

TEMPLE



Tools **E**nabling **M**etabolic **P**arents **L**Earning

ADAPTED BY THE DIETITIANS GROUP

BIMDG

British Inherited Metabolic Diseases Group



BASED ON THE ORIGINAL TEMPLE WRITTEN BY
BURGARD AND WENDEL
VERSION 3, MARCH 2025

Citrullinaemia

Supported by **NUTRICIA**
as a service to metabolic medicine

TEMPLE foreword

TEMPLE (Tools Enabling Metabolic Parents LEarning) are a set of teaching slides and booklets that provide essential information about different inherited metabolic disorders that require special diets as part of their management. These teaching tools are aimed at parents who may have an infant or child that has been recently diagnosed with a disorder. They are also useful when teaching children, extended family members, child minders, nursery workers and a school team.

They have been developed by a team of experienced clinical and research metabolic dietitians from the UK who are members of the British Inherited Metabolic Disease Group (BIMDG).

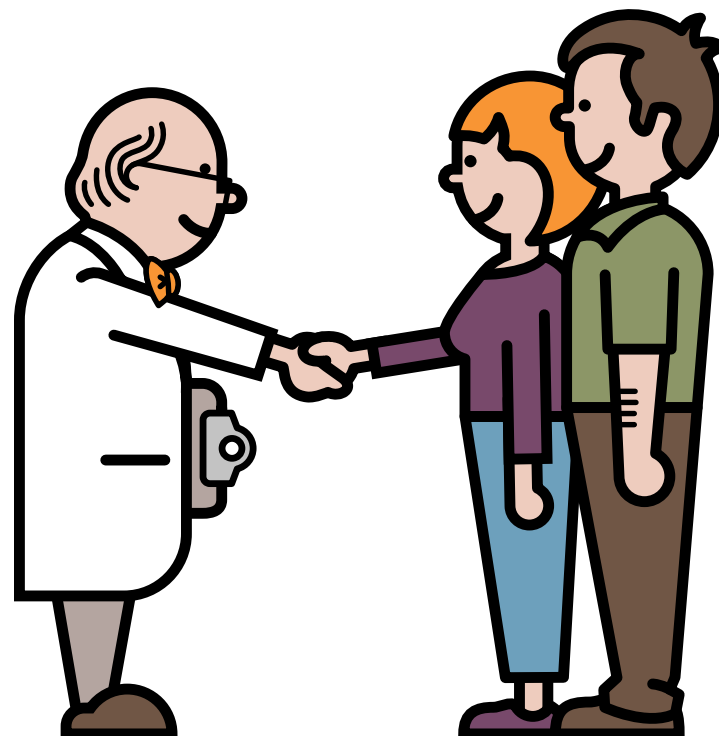
The team are Rachel Skeath, Karen van Wyk, Pat Portnoi and Anita MacDonald. The group is facilitated by Heidi Chan from Nutricia.

Each module produced is reviewed by a consultant clinician who is a member of the BIMDG.

This teaching tool is not designed to replace dietary information that may be given by a dietitian in clinic.

Citrullinaemia

Information for families
following a new diagnosis



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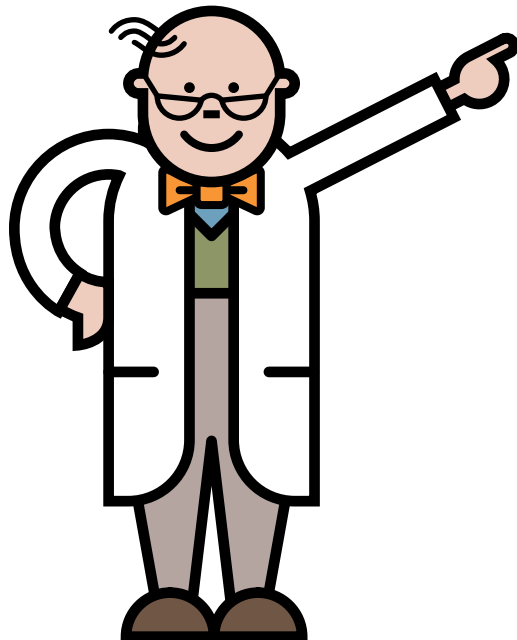


Tools Enabling Metabolic Parents LEarning

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as a service to metabolic medicine

What is Citrullinaemia?

It is an inherited metabolic condition.



Citrullin aemia

(Too much)

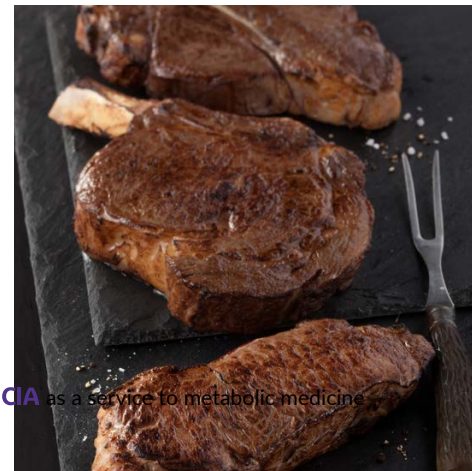
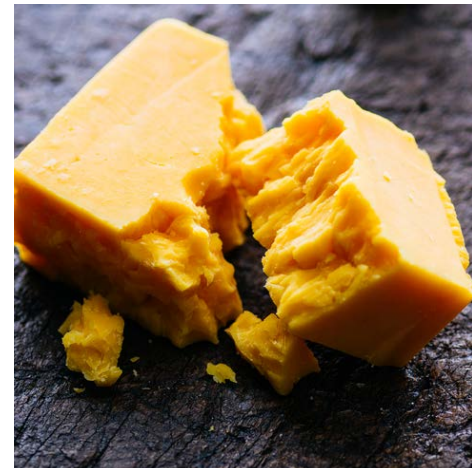
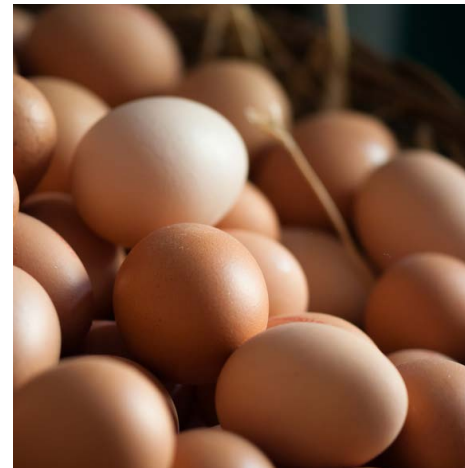
Citrulline in blood

What is protein?

Many foods contain protein.

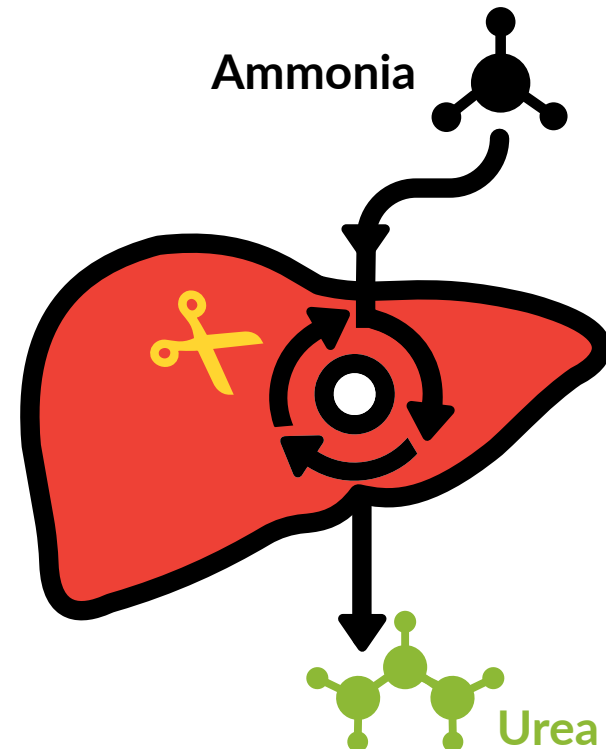
The body needs protein for growth and repair.

Many people eat more protein than the body needs.



How do we remove waste protein from the body?

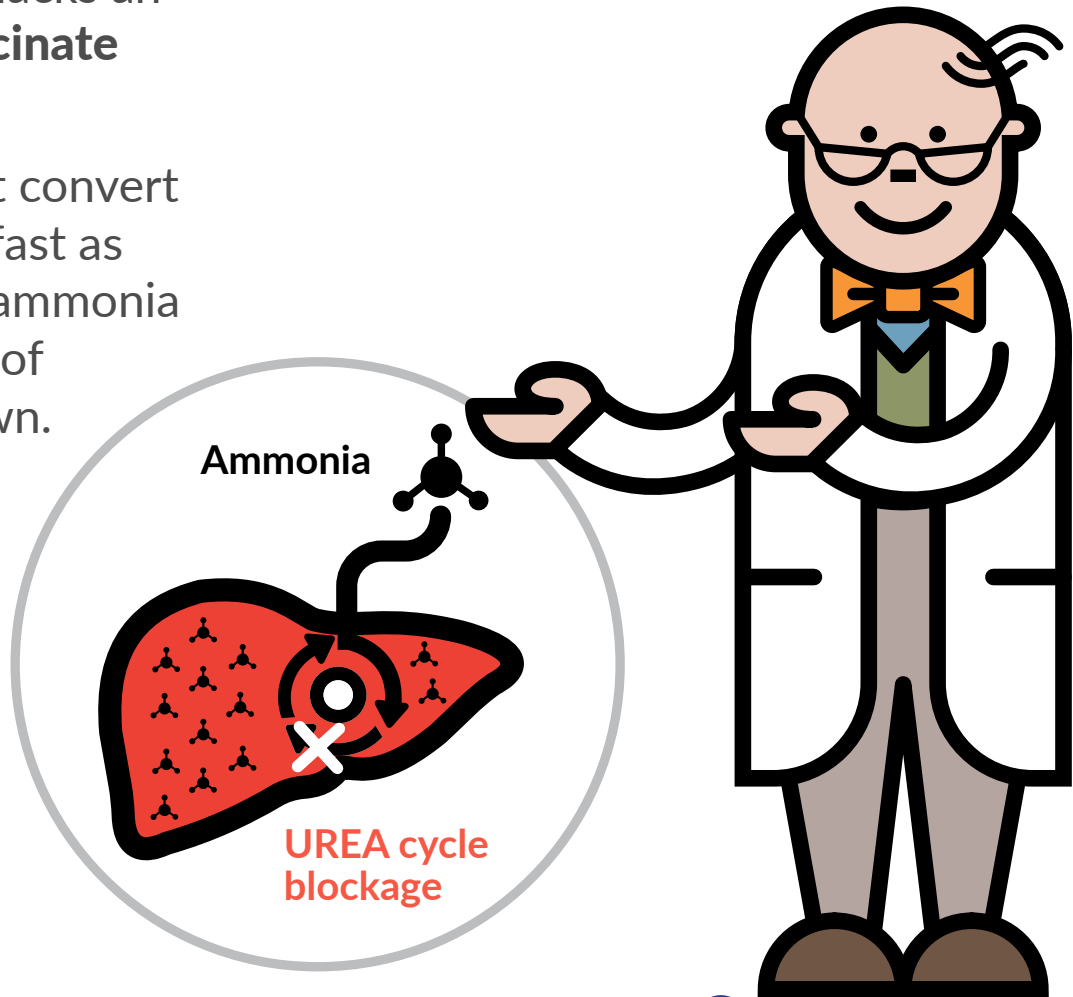
- Firstly, the body converts waste protein to a toxic chemical called **ammonia**
- Ammonia is then converted into a non-toxic chemical (**urea**) in the liver
- This process occurs via the **urea cycle**
- In the urea cycle, several steps have to take place. Each step needs an enzyme (like chemical scissors) for it to work
- Urea is then removed by the kidneys



What happens in Citrullinaemia?

In Citrullinaemia, the body lacks an enzyme called **argininosuccinate synthetase**.

This means the liver cannot convert waste protein into urea as fast as normal. It can lead to high ammonia levels, particularly at times of increased protein breakdown.

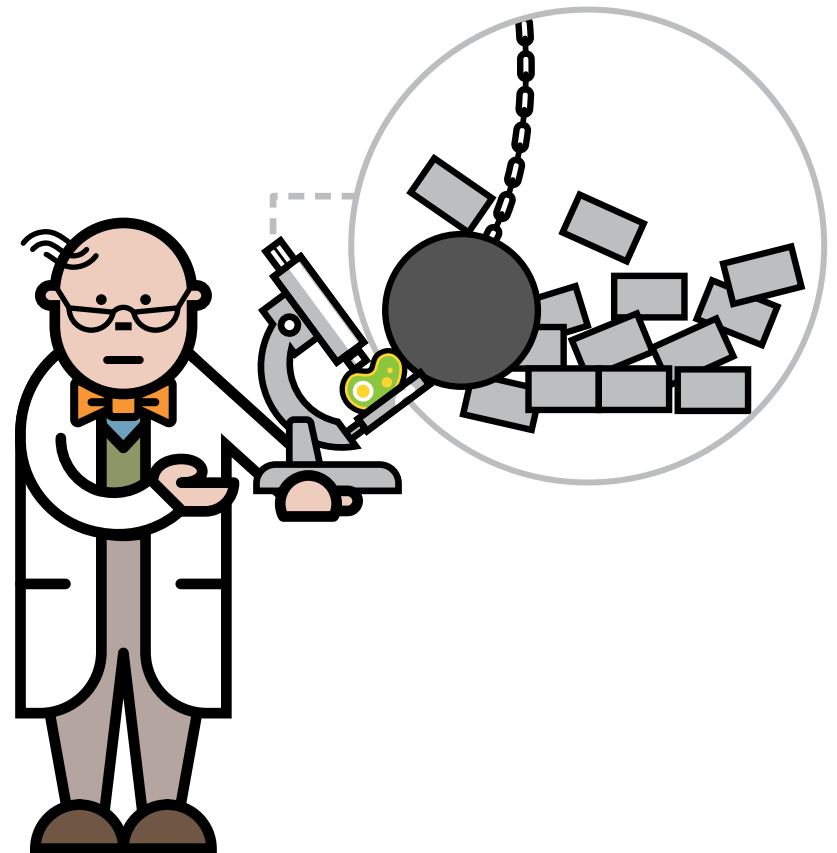


When does Citrullinaemia cause high ammonia levels?

Ammonia levels can rise when there is an increased break down of protein. This may happen if too much protein is eaten.

It commonly results from break down of the body's own protein. This is often triggered by infections, particularly if there is vomiting.

This causes **catabolism** which is a break down of body protein and can lead to a metabolic crisis.



What are the symptoms in Citrullinaemia?

Some babies become ill in the first few days of life.

Signs and symptoms:

- Poor feeding
- Vomiting
- Floppiness
- Excessive sleepiness
- Rapid breathing
- Dehydration (lack of body fluids)
- Seizures

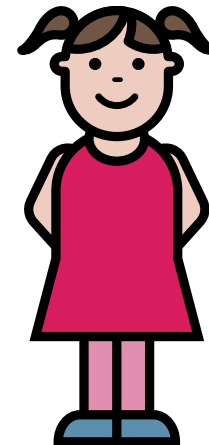
The effects of high ammonia can quickly become life-threatening if unmanaged.

What are the long term effects of Citrullinaemia?

It may cause learning difficulties.

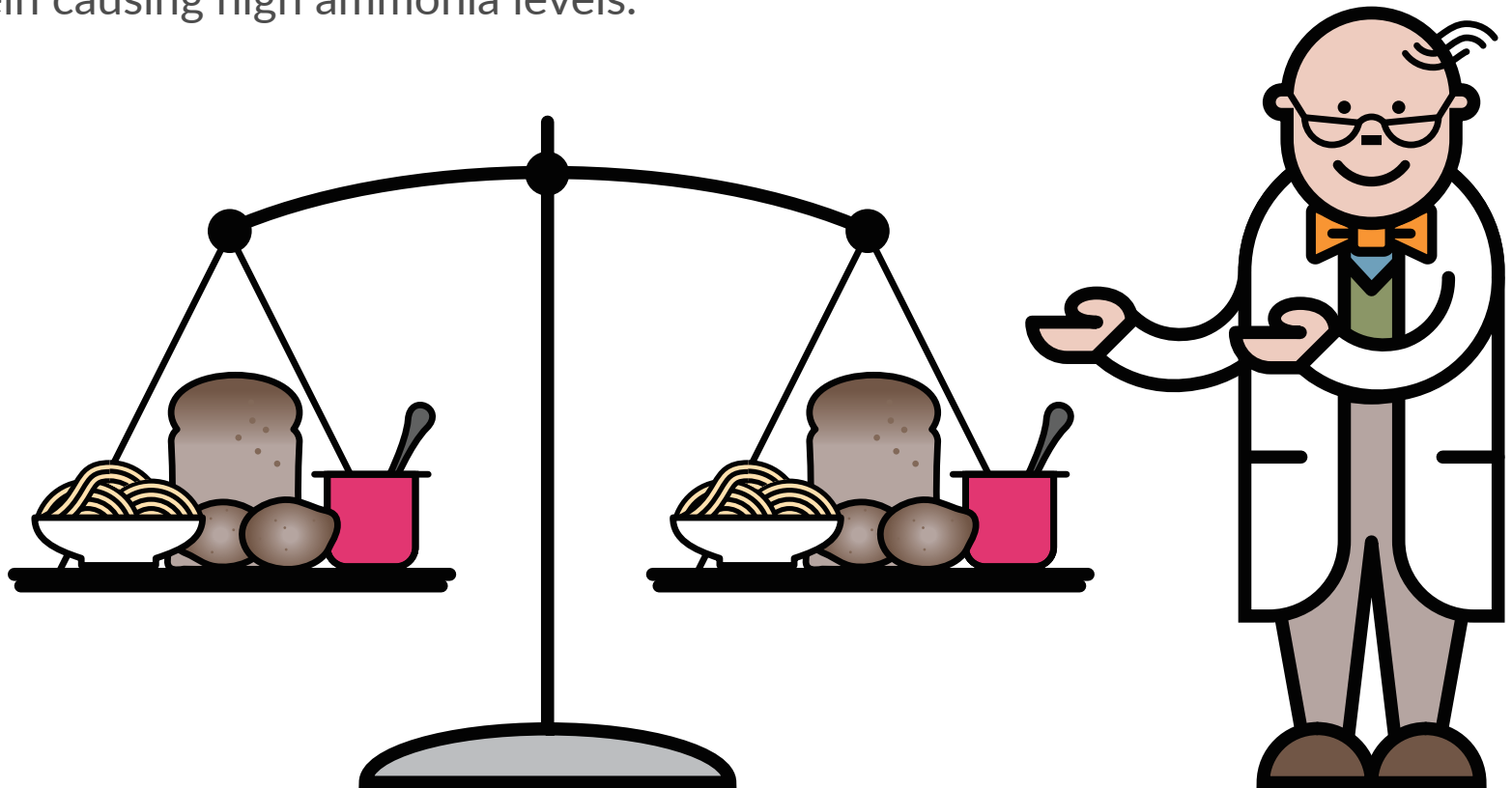


It may also cause delays to normal development like walking and talking.



Protein balance is needed in Citrullinaemia

In Citrullinaemia it is important that enough protein is given to grow... but not too much as it will make waste protein causing high ammonia levels.



How is Citrullinaemia diagnosed?

The diagnosis is suspected in a patient with high ammonia levels because of the pattern of chemicals in the blood and urine.



The diagnosis is confirmed by finding the mutation in the citrullinaemia gene.



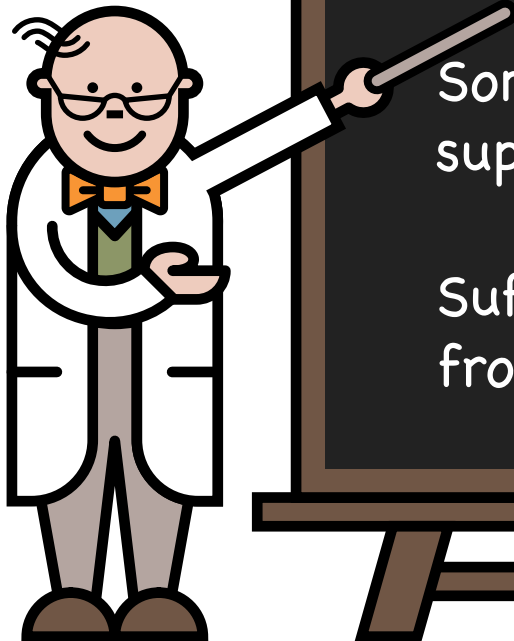
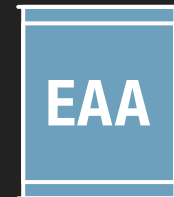
How is Citrullinaemia managed day to day?

Citrullinaemia is managed with the following:

A protein restricted diet

Sometimes a special amino acid supplement may be needed

Sufficient energy supply from food and feeds



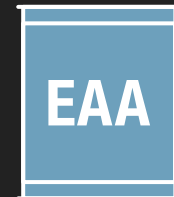
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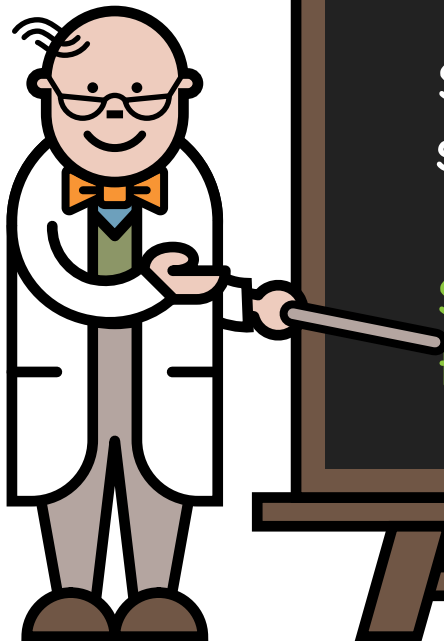
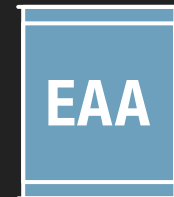
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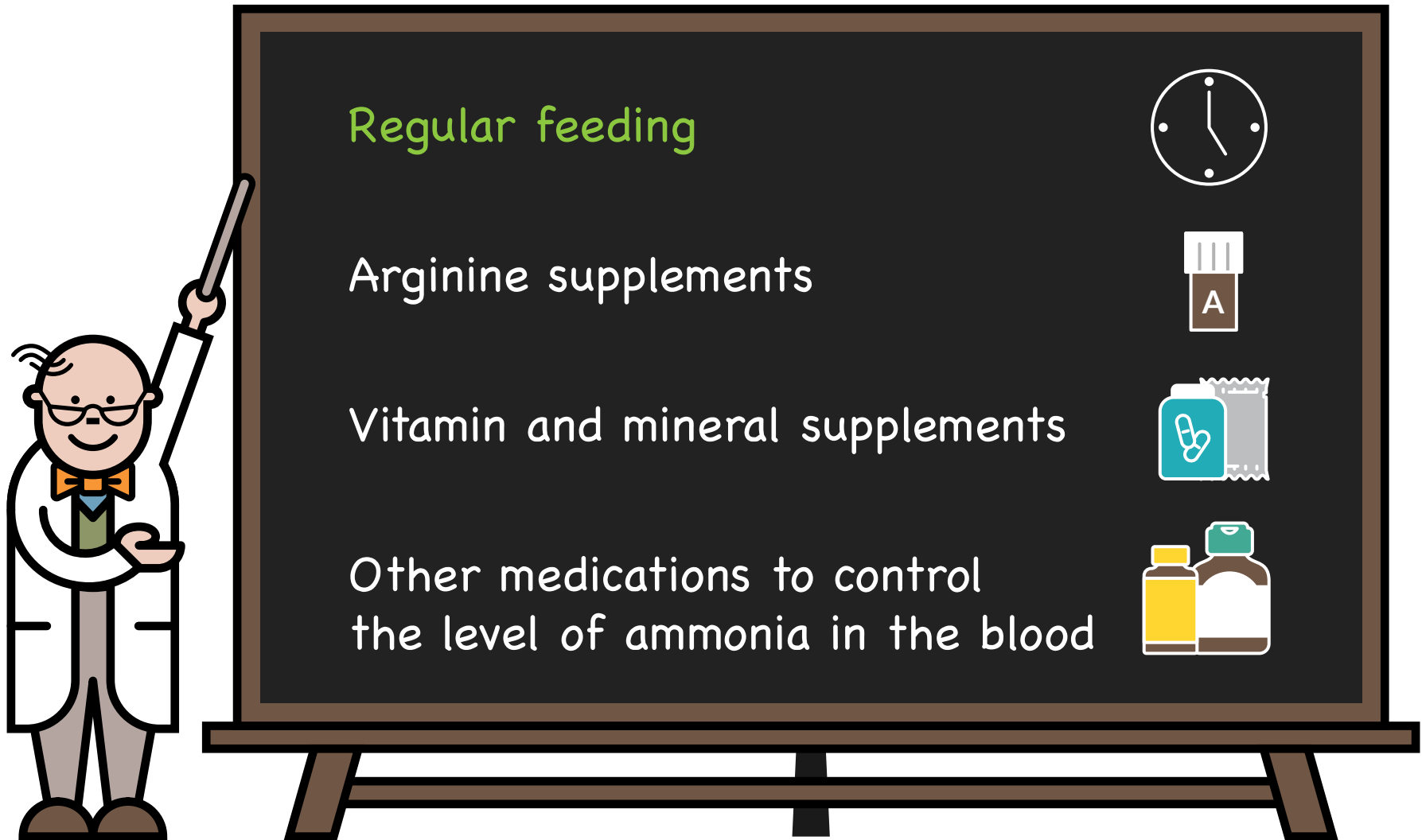
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How is Citrullinaemia managed day to day?



How is Citrullinaemia managed day to day?

Regular feeding



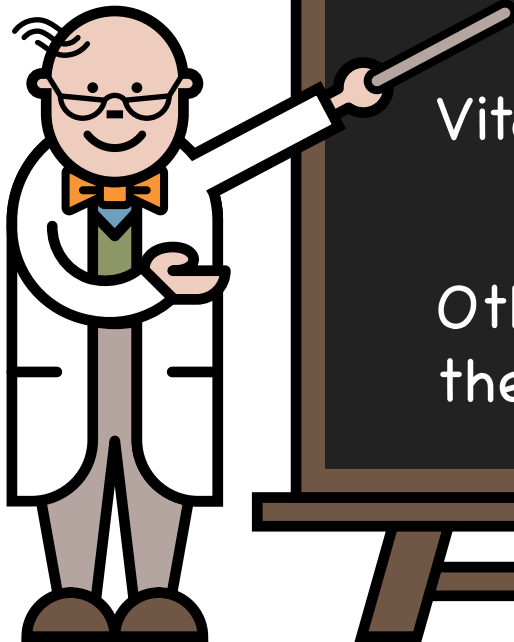
Arginine supplements



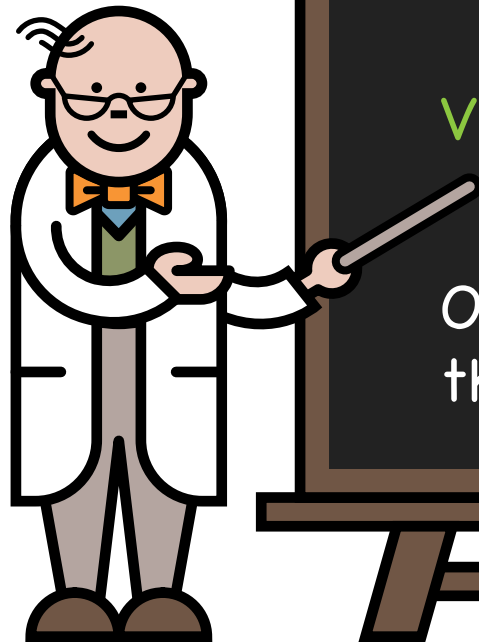
Vitamin and mineral supplements



Other medications to control the level of ammonia in the blood



How is Citrullinaemia managed day to day?



Regular feeding



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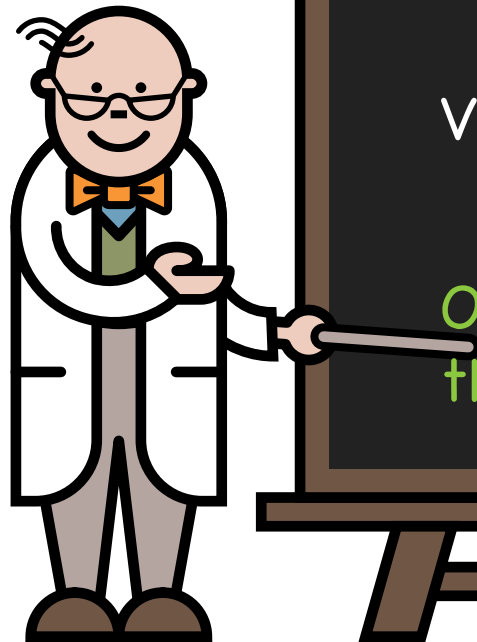
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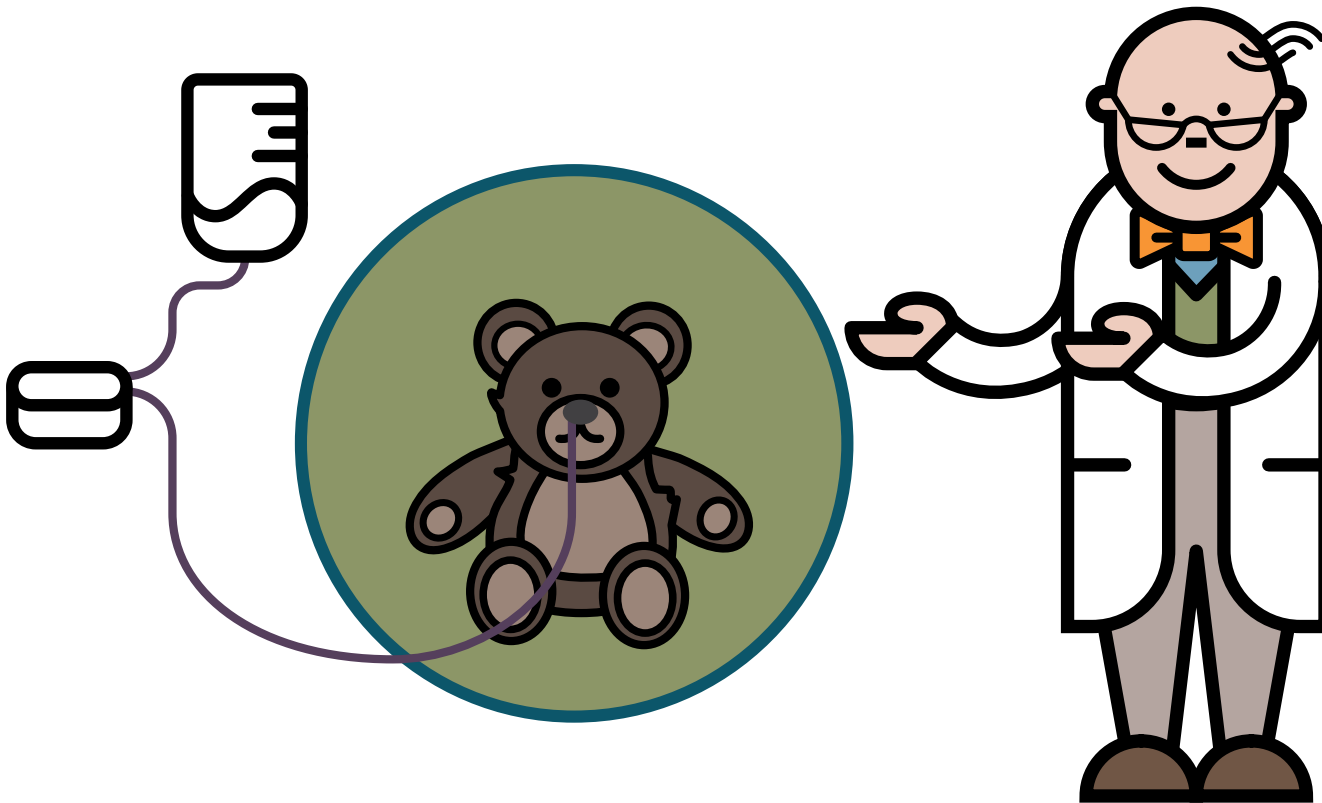


Other medications to control
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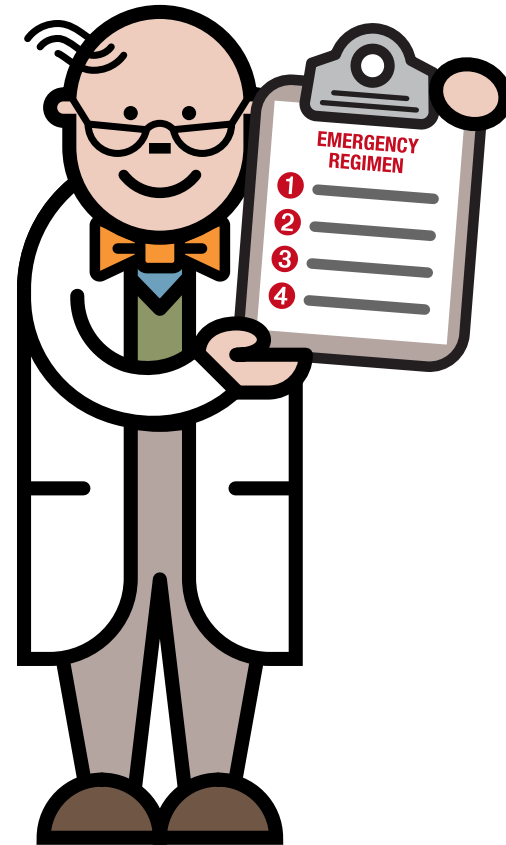
Is tube feeding needed?

Tube feeding may be necessary to give regular feeds. This will ensure energy, nutrient and fluid needs are met.

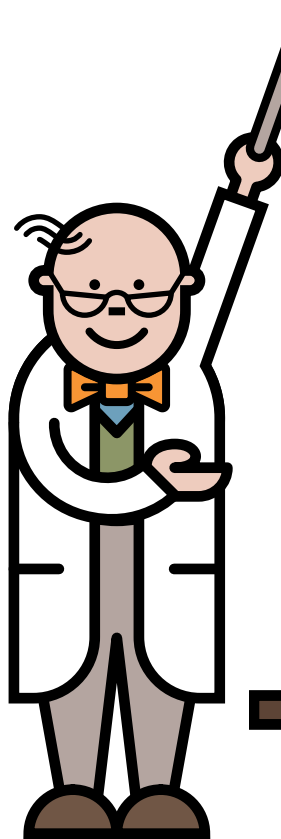


How is Citrullinaemia managed during illness?

- During any childhood illness, an emergency regimen is given
- This will reduce the break down of protein and the build-up of ammonia




How is Citrullinaemia managed during illness?




A cartoon doctor with glasses, a white lab coat, and an orange bow tie stands to the left of a large blackboard, pointing at it with a stick.

Stop all protein in food & drink




An illustration of a loaf of bread, a carton of milk, and a glass of juice with a spoon, all crossed out by a red diagonal line, indicating that protein intake should be stopped.

Start the emergency regimen.
This is made up of glucose polymer



An illustration of a pink rectangular container labeled "GLUCOSE POLYMER" in white capital letters.

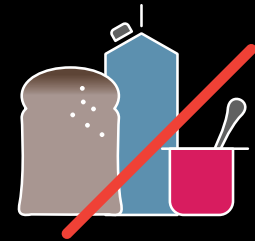
Continue medication as prescribed



An illustration of two medicine bottles, one yellow and one brown, representing prescribed medication.

How is Citrullinaemia managed during illness?

Stop all protein in food & drink



Start the emergency regimen.
This is made up of glucose polymer

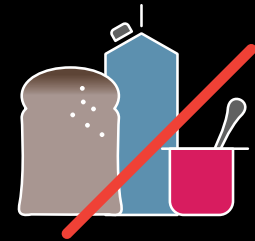


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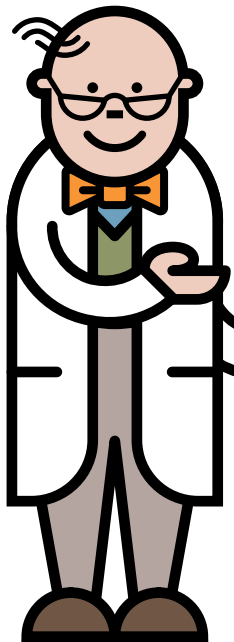
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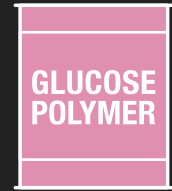


Continue medication as prescribed



Checklist for illness

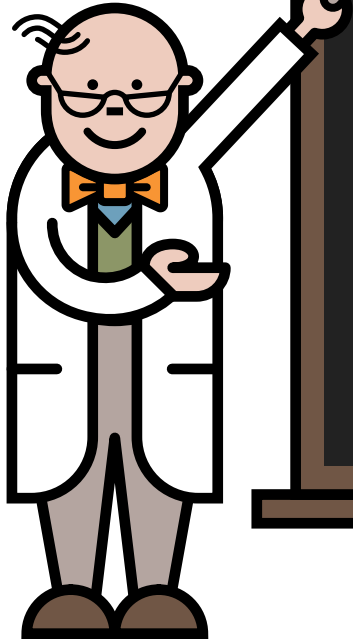
Always take full amounts of
emergency feeds as prescribed ✓



If symptoms continue and/
or you are worried, go
immediately to the hospital

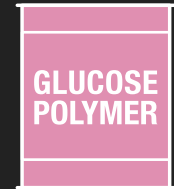


Regularly update your
metabolic team



Checklist for illness

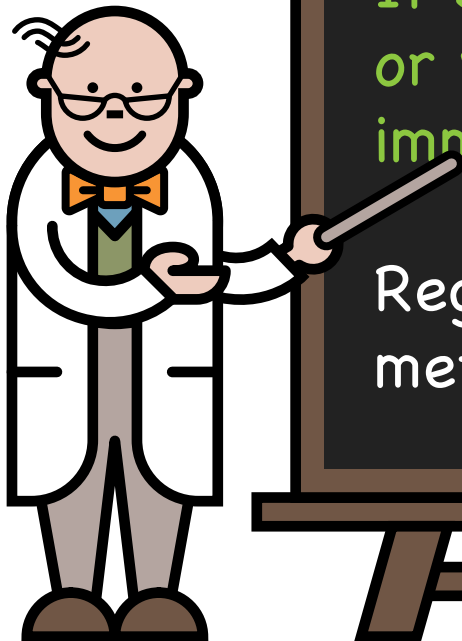
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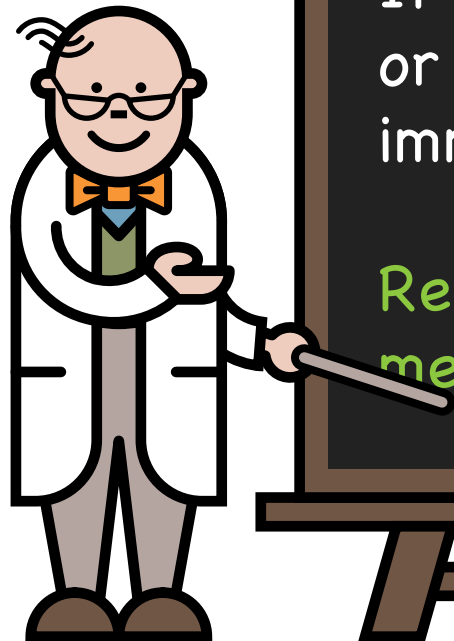
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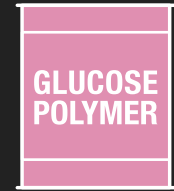
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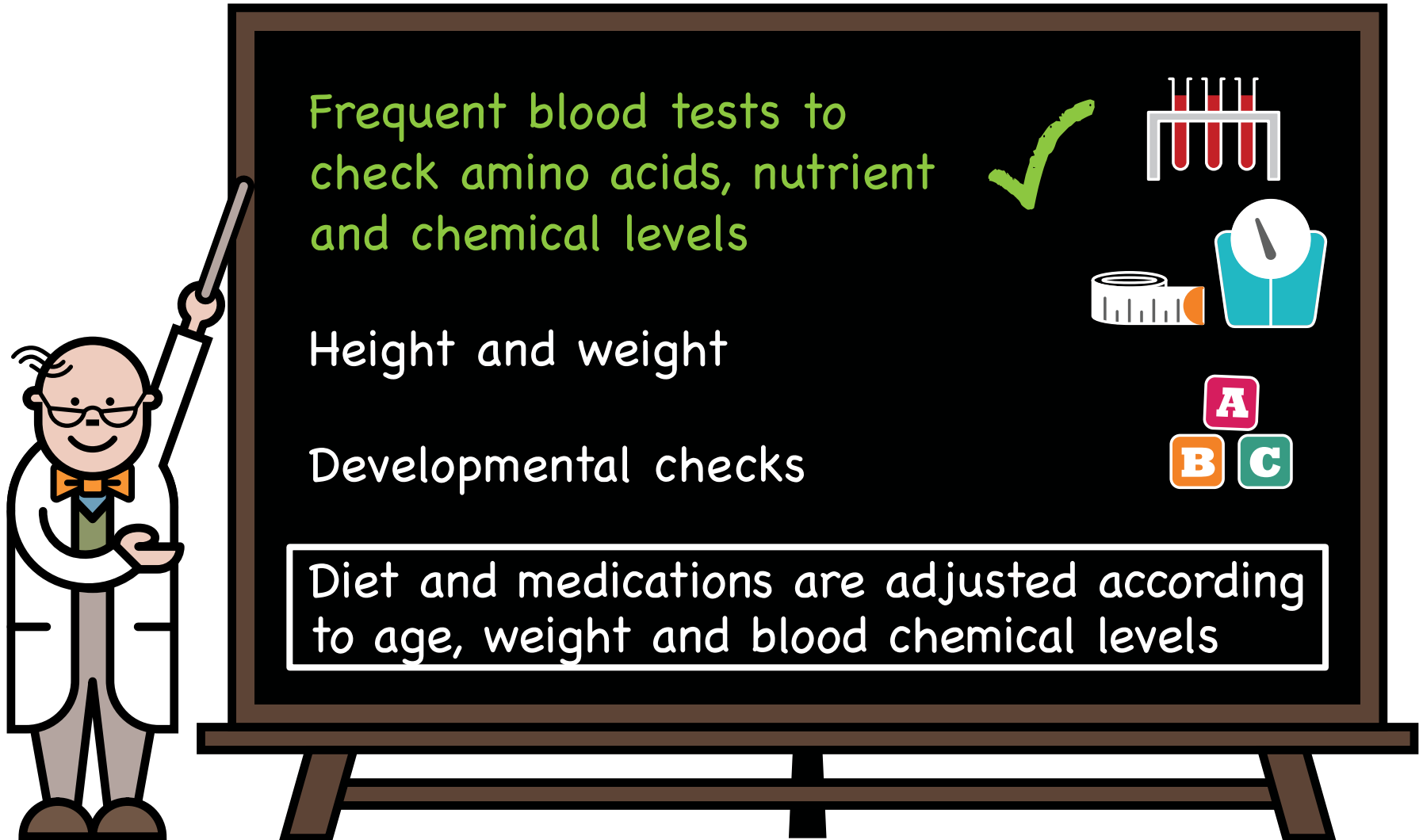


Key message



It is imperative that
emergency feeds are
started **promptly** and
there are **no delays**
in management.

How is Citrullinaemia monitored?



How is Citrullinaemia monitored?

Frequent blood tests to check amino acids, nutrient and chemical levels

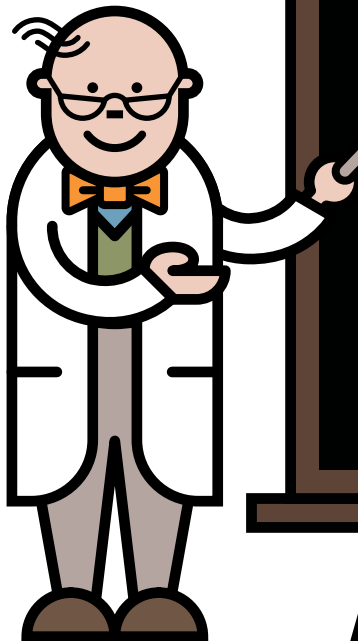


Height and weight

Developmental checks



Diet and medications are adjusted according to age, weight and blood chemical levels



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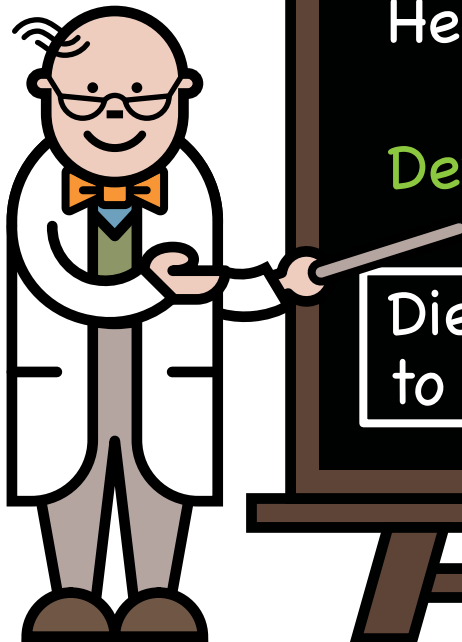
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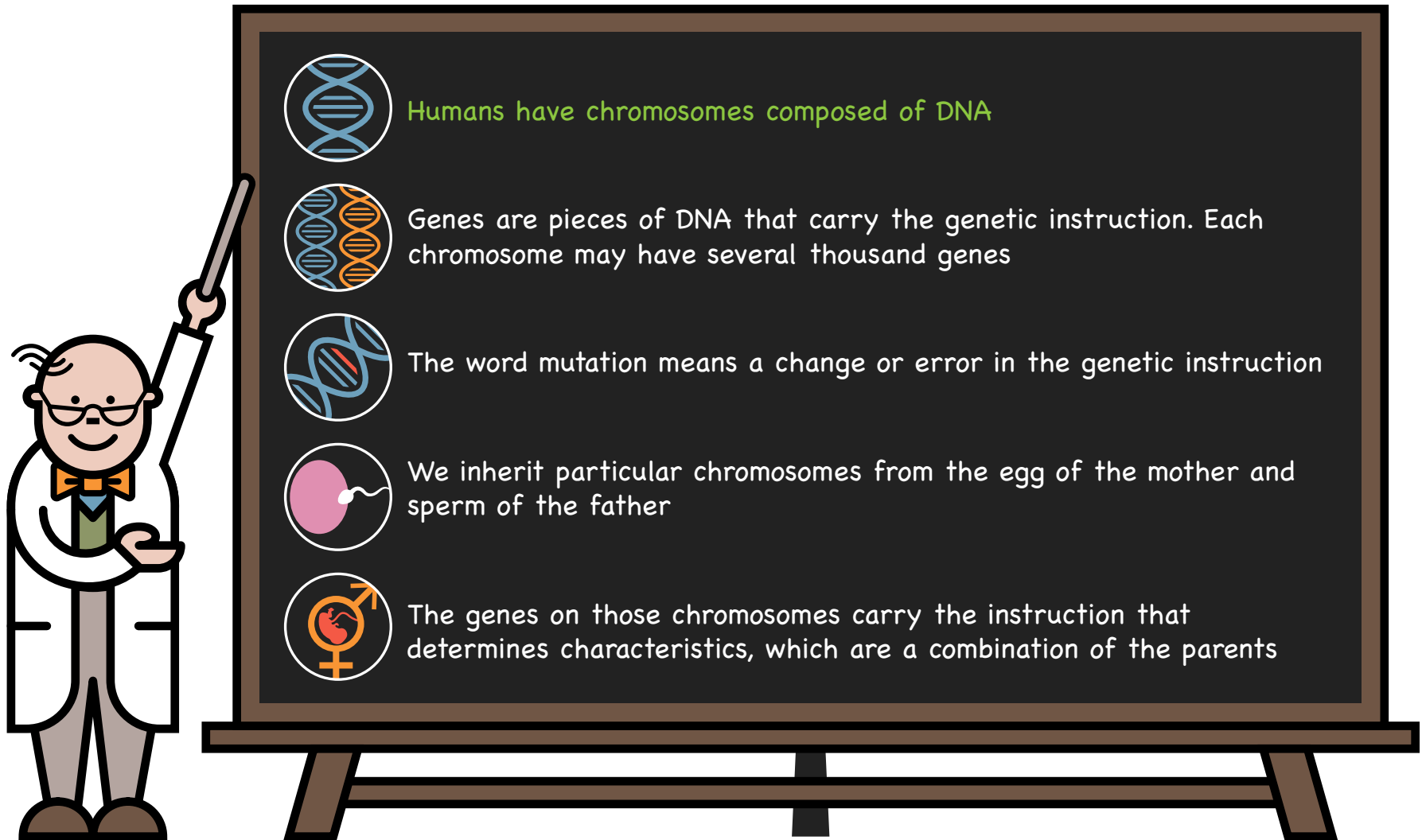
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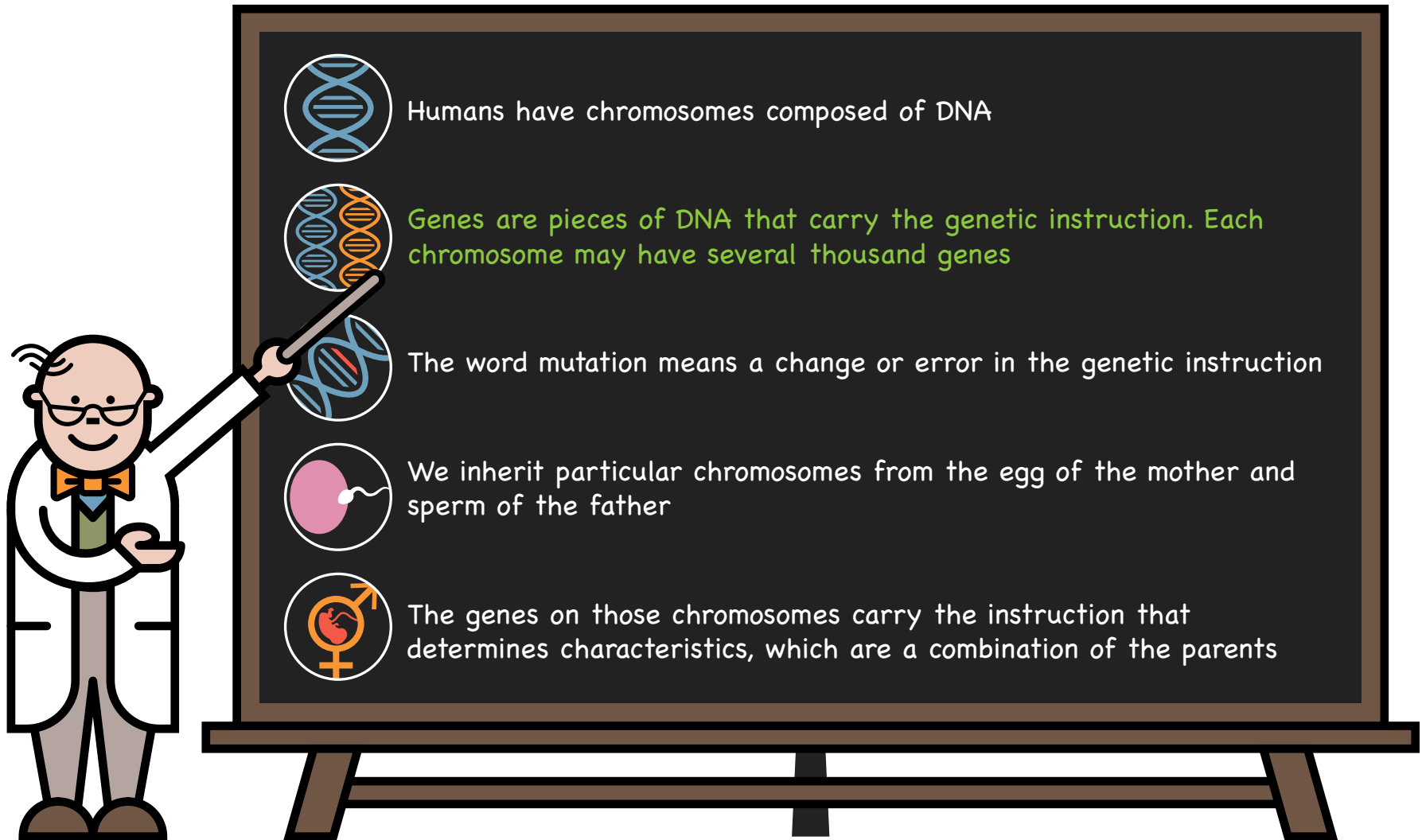
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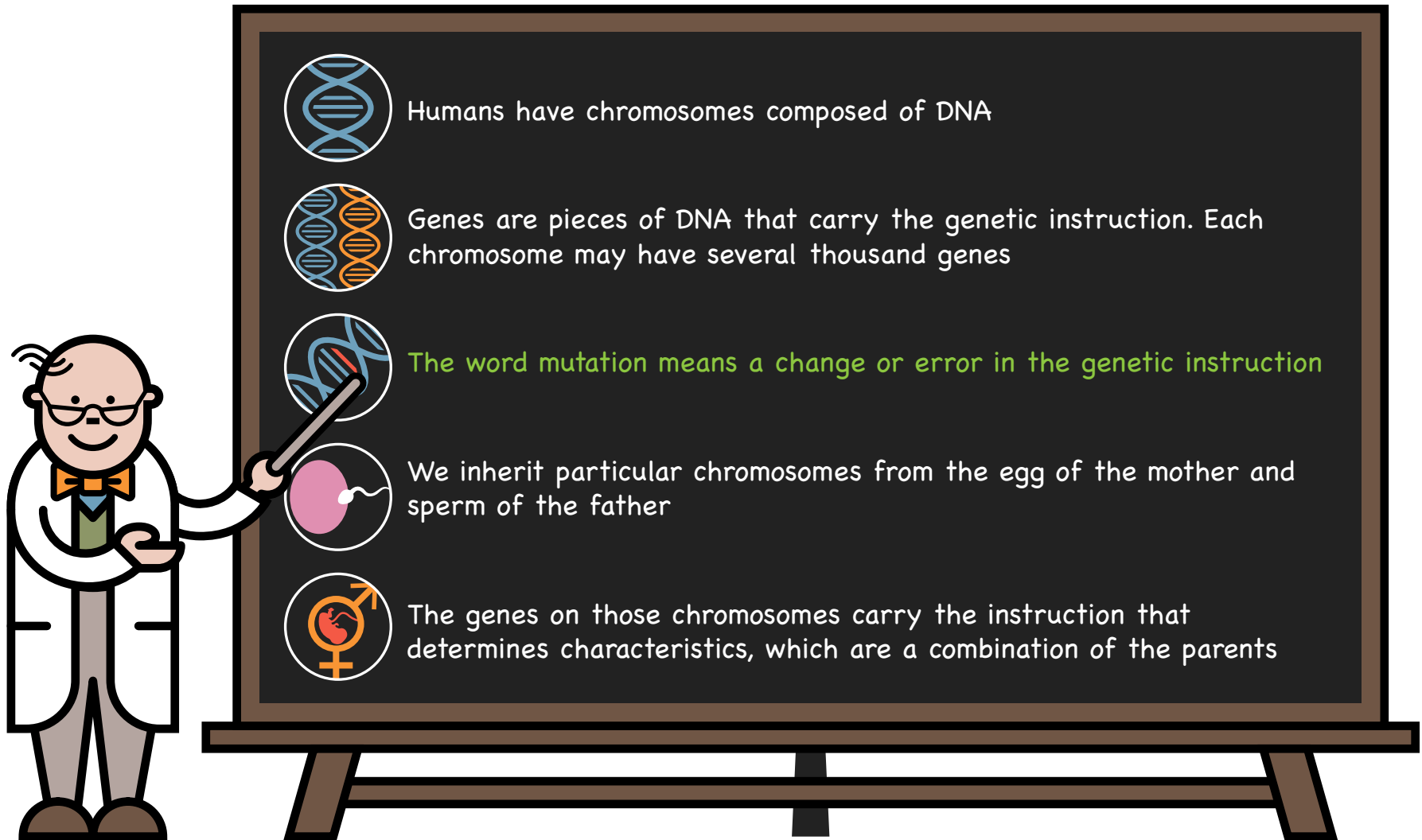
Chromosomes, genes, mutations



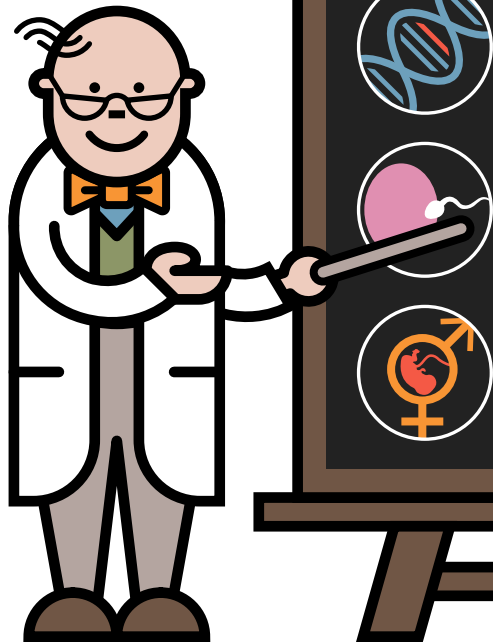
Chromosomes, genes, mutations



Chromosomes, genes, mutations



Chromosomes, genes, mutations



Humans have chromosomes composed of DNA



Genes are pieces of DNA that carry the genetic instruction. Each chromosome may have several thousand genes



The word mutation means a change or error in the genetic instruction

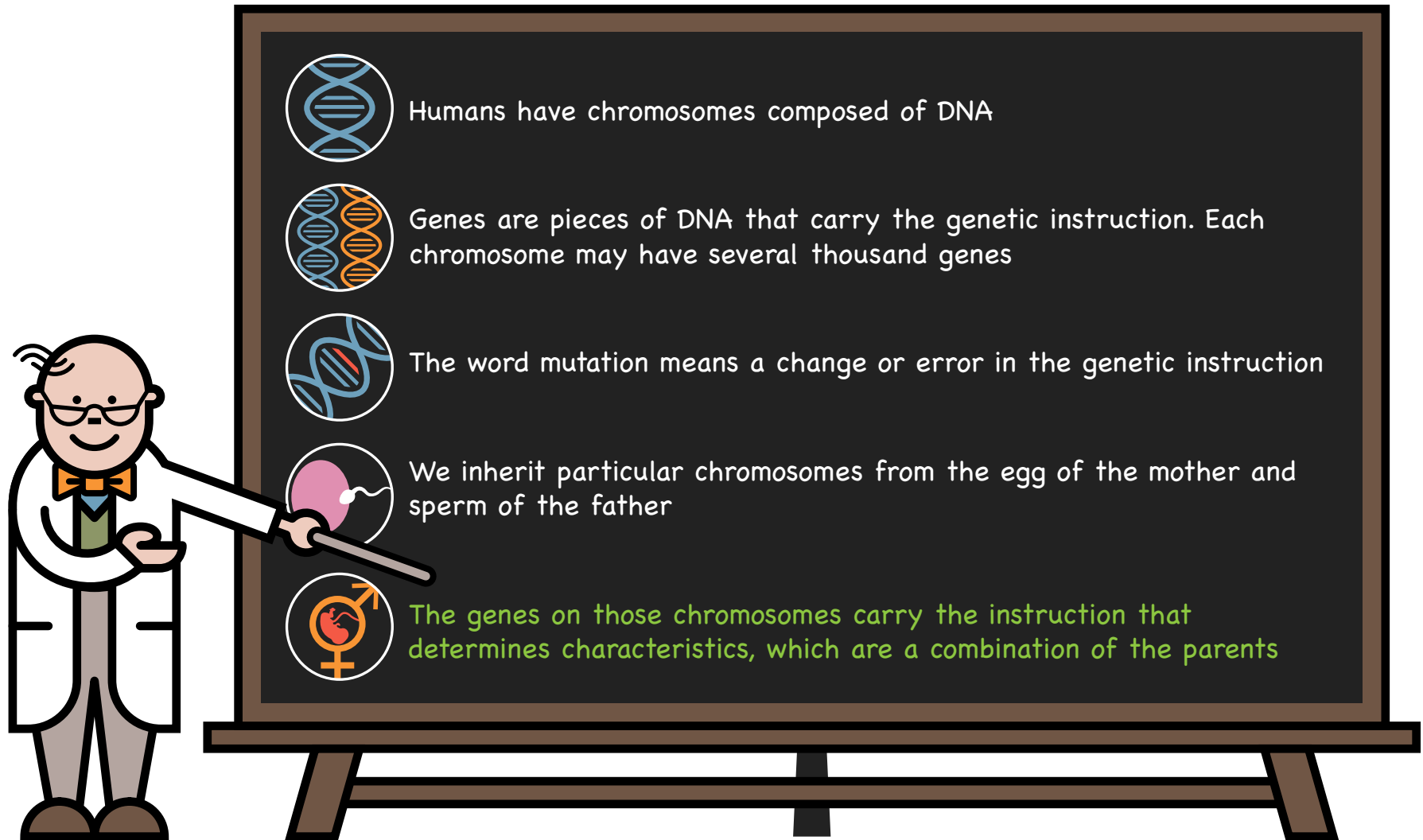


We inherit particular chromosomes from the egg of the mother and sperm of the father

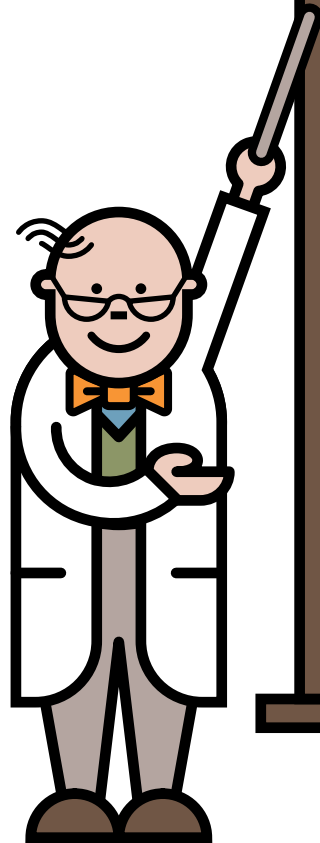


The genes on those chromosomes carry the instruction that determines characteristics, which are a combination of the parents

Chromosomes, genes, mutations



Inheritance



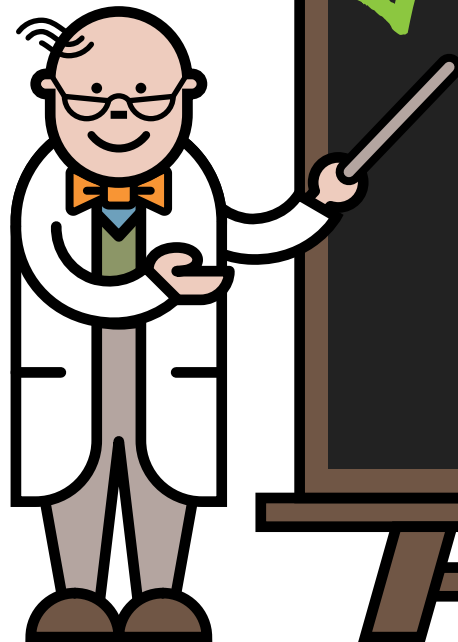
Citrullinaemia is an inherited condition. There is nothing that could have been done to prevent your baby from having Citrullinaemia

Everyone has a pair of genes that make the argininosuccinate synthetase enzyme. In children with Citrullinaemia neither of these genes work correctly. These children inherit one non-working Citrullinaemia gene from each parent

Parents of children with Citrullinaemia are carriers of the condition

Carriers do not have Citrullinaemia because the other gene of this pair is working correctly

Inheritance



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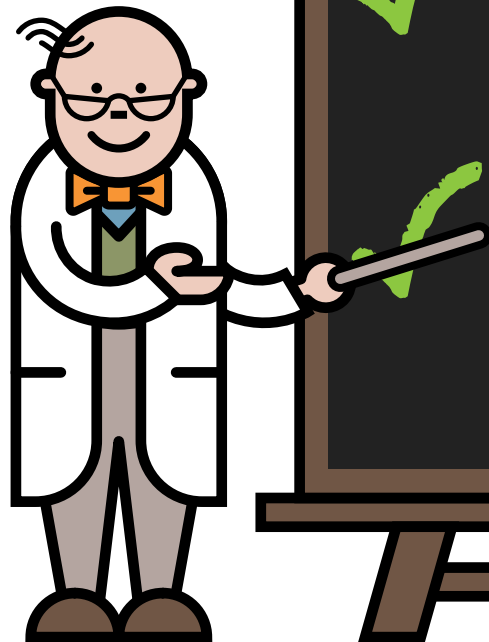


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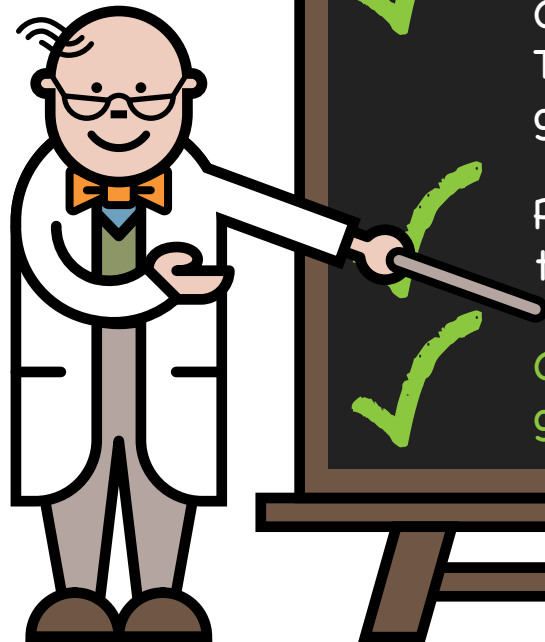
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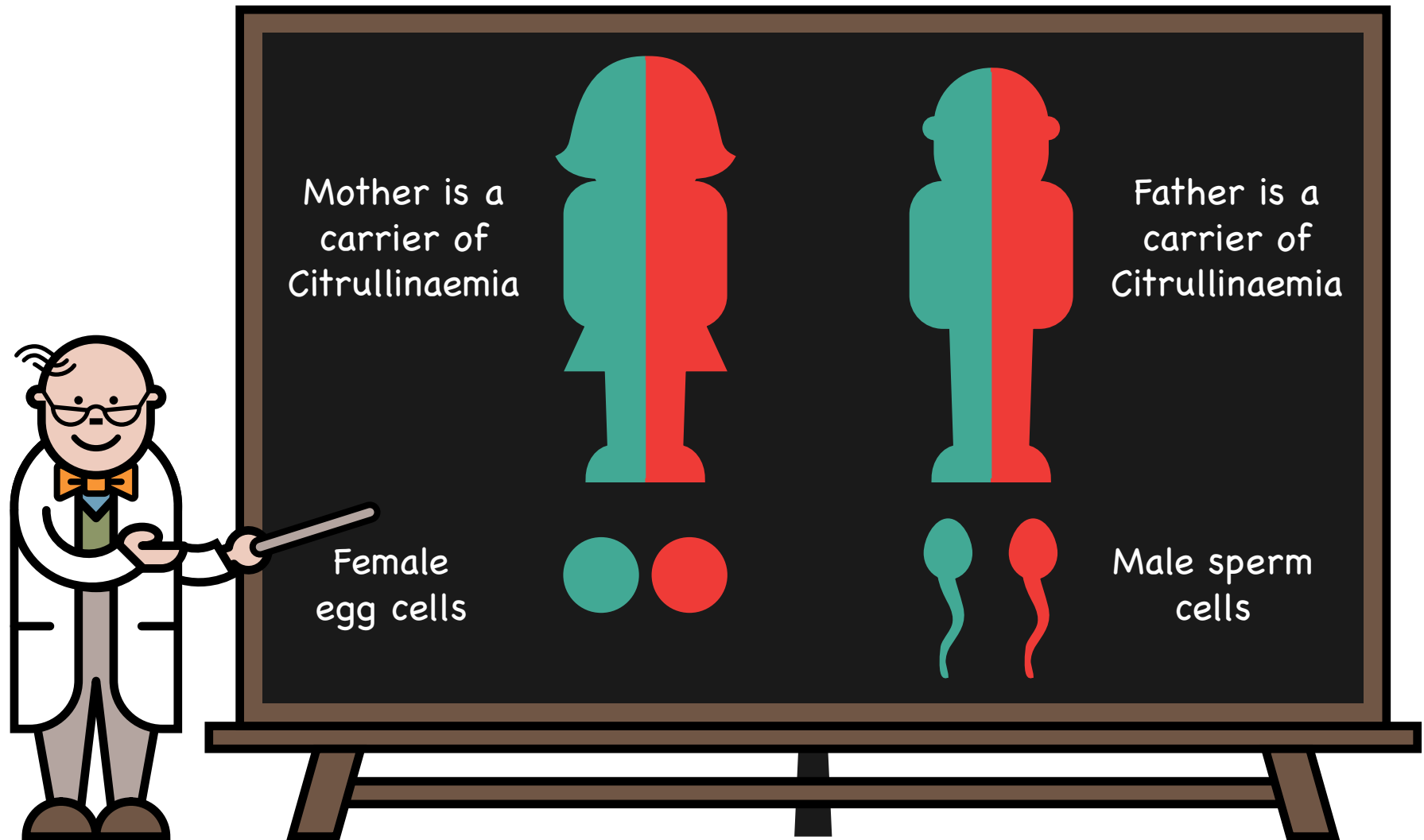


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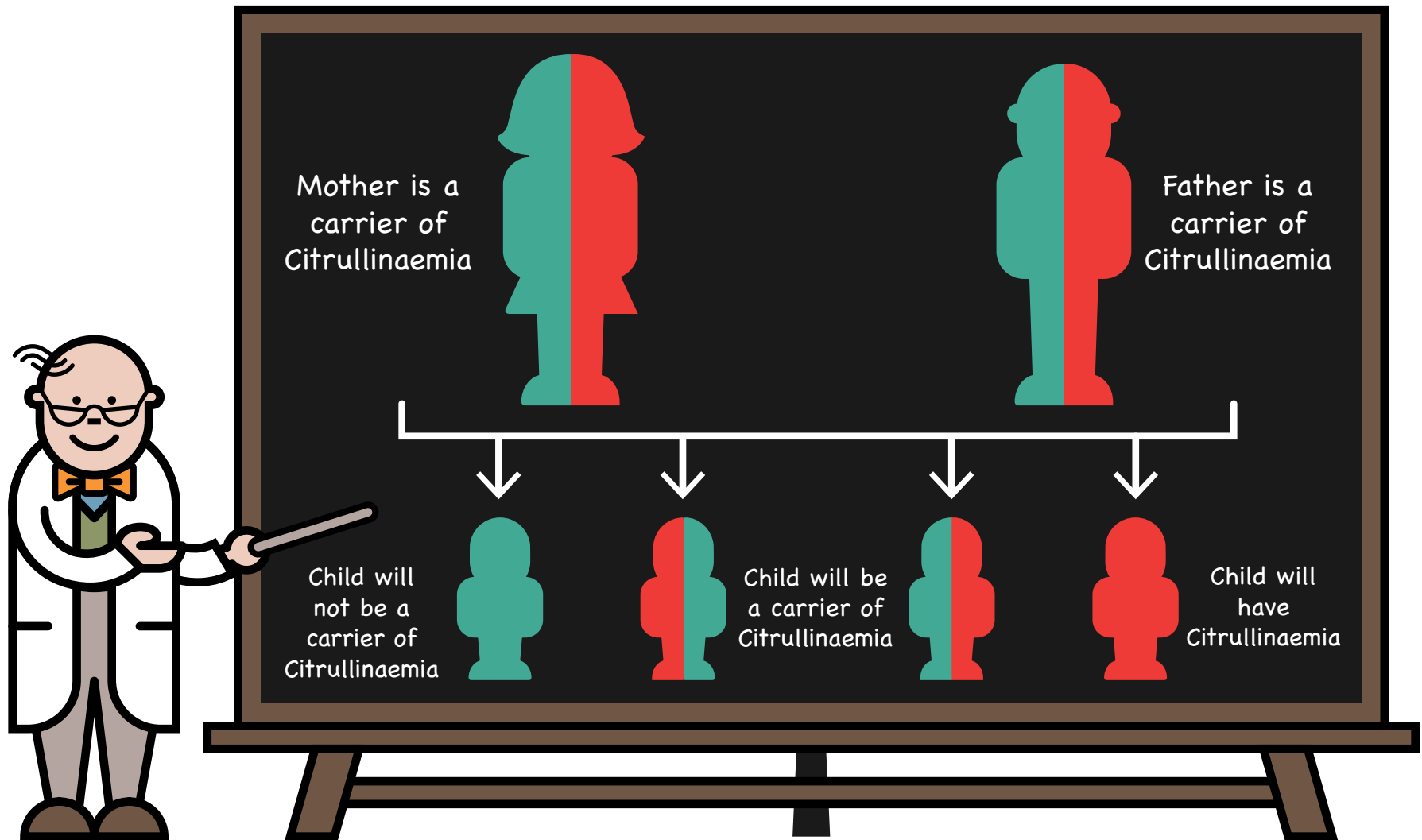


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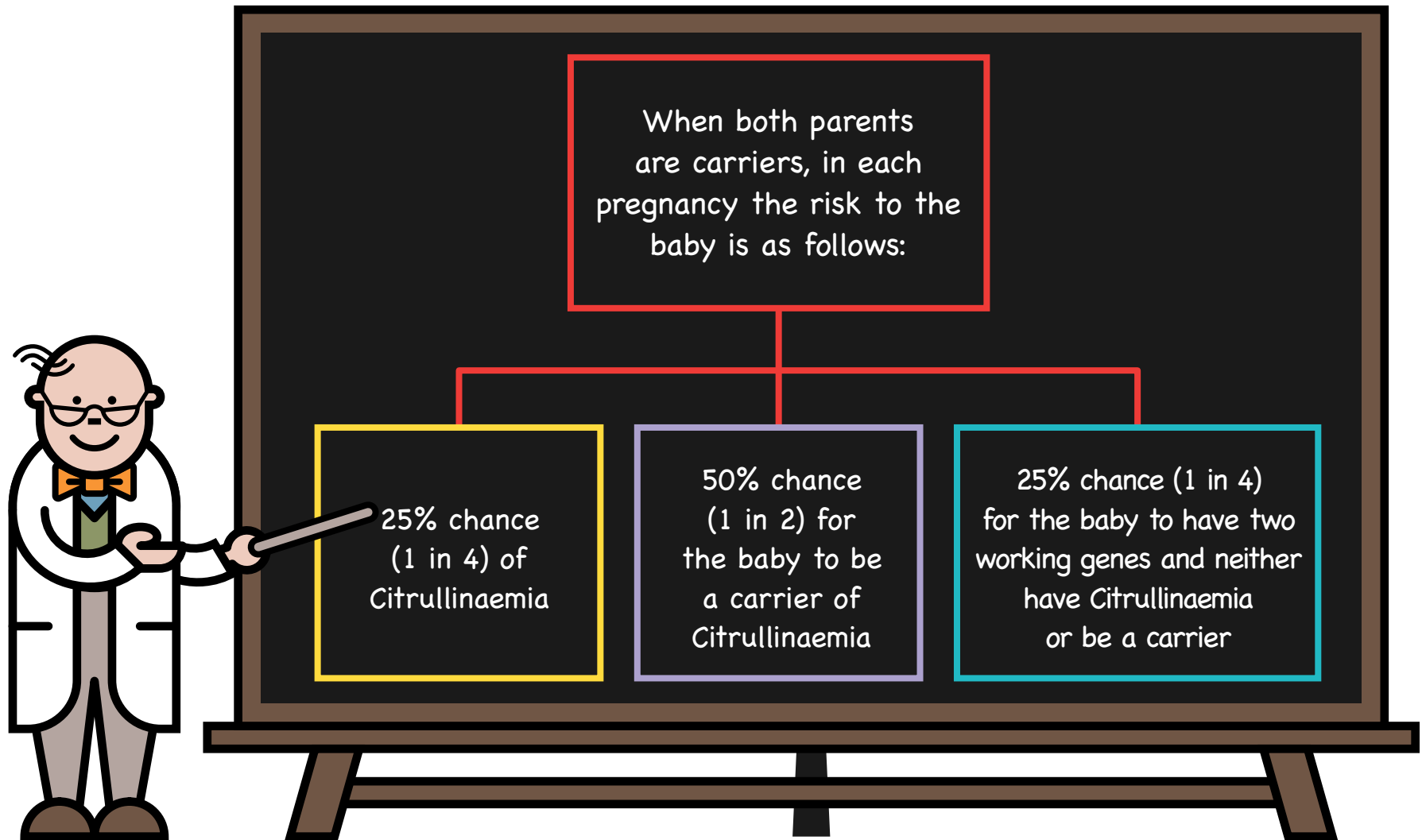
Inheritance – Autosomal recessive (carriers of Citrullinaemia)



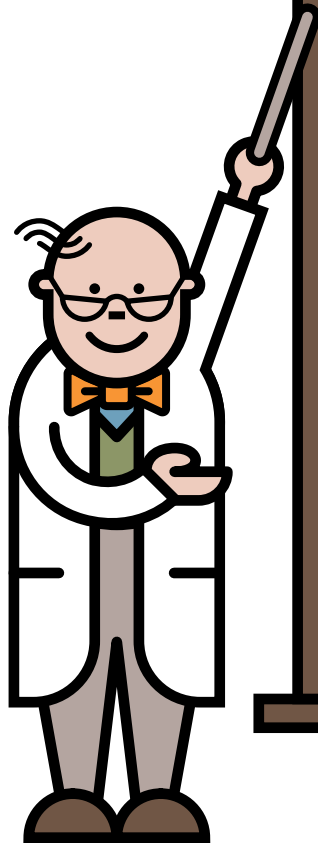
Inheritance – Autosomal recessive – possible combinations



Future pregnancies



Take home messages

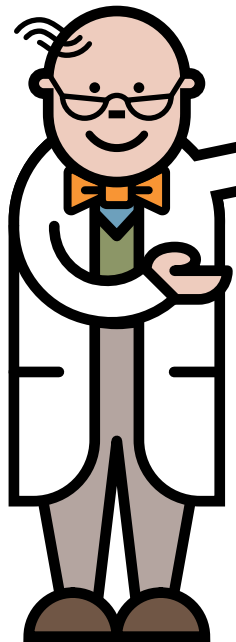


✓ Citrullinaemia is a serious inherited metabolic disorder that can lead to severe problems

The condition is managed with a protein restricted diet, regular feeding and medications

Remember, during illness, it is imperative that emergency feeds are started promptly, followed strictly and there are no delays in management

Take home messages



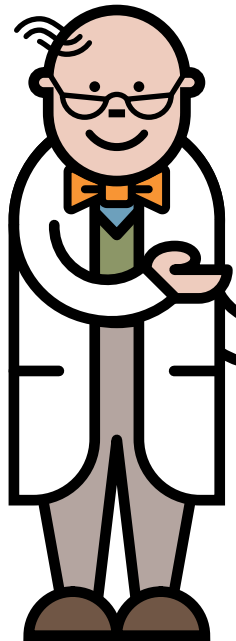
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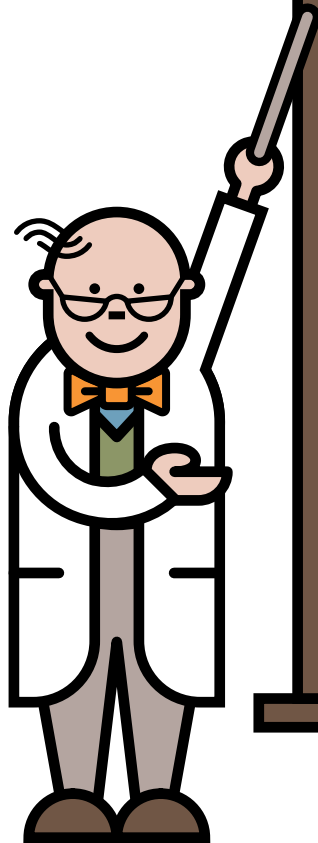
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- ✓ Citrullinaemia is a serious inherited metabolic disorder that can lead to severe problems
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Helpful hints



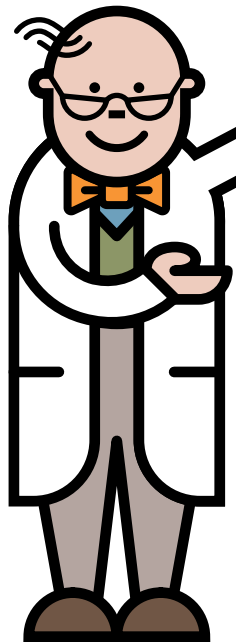
Always ensure you have a good supply of your dietary products and medicines and that they are in date

Your dietary products and medications are prescribed. These are obtained via a pharmacy or home delivery

Always ensure you have your emergency feed products and a written emergency plan

Medications to control fever should be given as normally recommended – always keep supplies available

Helpful hints



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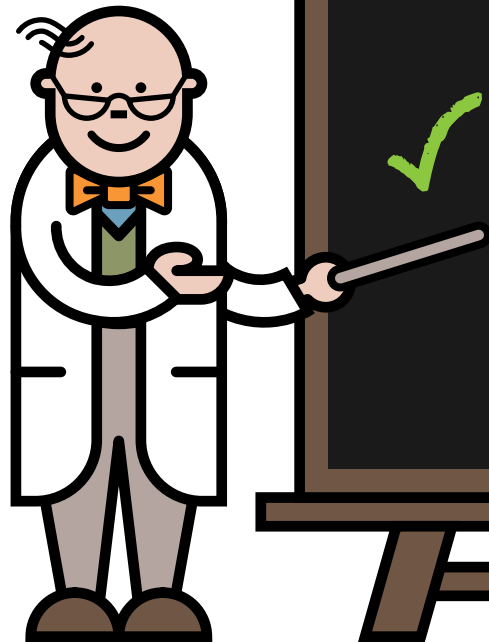


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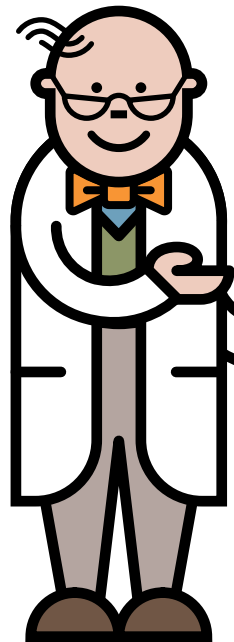
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Who's who

- My dietitians
- My nurses
- My doctors
 - Contact details, address, photos

Visit www.nutricia.co.uk/patients-carers/living-with/low-protein-diet.html and register to get access to support and practical advice for those living on a low protein diet.

The site also provides information on upcoming events and personal stories from others on a low protein diet.



@LowProConnect



LowProConnect



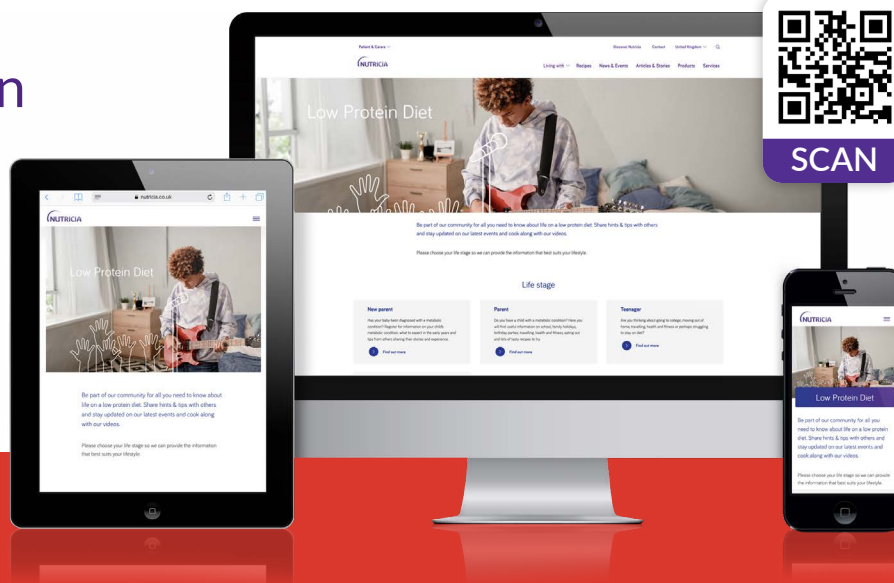
LowProteinConnect



LowProteinConnect



SCAN



BIMDG

British Inherited Metabolic Diseases Group



www.bimdg.org.uk

NUTRICIA
LIFE-TRANSFORMING NUTRITION

www.nutricia.co.uk

**METABOLIC
SUPPORT UK**

Your rare condition.
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