? The left thumb or the right?	Right: Left:
Can you make a V?		Can you make a V with your fingers like in the picture?	Yes: No:
Cross your arms		Cross your arms. Which arm is folded over the other?	Right: Left:

Activity 4: Who is it? -game.

Goal: The children learn that every DNA strand is unique.

What do you need?

- DNA strands from the children of the class

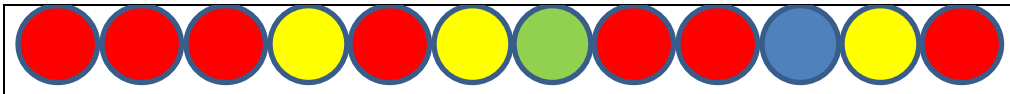
Duration: 15 minutes

Activity:
If every child has made a DNA strand, the DNA-who-is-it-game can be played. The teacher randomly picks one DNA strand from the class. All children stand up. Through the color code, the teacher reads the characteristics of the DNA strand aloud. If the teacher names a characteristic that a child does not have, the child will sit down. This is repeated until only one child remains because every DNA strand is unique.

Tip! To make it exciting, you can start by reading the DNA strand from the end. This way girls and boys are not separated from each other immediately.

Differentiation tip: You can choose to not read the characteristics yourself, but to let a child do it. This way the children get more insight into learning to read DNA.

Example:


etcetera.

- It is a girl, so all the boys have to sit down.
  because  = girl
- The person is right-handed, so all left-handed have to sit down.
  because  = left
- The person we are searching for cannot roll his/her tongue. So, everyone who can roll their tongue has to sit down.
  because  = no tongue roll
- The person we are searching for has blue eyes, everyone with brown eyes has to sit down.
  because  = blue eyes
- etcetera.

Activity 5: Complement DNA-strand

Goal: The child learns that a DNA code exists out of two strands.

What do you need?

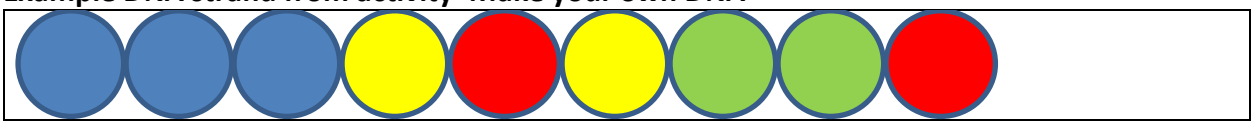
- Certain DNA strands from the activity '*Make your own DNA*'
- Stickers in the colors green, red, blue, and yellow

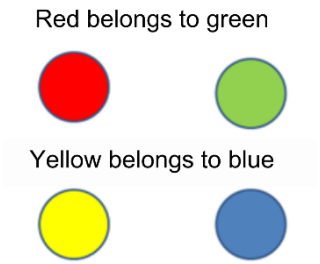
Duration: 20 minutes

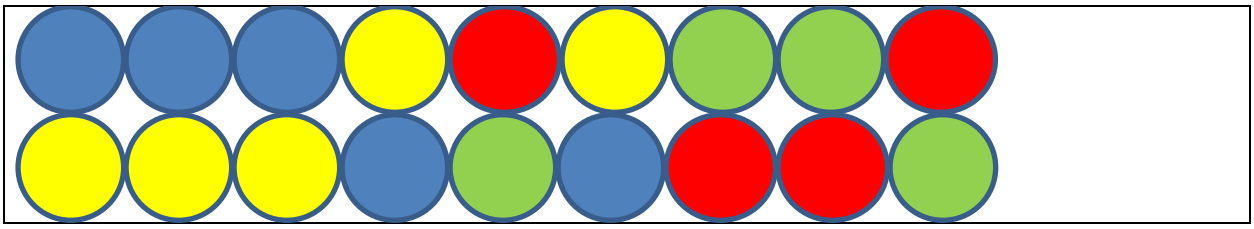
Activity:

During this activity, the children are going to complete their own DNA code. They will do this by sticking the complementary colors under the colors that are already stuck on the strand. The agreement is that red belongs to green and yellow to blue. You are supposed to stick the two rows of stickers next to each other.

Example DNA strand from activity 'Make your own DNA'







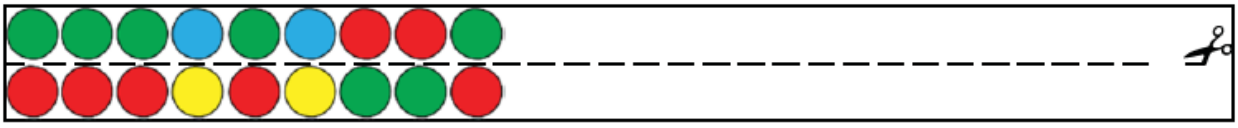
Activity 6: Copying under pressure

Goal: Children learn that mistakes can occur when DNA has to be copied under pressure.

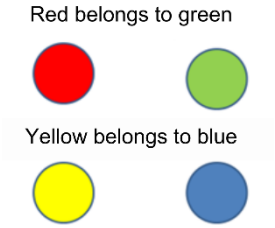
What do you need?
- Strands of paper
- Stickers in the colors green, red, blue, and yellow

Duration: 20 minutes

Activity:
During this activity, we are again focusing on the copying process. In this activity, a time element is added in: the student that finishes first, has won. The element of time pressure shows that under pressure mistakes are made. Even the cell is under constant pressure. So, in these exercises we imitate the cell!
Children get the assignment to cut the complementary strands of their DNA code loose and glue both halves on a new broad strand.



The agreement from activity 5 '*Complement DNA-strand*' stays:



After this both halves are copied complementary:

Next, you can let the children check each other's DNA strands. Are there any mistakes? And do those mistakes have a meaning: Is there now another characteristic in the code? This is also what happens to DNA in the cell: copying under pressure can lead to changes (mutations). These mutations can lead to a change in a characteristic, but also that you are born with a hereditary disease. Often these mistakes do not have any influence, because the part of the DNA where they arise is not used for the forming of characteristics.

Activity 7: Determine the disease

Goal: The child learns that diseases can arise due to certain combinations in DNA.

What do you need?

- Worksheet 4 – Determine the disease
  Caution: there are two different versions of worksheet 4. Both versions lead to a different disease/condition.
- Worksheet 5 – Decoding disk
- PowerPoint – Explanation of decoding disk

Duration: 30 minutes

Activity:
The color code from activities 3 through 5 is now replaced by letters, following the scientific designation:
A (adenine)
C (cytosine)
G (guanine)
T (thymine)
For example, a single strand DNA can look like this: **ACTGAGCTTGACCAT**

To complement the single strand to a double there are again determined combinations:
A always gets a U attached
C always gets a G
G always gets a C
T always gets an A

This activity consists of different parts.

Part 1: Every group gets a sheet with a piece of the DNA code. The children have to complement the strand to a double strand, according to the determined letter combinations.

Part 2: Each three consecutive letters (codon) of the second strand forms a code for an amino acid. Children can look up these codes on the decoding disk (worksheet 5). They write down the letter of the blue ring on the worksheet. Do this for every codon. In this way, a string of 15 letters is created.
Caution: Do this by using the PowerPoint that shows how the decoding disc of worksheet 5 works.

Part 3: Children now have a string of 15 amino acids and those form a protein together. This protein is involved in the creation of a certain disease or condition.
Go to the laptop and fill your string of 15 letters (without gaps) into Google.

If you have done it right, Google will recognize the protein and lead you to a page where you can find which protein it is and what disease or condition is connected to it.

Answers:
The disease that belongs to the first DNA strand: Alzheimer
The disease that belongs to the second DNA strand: Parkinson

Worksheet 4 – Determine the disease (1)

You are going to look for the disease that belongs to this DNA strand. You are going to do this in 3 steps.

1. The DNA strand does not exist out of colored circles anymore, but out of letters. Just like the colored circles, every letter belongs to a determined letter. The rules are:
   A belongs to U
   C belongs to G
   G belongs to C
   T belongs to A

   Now you are going to fill in the right letters next to the ★. The first 3 letters are already filled in.

2. Now take **worksheet 5 – Decoding disk**. Every 3 letters in the colored row form one letter together. You can find this letter in the blue circle of the disk.

   You are now going to fill in the right letter next to the ♥. The first letter is already filled in.
   Let your teacher show you first how to work with the disk.

3. Next to the ♥ there are now 15 different letters. Type these letters (without gaps!) into Google.

   What disease did you find? _____

	t	a	c	g	a	g	t	g	t	a	a	g	t	a	c	c	g	g	a	g	a	c	t	g	t	c	g	c	t	c	c	t	t	c	t	t	c	a	c	a	c	a	c	t	a
★	*a*	*u*	*g*																																										
♥	*m*																																												

Worksheet 4 – Determine the disease (2)

You are going to look for the disease that belongs to this DNA strand. You are going to do this in 3 steps.

1. The DNA strand does not exist out of colored circles anymore, but out of letters. Just like the colored circles, every letter belongs to a determined letter. The rules are:
   A belongs to U
   C belongs to G
   G belongs to C
   T belongs to A

   Now you are going to fill in the right letters next to the ★. The first 3 letters are already filled in.

2. Now take **worksheet 5 – Decoding disk**. Every 3 letters in the colored row form one letter together. You can find this letter in the blue circle of the disk.

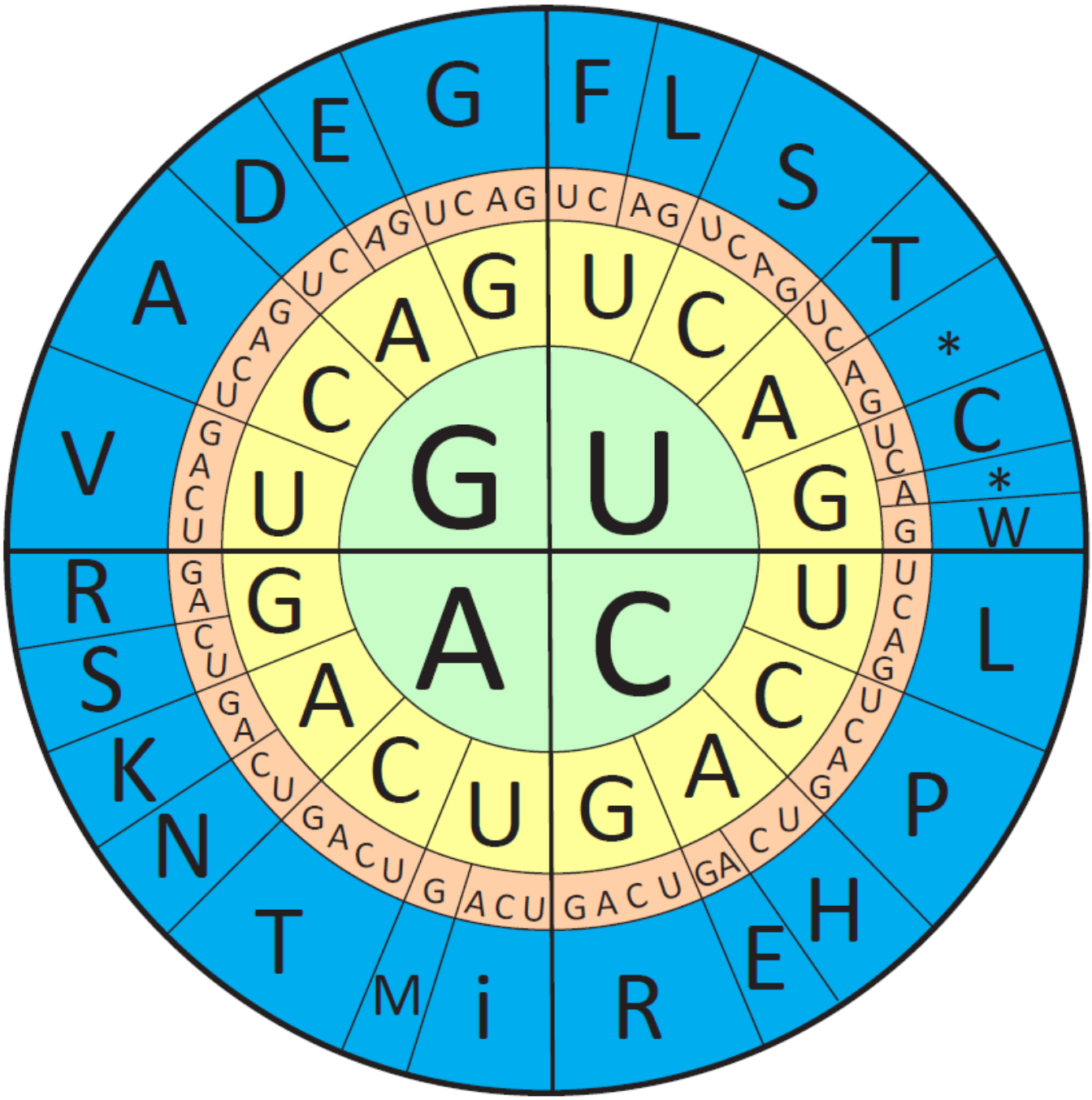
   You are now going to fill in the right letter next to the ♥. The first letter is already filled in.
   <u>Let your teacher show you first how to work with the disk.</u>

3. Next to the ♥ there are now 15 different letters. Type these letters (without gaps!) into Google.

   What disease did you find? _____

	t	a	c	c	t	a	c	a	t	a	a	g	t	a	c	t	t	t	c	c	t	g	a	a	a	g	t	t	t	c	c	g	g	t	t	c	c	t	c	c	c	t	c	a	a
★	*a*	*u*	*g*																																										
♥		*m*																																											

Worksheet 5 – Decoding disk



A - Alanine	G - Glycine	M - Methionine	S - Serine
C - Cysteine	H - Histidine	N - Asparagine	T - Threonine
D - Aspartic acid	i - Isoleucine	P - Proline	V - Valine
E - Glutamic acid	K - Lysine	Q - Glutamine	W - Tryptophan
F - Phenylalanine	L - Leucine	R - Arginine	Y - Tyrosine

Activity 8: It runs in the family

Goal: Children become aware of the fact that characteristics come from both parents.

What do you need?

- Build materials for the sweets
  (In the used example: marshmallows, skewers, lucifers, tumtums, sour rolls)
  Caution: this activity can be done with different (non-edible) materials.
- Strip with characteristics of father and mother (make different strokes, so children get multiple "babies").
- Worksheet 6 – Parts and the possible characteristics of the candy animal

Duration: 30 minutes

Activity:

During this activity the children get the instructions to make a "baby candy animal" by using the blueprint from the mother- and father candy animal. To do this they get a strip with characteristics from the father and a strip with characteristics from the mother. The blueprint is made up of a series of characteristics. (It's made up by the teacher.)

Example:

The characteristics made up by teachers are (see worksheet 6)

- The tail could be long or short;
- The eyes could be on the side or the front;
- The head could be angled or twisted;
- The body could be long or short;
- The legs could have different colors.

Blueprint father and mother:

Father	**Tail:** Short	**Eyes:** Front	**Head:** Twisted	**Torso:** Short	**Feet:** Colored
Mother	**Tail:** Short	**Eyes:** Side	**Head:** Twisted	**Torso:** Long	**Feet:** Green
Baby candy animal (Child)					

By using the blueprint of the father and mother, the children have to base the characteristics of their baby candy animals on the characteristics of both parents.

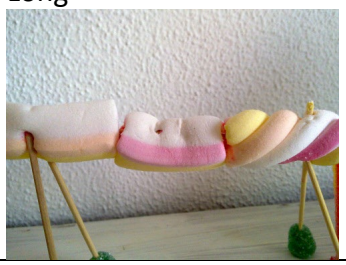
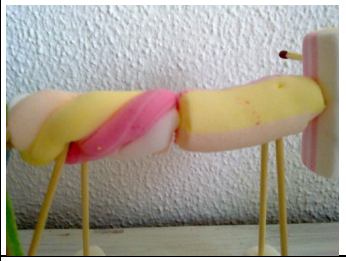
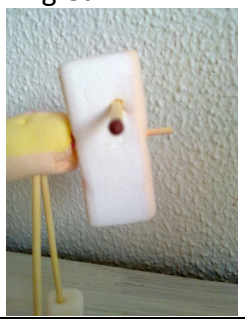
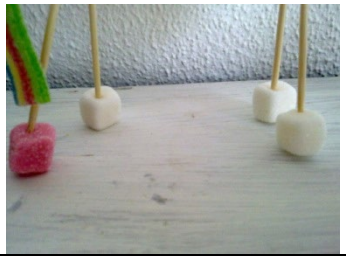
Instructions:

- If both parents have the same characteristic, then the baby candy animal also gets this characteristic. So, if the father and mother both have a long tail (a long sour roll), then the baby gets it as well.
- If the parents have a different characteristic, the child can choose the characteristic.

Father	**Tail:** Short	**Eyes:** Front	**Head:** Twisted	**Torso:** Short	**Feet:** Colored
Mother	**Tail:** Short	**Eyes:** Side	**Head:** Twisted	**Torso:** Long	**Feet:** Green
Baby candy animal (Child)	**Tail:** Short	**Eyes**: *Child chooses*	**Head:** Twisted	**Torso:** *Child chooses*	**Feet:** *Child chooses*

Through this assignment, the children become aware of the fact that characteristics are derived from both parents. In addition, they learn that some characteristics win (are dominant).

Worksheet 6 - Parts and the possible characteristics of the candy animal

Part	Characteristic	
Torso	Long 	Short 
Head	Angled 	Twisted 
Feet	Green 	Other colors 
Eyes	Front 	Side 
Tail	Long and slim 	Short and wide 

Activity 9: Watch and listen

Goal: Children come into contact with different informative websites around the theme 'DNA'.

What do you need?

- Computer
- Websites:
    - SchoolTV 'Iedereen is anders' (*Everyone is different*) [Video only available in Dutch, text available in English] https://schooltv.nl/video-item/iedereen-is-anders-je-dna-bepaalt-hoe-je-eruit-ziet
    - Klokhuis 'Technische recherche' (*Forensic detective*) [Only available in Dutch] https://www.zapp.nl/programmas/het-klokhuis/gemist/NPS_1097109
- Worksheet 7 – Watch and listen
- Worksheet 8 – Answers Watch and listen

Duration: 40 minutes

Activity:
On the internet is much information to be found about DNA and heredity. Following a DNA assignment sheet the children come into contact with different informative sites.
The activity can be done classical, in groups or individually.

Worksheet 7 – Watch and listen

Watch the video from SchoolTV 'iedereen is anders' https://schooltv.nl/video-item/iedereen-is-anders-je-dna-bepaalt-hoe-je-eruit-ziet
(*Everyone is different)* [Video only available in Dutch, text available in English] (https://schooltv.nl/video-item/iedereen-is-anders-je-dna-bepaalt-hoe-je-eruit-ziet)

1. Why is DNA like a fingerprint?

2. Name a few characteristics that are stored in your DNA.

DNA plays an important role in tracking criminals. [Only available in Dutch]
Watch the fragment from Klokhuis (https://www.zapp.nl/programmas/het-klokhuis/gemist/NPS_1097109). **Pay attention!** Until 04.30 minutes.

3. Why can a piece of gum help track a criminal?

4. What does the forensic detective look for?

Continue the episode from Klokhuis, from 07:45 until 08:40 minutes. [Only available in Dutch]
5. Can you now explain how the forensic detective tracks a criminal?

Worksheet 8 – Answers Watch and listen

Watch the video of SchoolTV (http://www.schooltv.nl/no_cache/video/crid/20030904_dna01/). [Video only available in Dutch, text available in English]
Can you answer the following questions?

1. Why is DNA like a fingerprint?

DNA is, just like a fingerprint, different for every human being. Only identical twins have the same DNA.

2. Name a few characteristics that are stored in your DNA.

For instance: hair color, color of your eyes, skin color

DNA plays an important role in tracking criminals.
Watch the fragment from Klokhuis (https://www.zapp.nl/programmas/het-klokhuis/gemist/NPS_1097109). **Pay attention!** Until 04.30 minutes.

3. Why can a piece of gum help track a criminal?

The piece of gum could be from the criminal. The forensic detective investigates the saliva that is on the piece of gum. In the saliva is DNA. Through the DNA the forensic detective could track the criminal down.

4. What does the forensic detective look for?

The forensic detective looks for traces of the criminal like blood, hairs, saliva and sweat. In these traces are cells in which there is DNA. Every person is unique, so every trace has unique DNA.

Continue the episode from Klokhuis, from 7:45 minutes until 8:40 minutes. [Only available in Dutch]

5. Can you now explain how the forensic detective tracks a criminal?

The forensic detective looks for traces of the criminal which have DNA in them (blood, hairs, saliva, sweat). The DNA is a unique code of a person. During the solving of the crime, the forensic detective compares the DNA of the trace to the DNA of the suspect. If they match, you have evidence.

Activity 10: Isolate your own DNA

Goal: Children learn to isolate DNA from their saliva by following a step-by-step experiment.

What do you need?

1. Water
2. Salt
3. Dish soap
4. 70% alcohol (can be bought at drugstore, keep cold until use)
5. (Measuring) cup
6. Glass/cup (see-through!)
7. Freezer
8. Teaspoon and tablespoon (possibly pipette)

Duration: 20 minutes

Activity:

1. Put as much salt into the water in the measuring cup until it does not dissolve anymore.
2. Take 3 tablespoons of salt water and put these in the cup.
3. Rinse your mouth with the salt water (do not swallow!).
4. Spit the water back into the cup.
5. Dip the back of the teaspoon in the dish soap.
6. Stir the salt water **calmly**.
7. Carefully put the alcohol into the cup with the teaspoon/pipette.
8. The alcohol will lie on the salt water.
9. Stop when you have a layer of about 1 cm or 0.39 inch.
10. Stir **carefully** with the spoon/stirrer through the alcohol.

There is now a sort of web of white strings: that is your DNA!

What happened?

- The buccal mucous cells in your mouth easily let go because of the salt water.
- The dish soap breaks down the cells.
- Because of the alcohol, the DNA sticks together.

Activity 11: DNA from a banana

Goal: Children learn to purify DNA from a banana by following a step-by-step experiment.

What do you need?
For the class
- Mixer, kitchen machine or blender
- Freezer
- Worksheet 9 – Purify DNA from a banana

Per child
- Half a banana
- Ananas juice
- 100 ml cold water
- Half a coffee spoon of kitchen salt
- A coffee filter with a filter holder
- A test tube (a long, narrow, glass tube)
- A bit of dish soap
- 70% alcohol (can be bought at a drugstore, keep cold until use)
- A small wooden stick

Duration: 30 minutes

Activity:
In the step-by-step plan below, the contributions of the different ingredients are explained in bold.

STEP 1
Cut the banana into small pieces and put the pieces into a blender with 100 ml cold water and halve a coffee spoon of salt into the mixer/blender. Mix for 15 seconds with maximum power. You now have banana cell soup.
The salt later helps to solidify the DNA so you can remove it from the solution.

STEP 2
Filter the banana soup through the coffee filter and catch the juice in a test tube (about three fingers high).

STEP 3
Add a couple of droplets of dish soap and softly shake the test tube back and forth. ***Through this, the cell membrane (the outside) and the cell core break down and the DNA, which was stored in the core, is released.***

STEP 4
Add half a coffee spoon of ananas juice to the test tube. Again, softly shake for 5 minutes.

DNA is folded in the cell core around proteins that protect it. The enzyme from the ananas juice cuts the proteins into pieces but keeps the DNA intact so you can isolate it. If you stir too hard, you break the long DNA molecule into smaller pieces which makes it harder for you to see.

STEP 5
Now take the very cold alcohol from the freezer and add it carefully. Make sure that the alcohol softly runs down the side and that the volume in your test tube approximately doubles.
After a few seconds a white snot forms on the dividing line between the juice and alcohol. Carefully stir with a wooden stick through the snot and wind it up…. The DNA of the banana.
DNA will go to the alcohol layer as white stringy goo because it feels the most pleasant there, chemically at least.

Extra
For the children in the higher classes, there is extra background information added below. You can add this to the lesson at your own discretion.

So, how does it work?
All living organisms (animals, plants, and humans) are made up of cells. In humans, every body cell has a cell nucleus, which in turn contains 46 chromosomes (hereditary code carriers) (except for sex chromosomes, which contain only 23 chromosomes). Our DNA forms the building blocks for these chromosomes.

DNA is built like a sort of double spiral, comparable to a spiral staircase. The sides of this spiral staircase are made up of sugar and phosphate compounds and these firmly hold the steps of the spiral staircase. The steps are made up of 4 chemical substances that we qualify with the letters A (Adenine), T (Thymine), C (Cytosine) and G (Guanine). Every step of the spiral staircase is made up of a connection between substance A and substance T, or a connection between substance C and substance G. It is that sequence of steps that differs from person to person and that makes us all unique.

Equally surprising is that every body cell contains exactly the same code. In each cell the DNA is identical, but, per body part only the information that is needed for *that* cell is activated. Every cell in your big toe contains information about the color of your eyes, but that information is non-active.

That is also the explanation why you only need 1 cell to, for instance, clone a sheep. In that one cell is all the information about how the sheep is built and if you can copy that information, you get an identical sheep.

Worksheet 9 – Purifying DNA from a banana

Name: …….

Take DNA out of a banana?

Not only humans have characteristics stored in DNA. Animals and plants also have this information in all of their cells. Complete DNA can be extracted from those cells, also called isolating. It's so easy you can do it in class.
Now imagine you want to make a banana, then you need the DNA from the banana. With this experiment, you can get the DNA out of a banana.

What do you need?

Getting DNA out of a banana is a piece of cake but ensure that all the ingredients are ready so you can finish the experiment in one go.

- Half a banana
- Ananas juice
- 100 ml cold water
- Half a coffee spoon of kitchen salt
- A mixer
- A coffee filter with a filter holder
- A test tube (a long, narrow, glass tube)
- A bit of dish soap
- 70% alcohol
- A small wooden stick

And this is how you go about it:

STEP 1
Cut the banana into small pieces and put the pieces into a blender with 100 ml cold water and half a coffee spoon of salt into the mixer/blender. Mix for 15 seconds with maximum power. You now have banana cell soup.

STEP 2
Filter the banana soup through the coffee filter and catch the juice in a test tube (about three fingers high).

STEP 3
Add a couple of droplets of dish soap and softly shake the test tube back and forth.

STEP 4
Add half a coffee spoon of ananas juice to the test tube. Again, softly shake for 5 minutes.

STEP 5
Now take the very cold alcohol from the freezer and add it carefully. Make sure that the alcohol softly runs down the side and that the volume in your test tube approximately doubles.
After a few seconds a white snot forms on the dividing line between the juice and alcohol. Carefully stir with a wooden stick through the snot and wind it up…. The DNA of the banana!

Other sources:

- SchoolTV ‘Een code in je lijf’ (*‘A code in your body’*) http://www.schooltv.nl/video/dna-een-code-in-je-lijf/#q=DNA [Text available in English. Video only available in Dutch]