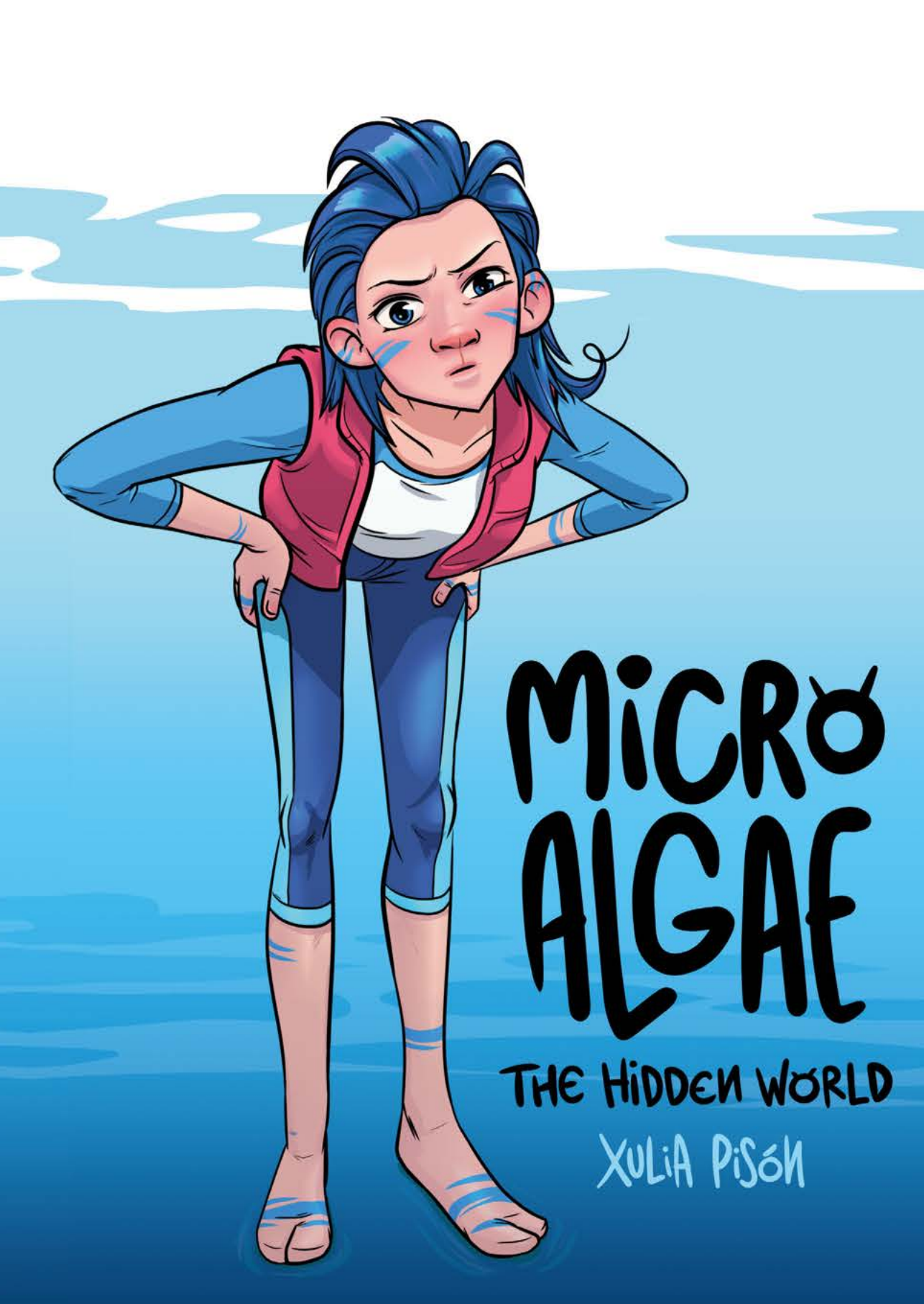
MICRO ALGAE
THE HIDDEN WORLD
XULIA PISÓN

MICRO ALGAE

THE HIDDEN WORLD

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MICRO ALGAE

THE HIDDEN WORLD

Micro- what?! The words microalgae and cyanobacteria refer to a group of more than 30,000 species of related organisms of which only a few dozen species have been studied in detail. Microalgae are found practically everywhere on Earth, from the poles to the tropics and all the places in between, and include some of the oldest types of organisms on the planet. Microalgae specimens can live in even the most extreme environments in the world, withstanding extremes of temperature and pH and high levels of pollution. Their versatility and robustness have made microalgae prime candidates for the terraformation of Mars. In spite of all this, they are virtually unknown by the general public and receive very little attention on the whole.

This comic has been created as part of the Enhance Microalgae (EMA) project, with the aim of raising awareness and understanding of this 'hidden world'. The project, financed by the European Regional Development Fund (ERDF) within its Atlantic Area call, brings together nine institutions from five different countries: Glecex (Spain), Swansea University (UK), University of Manchester (UK), Universidade do Porto (Portugal), Universidade da Coruña (Spain), Université de La Rochelle (France), and the technology research centres Teagasc (Ireland), INL (Portugal) and Anfaco-Cecopesca (Spain), which is leading the project.

Just as Popeye the Sailor helped people to realize the nutritional virtues of spinach, so too we would like to take readers on a journey into the fascinating, diverse world of microorganisms that are the bedrock of biotechnology and the food/feed industries of the 21st century.

SPIRULINA
Spirulina

Spirulina, Latin for 'small spiral', gets its name from its shape. In fact, two species are referred to as Spirulina: Arthrospira platensis and Arthrospira maxima. Curiously, although these species are often referred to as microalgae, Spirulina is actually a special type of bacteria called cyanobacteria. Cyanobacteria are tiny, unicellular photosynthetic organisms that form spiral colonies, and are blue-green in colour owing to a pigment called Phycocyanin, one of the few blueish pigments present in nature. Their spirals are just half a millimetre long.

Spirulina has a high percentage of protein (close to 60% of their body mass), including all of the essential amino acids and nine of the non-essential ones. Owing to its content of minerals, vitamins and micro-nutrients, Spirulina is considered an excellent natural food supplement.

APPLICATIONS

Because of its nutritional richness, Spirulina is considered a super food and is being researched as a way to help combat malnutrition in developing countries and global food shortages.

During the 1974 United Nations World Food Conference, Spirulina was declared the best food for the future.

CHAPTER 1:
A PERFECT WORLD

GOOD MORNING! IT'S A BEAUTIFUL DAY IN ALGAEVILLE. THIS IS YOUR LOCAL STATION. BRINGING YOU THE NEWS FROM HERE. THERE AND EVERYWHERE.

MUNCH MUNCH

BE READY WITH YOUR BUBBLESCOPES. BECAUSE IN THE INTERNATIONAL SECTION. WE HAVE REPORTS FRESH INTO FROM OUTER SPACE - OR AT LEAST FROM OUR SOLAR SYSTEM. WHAT'S THE NEWS FROM MARS?!

THE FOUR-YEAR MISSION ON THE RED PLANET HAS ENTERED ITS FINAL PHASE AND COMMANDER CHROOCOCCIDIOPSIS (WOW. WHAT A NAME!) HAS RETURNED TO EARTH WITH GREAT...

... NEWS FOR THE PLANET AND ITS INHABITANTS. ACCORDING TO MICRONASA SOURCES. THE TERRAFORMATION OF MARS IS HAVING MAGNIFICENT RESULTS AND COULD BE OUR NEW HOME VERY SOON. IN HER FIRST WORDS TO THE PRESS. THE COMMANDER STATED: "WHAT SEEMED LIKE SCIENCE FICTION IS NOW A REALITY."

CHROOCOCCIDIOPSIS RETURNS FROM HER MISSION TO MARS

"FOR MANY IT WAS NOTHING MORE THAN AN IMPOSSIBLE DREAM. WE SHOULD NOT BE AFRAID TO BE HEROES"

AAAHH

SPACE

LEAVE ME ALONE!

AAAH

ROOAHRG

ROOOU

WREECH

Hey!!

GET OFF HER!

THAT'S RIGHT! AND DON'T COME BACK!

AND WHO MIGHT YOU BE?

I... I... I'M NANNO. I... I'M LOST. I WAS RUNNING AWAY FROM THE MONSTER.

YOU WERE LUCKY. IT WAS JUST A BABY WATER BEAR.

AND NOW IT'S TIME FOR YOU TO HEAD HOME.

BUT WHAT IF THE MONSTER COMES BACK.

FINE. I'LL GO WITH YOU.

LET'S GO BEFORE I START TO REGRET IT.

YAY!

SO WHICH ALGAE CLAN DO YOU BELONG TO?

NANNOCHLOROPSIS!

WE'RE THE BEST MICROALGAE, YOU KNOW.

REALLY? AND WHY'S THAT?

BECAUSE IT'S OUR JOB TO FIGHT AGAINST CLIMATE CHANGE.

WE CAN ABSORB CO_2 AND DECREASE THE GREENHOUSE EFFECT...

I'LL SHOW YOU SOMETIME IF YOU LIKE!

JOIN ALGAE ARMY

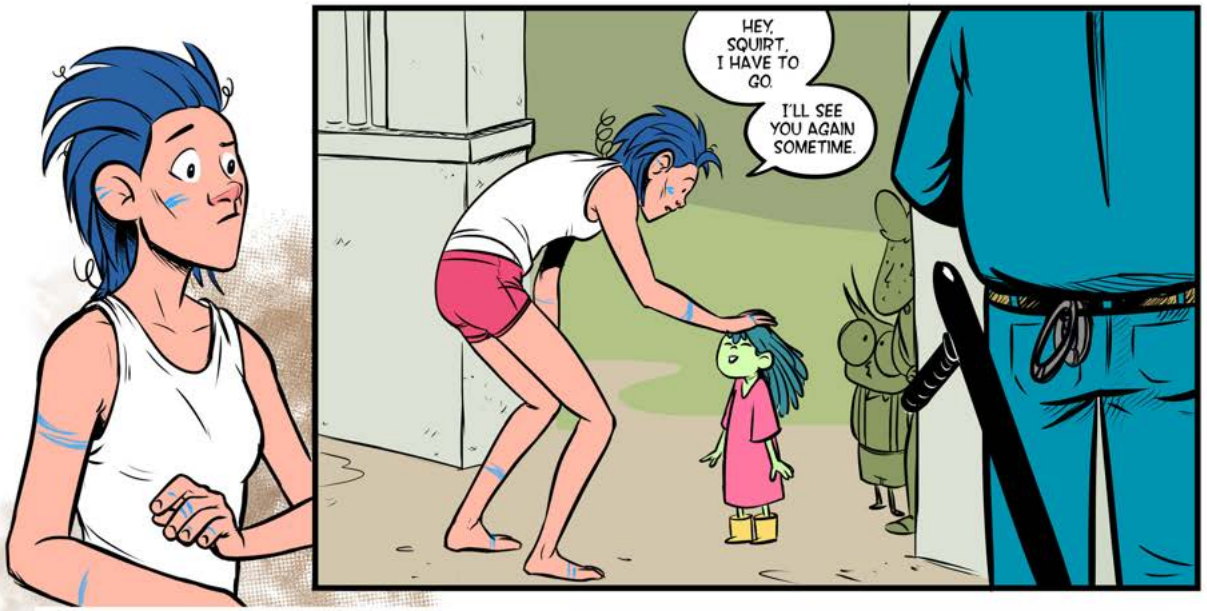
ALGAEVILLE

HERE WE ARE!

COME ON! I'LL INTRODUCE YOU TO MY FRIENDS!

STOP THERE!

EXCLUSIVE ACCESS MICROALGAE



NANNOCHLOROPSIS

Nanno

Nannochloropsis is a genus of microalgae comprising six known species (N. gaditana, N. granulata, N. limnetica, N. oceánica, N. oculata, N. salina). It is very small, with a cell diameter of approximately 2-3 micrometres (0.002-0.003 mm) and a very strong, simple structure.

The species is mainly marine, but is also found in fresh and brackish waters.

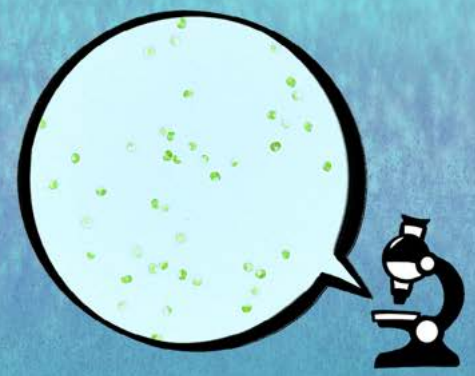
It can accumulate high concentrations of a range of pigments, such astaxanthin, zeaxanthin and canthaxanthin, and is also a prolific producer of omega-3 fatty acids.

APPLICATIONS

Nannochloropsis is considered a very promising alga for industrial applications owing to its ability to accumulate high levels of polyunsaturated fatty acids (PUFAs). These PUFAs are known for their food/feed nutritional applications.

Its high capacity for CO_2 uptake from the environment makes it a great ally in the fight against climate change. Because of this and others characteristics, experts are exploring ways to genetically improve existing Nannochloropsis strains, with promising results.

Currently, Nannochloropsis is mainly used in fish farming as a nutritionally rich food for larvae and rotifers (small food animals), and in the production of biofuel.



CHAPTER 2:
ONE OF A KIND

LOOK WHAT I FOUND NOSING AROUND IN THE GARDEN...

LET ME GO, GIANT! SPIRULINA IS A FRIEND OF MINE!

?

HE HE

weenk

PUF

WHAT'S UP WASTO? TOUGH DAY AT THE ACADEMY?

PFFF, YOU COULD SAY THAT!

WASTE MANAGEMENT IS HARDER THAN I THOUGHT...

THE TEACHER FOR HEAVY METAL MANAGEMENT 2 HAS IT IN FOR ME BECAUSE IT COMES SO EASY TO ME.

SERIOUSLY!

HEY, DO YOU WANT TO SEE WHAT I CAN DO?

WHOAA!

UBGLUBGLUBGL

I CAN CONVERT THE CO_2...

...IN O_2!

WOW!

UNBELIEVABLE! HOW CAN SOMEONE SO SMALL DO THAT?

SO, THIS IS HOW YOU SPEND YOUR TIME?

DON'T YOU HAVE ANYTHING BETTER TO DO?

WELL NO. YOU KNOW, NOT ALL OF US HAVE A NOBLE MISSION TO SAVE THE WORLD.

BESIDES, DON'T YOU DIATOMS HAVE THE WHOLE WORLD-SAVING THING COVERED?

YOU BET WE DO!

STARTING WITH THIS TOWN! THE TOXIN GANG IS UP TO SOMETHING AND I'M GOING TO STOP THEM. THAT'LL GIVE ME THE MERITS I NEED TO GO OUT INTO THE WORLD.

YES, LET'S GO SAVE ALGAEVILLE!

NOT SO FAST! I DON'T NEED TO GO SAVING ANYBODY.

COME ON, SPIRULINA. THIS WOULD BE OUR CHANCE TO SHOW WHAT WE CAN DO!

COME ON YOURSELF!

I'M NOT RISKING MY NECK FOR ANYONE.

I'M NOT LIKE YOU. I DON'T BELONG TO ANY CLAN...

AND I DON'T GO TO ANY FANCY ACADEMY, SO I DON'T HAVE TO PROVE MYSELF TO ANYBODY!

I'M NOT EVEN A MICROALGA!

SO COUNT ME OUT!

...

SCENEDESMUS
Wasto

Scenedesmus is a microalgae genus made up of 74 species and several subgenera. Fossil records date from 70 to 100 million years ago.

Scenedesmus is one of the most common genus of freshwater algae, with an extremely diverse morphology and a worldwide distribution.

It can occur as a single cell or form colonies of four to eight cells.

APPLICATIONS

This microalgae group is used to combat pollution through water bioremediation and in the treatment of different types of wastewater.

CHAPTER 3:
WE CAN BE HEROES

I KNEW IT!

THEY'RE PLANNING SOMETHING.

IT LOOKS LIKE THEY'RE GOING TO TAKE THOSE CONTAMINANT CONTAINERS SOMEWHERE AND EMPTY THEM INTO THE WATER...

I'LL GET CLOSER TO FIND OUT WHERE THEY'RE TAKING THEM.

HEY, WAIT A MINUTE, HERO...

WHY YOU?

AND WHO ELSE DO YOU HAVE IN MIND? YOU?

YOU DIDN'T EVEN WANT TO COME!

CUT IT OUT YOU TWO!

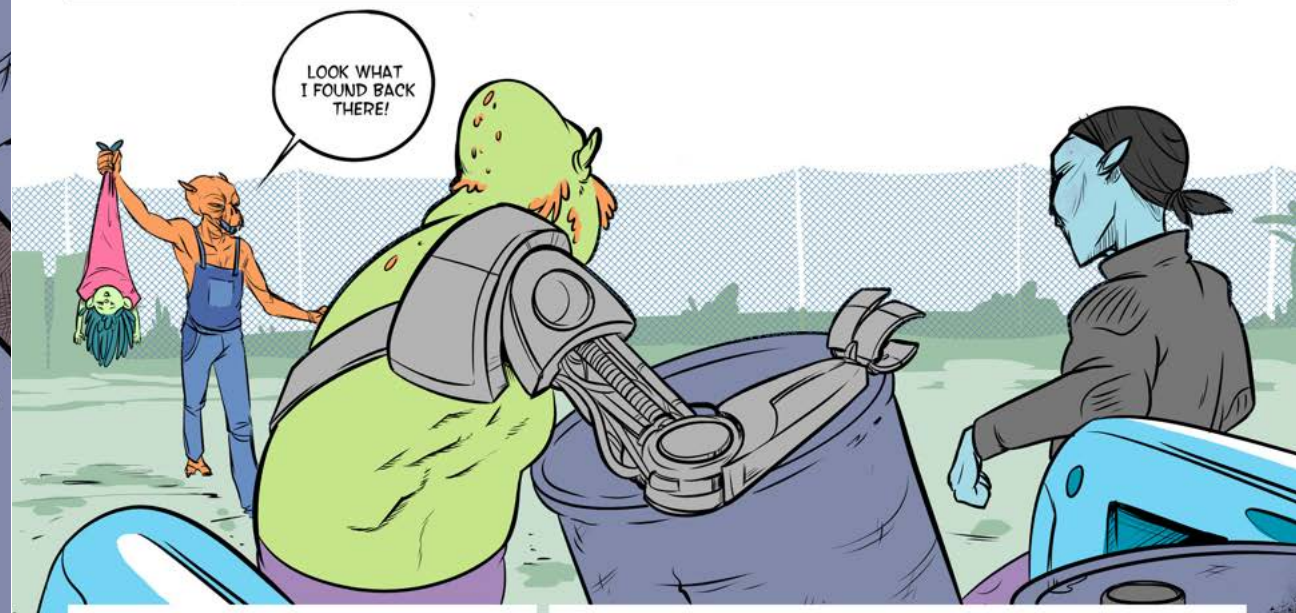
THAT'S ENOUGH, ALREADY.

WHERE'S NANNO!?

!!!


RISS
RISS
RISS
RISS
RISS


WELL, WELL...
WHAT DO WE HAVE HERE?


LOOK WHAT I FOUND BACK THERE!


WHAT WERE YOU UP TO?
MEDDLING MICROPHYTE! DIDN'T ANYBODY EVER TEACH YOU NOT TO STICK YOUR NOSE INTO OTHER PEOPLE'S BUISINESS?


WE DON'T HAVE TIME FOR THIS.
HANG HER ON THE HOOK AND WE'LL DEAL WITH HER LATER.

OH NO! WE HAVE TO HELP HER!

I KNEW IT. I KNEW THIS WAS GOING TO HAPPEN. I KNEW IT WAS A BAD IDEA.

WE HAVE... WE HAVE TO GO AND GET HELP. MAYBE WE SHOULD GO TO THE AUTHORITIES.

THERE'S NO TIME FOR THAT!

WE HAVE TO DO SOMETHING NOW! BEFORE THEY TAKE HER AWAY!

COME ON, WE NEED A PLAN. THINK!

THAT'S IT!

THE ROCKS!

IF WE MAKE THEM FALL...

THEY'LL CREATE A DOMINO EFFECT AND THE ROCK BRIDGE WILL GIVE WAY...

BLOCKING THE ONLY WAY OUT OF THE CANYON...

SO THEY WON'T BE ABLE TO TAKE NANNO WITH THEM.

I CAN DO IT, BUT I'LL NEED TIME TO GET UP THERE.

WE'LL BUY YOU SOME TIME!

DIATOM
Tom

Diatoms belong to a family of photosynthesizing microalgae known as phytoplankton. They are surrounded by a cell wall made of opaline silica (hydrated silicon oxide) called a frustule.

There are currently more than 200 known genera of diatom, 20,000 living species and an estimated 100,000 extinct species.

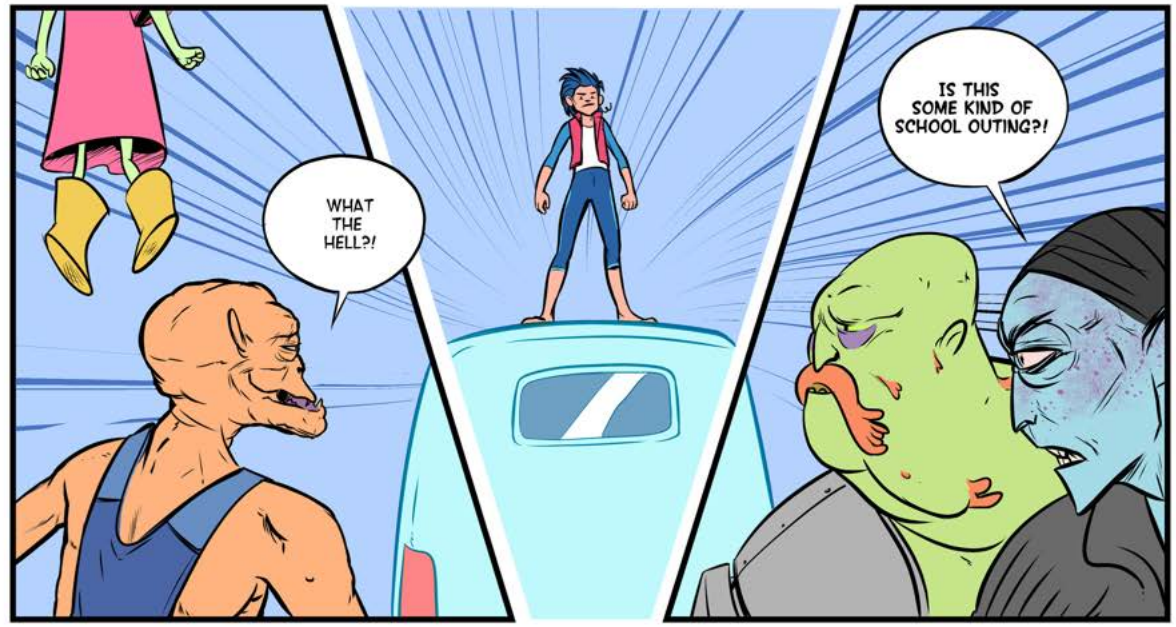
They can be found in any type of marine, freshwater, terrestrial or wet surface environments, and even under conditions of extreme temperature or salinity.

They are particularly important in oceans, where they are estimated to provide up to 45% of total ocean primary production.

APPLICATIONS

Diatomaceous earth is a soft, fine powder made up of tiny, interconnected particles of fossilized diatomaceous frustules. It has an astonishing array of uses and commercial applications, ranging from its most basic use as a natural fertilizer and insecticide, to the production of dynamite, cosmetics and toothpaste, and developments of all kinds in the fields of nanotechnology and pharmacology.

CHAPTER 4:
LEAVE NO ONE BEHIND



COME ON DOWN HERE, SWEETHEART, SO WE CAN TALK.

I HAVEN'T GOT TIME FOR YOU AND YOUR NONSENSE. YOU DON'T WANT TO MAKE THINGS WORSE, DO YOU?

COME ON DOWN HERE OR WE'LL TAKE YOU DOWN.

HE HE HELLO!

NICE BONESHAKER YOU GOT THERE.

I THINK I'LL HAVE THAT.

AND NOW YOU REALLY GOT PROBLEMS - COZ NOBODY TOUCHES MY MOTORBIKE, YOU LITTLE SCUT!

BRRRRRMM

THEN COME AND GET IT!

THOMP

HE HE

GLUPS

BROOUM

CRACK

WHAT THE HELL??

WHAT HAVE YOU DONE?!

YES!

YOU ARE DEAD!! I'M GONNA MAKE A NECKLACE OUT OF YOUR TEETH... DO YOU HEAR ME, SNOT?

WOOOSH

WHAT THE...?!

WOOOOSH

STAY WHERE YOU ARE!

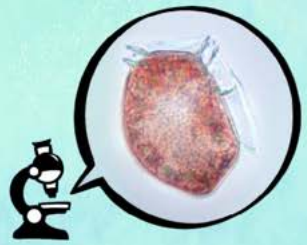
DROP YOUR WEAPONS!!

THE BIOLOGICAL THREAT HAS BEEN NEUTRALIZED. WE'VE STOPPED THE TOXIN GANG BUT TWO OF THE HOSTAGES ARE SERIOUSLY INJURED.

YES, SIR. WE'LL TAKE CARE OF THE EVACUATION.

DINOPHYSIS ACUTA

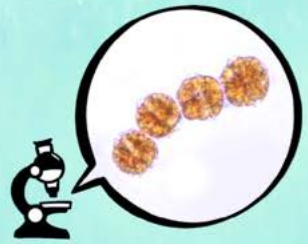
It is a dinoflagellate and an unusual photosynthetic protist insofar as it also eats. It is one of the main producers of the diarrheic toxin (okadaic acid) responsible for the harmful algal blooms (HABs, or 'red tides') that typically contaminate bivalves, marine crabs and other species.



ALEXANDRIUM CATENELLA

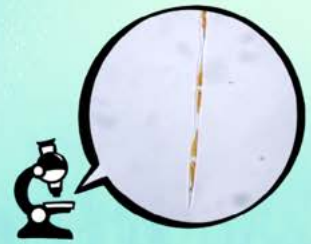
Another dinoflagellate, Alexandrium catenella is responsible for HAB events on the coasts of America, Australia and Africa.

It produces a powerful paralyzing neurotoxin known as saxitoxin.

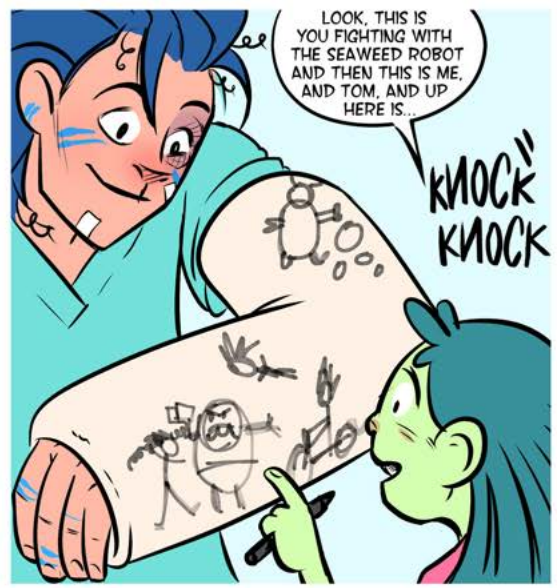


PSEUDONITSCHIA AUSTRALIS

Pseudonitschia australis is a type (genus) of unicellular algae classed as diatomea. Unlike Tom, however, this diatom produces an amnesic toxin (domic acid), which is transmitted through molluscs that have accumulated the toxin.



CHAPTER 5:
YOU WERE NEVER REALLY ALONE



I'M GLAD YOU'RE ALL OKAY.

WE ARE MADE OF TOUGHER STUFF THAN THAT!

HM-FRBH

I CAN'T BREATHE!

I DON'T KNOW HOW WE'RE GOING TO EXPLAIN THAT WE MADE UP THE PLAN AS WE WENT ALONG.

WE HAD TO DECIDE FAST.

I GUESS BUT REMIND ME NOT TO FOLLOW SPIRULINA AGAIN IN ANY MORE OF HER CRAZY PLANS. HE,HE!

HE HE

HEY, I NEVER SAID IT WAS A GOOD PLAN! BUT IT WORKED, DIDN,T IT?

I DREW ON HER PLASTER.

TOC TOC

PLEASE FORGIVE THE INTERRUPTION. AS SOON AS YOU'RE READY. I WOULD ASK YOU TO COME WITH ME. THE MAYOR IS WAITING FOR YOU IN HIS OFFICE FOR AN EMERGENCY MEETING.

THIS IS UNBELIEVABLE! IN ALL THE YEARS I'VE LIVED IN THIS COMMUNITY, I'VE NEVER SEEN SUCH A LACK OF COMMON SENSE!

WHAT ON EARTH WERE YOU THINKING? WERE YOU NOT THINKING??

TELL ME, WHAT DO YOU THINK WOULD HAVE HAPPENED IF WE HADN'T BEEN WATCHING THE BAND'S ACTIVITIES?

IF WE HAD NOT BEEN PREPARED TO INTERVENE, YOU WOULD HAVE BEEN KILLED THERE AND THEN - OR WORSE!

SUCH RECKLESS BEHAVIOUR IS UNHEARD IN YOUR CLANS.

YET...

I CANNOT DENY THAT WHAT YOU DID WAS VERY NOBLE AND REQUIRED GREAT COURAGE. THE MEDIA ARE DELIGHTED WITH YOUR STORY AND YOU ARE AS AN EXAMPLE FOR MANY YOUNG MICROALGAE.

AS A MAYOR, THEREFORE, I WILL BE RECOMMENDING THAT YOU BE PROMOTED TO THE OPERATIONAL LEVEL AS SOON AS I RECIEVE CONSENT FROM YOUR CLAN SUPERIORS. YOU CAN GO OUT AND LEARN HOW TO SAVE THE WORLD AS TRUE HEROES.

NOW, IF YOU'LL EXCUSE US, I'D LIKE A FEW MINUTES ALONE WITH SPIRULINA.

WHAT DO YOU KNOW ABOUT YOUR SPECIES, DEAR?

NOT MUCH, I'VE ALWAYS BEEN ALONE. I NEVER MET MY PARENTS, AND I'VE NEVER HEARD OF OTHERS LIKE ME. I AM THE ONLY ONE LEFT.

THE ONLY ONE LEFT... HERE.

YOU LISTEN TO ME, YOUNG LADY. CYANOBACTERIA HAVE BEEN AROUND FOR 3 000 MILLION YEARS, THEY CREATED PHOTOSYNTHESIS AND SHAPED THE WORLD AS WE KNOW IT BY ADDING OXYGEN TO THE PRIMITIVE ATMOSPHERE.

MICROALGAE COME FROM THEM. THEY ARE OUR EVOLUTIONARY ANCESTORS.

ALL YOUR LIFE, YOU HAVE THOUGHT YOU WERE THE LAST OF AN INFERIOR SPECIES. BUT YOU JUST HAD THE BAD LUCK TO GROW UP IN A COMMUNITY POPULATED EXCLUSIVELY BY MICROALGAE, WHERE NOT MANY WANT TO ADMIT THE TRUTH ABOUT YOUR SPECIES.

I KNOW YOU DO NOT HAVE A CLAN BEHIND YOU, UNLIKE YOUR THREE FRIENDS. SO, IN YOUR CASE, I WILL BE THE ONE TO AUTHORIZE YOUR EXIT INTO THE WORLD - IF YOU STILL WANT TO FIGHT AGAINST THE THREATS TO THE ENVIRONMENT, THAT IS...

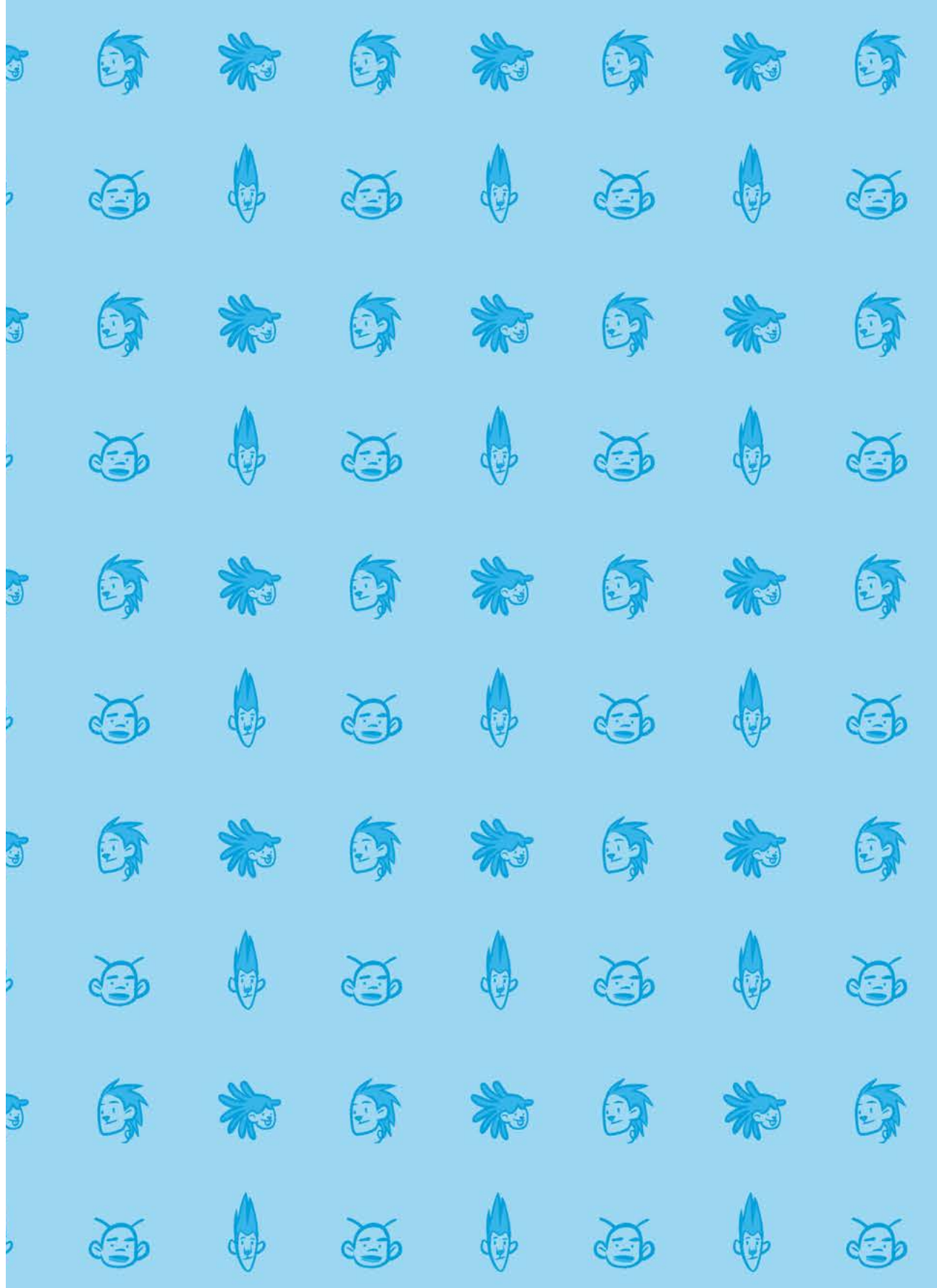
...AND DISCOVER YOUR ORIGIN AND TRUE PLACE IN THIS WORLD.


THANK YOU


WHAT DO YOU THINK IS GOING ON IN THERE?
I DON'T KNOW...
CREEEE
WHAT DID HE SAY? IS THERE A PROBLEM?
WHAT HAPPENED?
WELL... IT SEEMS THAT...
YOU'RE GOING TO BE FOLLOWING MY CRAZY PLANS FOR A LITTLE LONGER!

MICRO ALGAE

THE HIDDEN WORLD



Microalgae have been in the world for 1.5 billion years. With the help of these small organisms, we can save the planet from threats such as climate change, pollution and global malnutrition.

However, microalgae have their own problems. If you don't believe me, just ask Spirulina! It's not easy to find your place in the world when you're different.

UNIVERSIDADE DA CORUÑA

ENHANCE MICROALGAE

Interreg Atlantic Area
European Regional Development Fund

EUROPEAN UNION