



# SINC

## Symbiosis in Nature and Community

A Designmatters Studio in Partnership with the J. Craig Venter Institute



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## Designmatters

Designmatters is ArtCenter College of Design's social impact department, with the mission to utilize art and design education as a catalyst for change, imagining and building a more humane future for all. Through Designmatters, students, faculty and alumni from across disciplines are engaged in an ongoing exploration of the role of art and design in effecting large-scale sustainable change through innovative partnerships, locally and around the world. It is through the impressive outcomes generated by Designmatters that the College became the first design school to receive United Nations Non-Governmental Organization (NGO) status. The award-winning social innovation outcomes of Designmatters throughout the past decade are providing a key foundation for the framework of Media Design Practices: Field, a graduate track in the College's Media Design Practices program that focuses on communication design at the intersection of new technology and social engagement.

## J. Craig Venter Institute

The J. Craig Venter Institute (JCVI) is a world leader in genomic research with approximately 150 scientists and staff who are bold innovators fearlessly pursuing revolutionary ideas. With a long track-record of creativity and an interdisciplinary approach to genomics, JCVI is committed to accelerating foundational scientific research to drive advances in human health and environmental sustainability.

JCVI is advancing the science of genomics through bold innovations. Our mission is to understand more about the biological world, and to develop unique insights and answers about disease, health, and the environment for the benefit of all.

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Copy Editor: Alex Carswell  
Printed By: Typecraft

This material is based upon work supported by the  
National Science Foundation under Grant No. IOS 1926972

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SYMBIOSIS  
AS A



COMMUNITY  
STRUCTURE

Sketch by Madison E. Griffin

“

*We have been so isolated from each other for a long time, and this class gave us the chance to be connected and form connections.*

– Rachael Chan, ArtCenter student



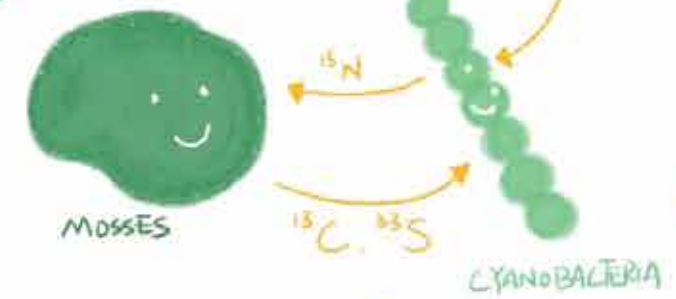
# PROCESS

1. LACK OF NITROGEN
2. USE CHEMICAL SIGNAL TO TELL *HELP!*
3. RECEIVE THE SIGNAL *got it!*
4. GENOMICS THAT ENABLES MOBILITY
5. LIVE ON THE SURFACE (EPIPHYTIC) TO PROVIDE NITROGEN.

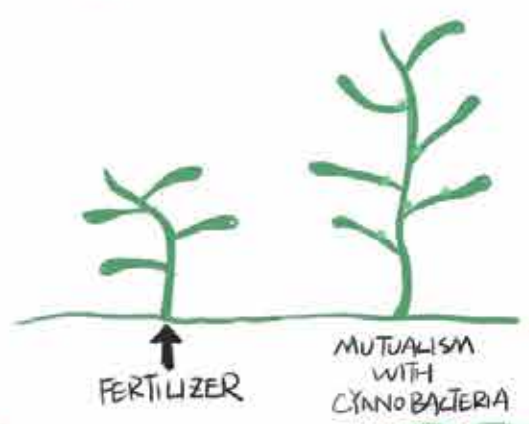
ONLY 0.25% OF THE GENOME PARTICIPATE IN THIS PROCESS.

USE <sup>15</sup>N, <sup>13</sup>C, <sup>33</sup>S TO TEST HOW THEY TRAVEL BETWEEN EACH OTHER.

## MUTUALISM.



## BENEFITS.



LIVE BETTER!



A KIND OF SYMBIOSIS

- PARASITIC (X)
- COMMENSAL (✓)
- MUTUALISM (✓)

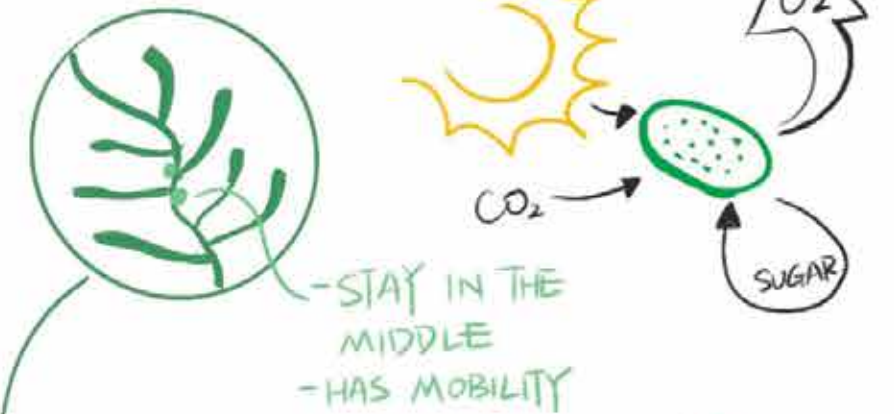
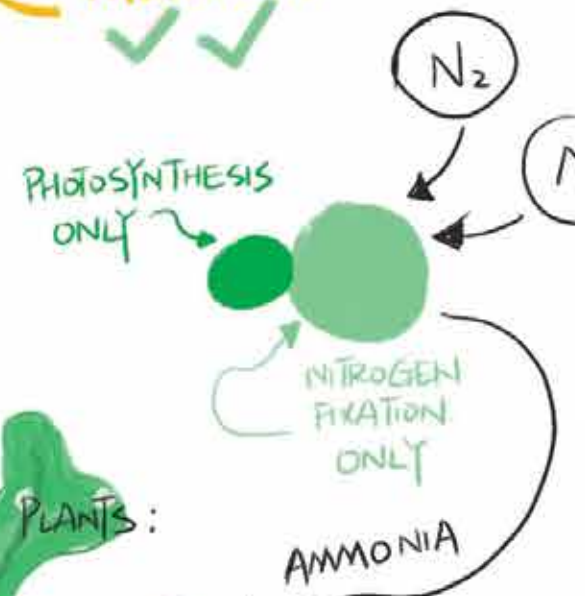
# THE UNIQUE MUTUALISM.

between **MOSSES** and **CYANOBACTERIA**



PROVIDE FOOD SOURCE TO PLANTS:

- CYCADS
- BRYOPHYTES
- GUNNERA
- MOSSES



TYPICAL KINDS OF MOSSES.

MOSSES

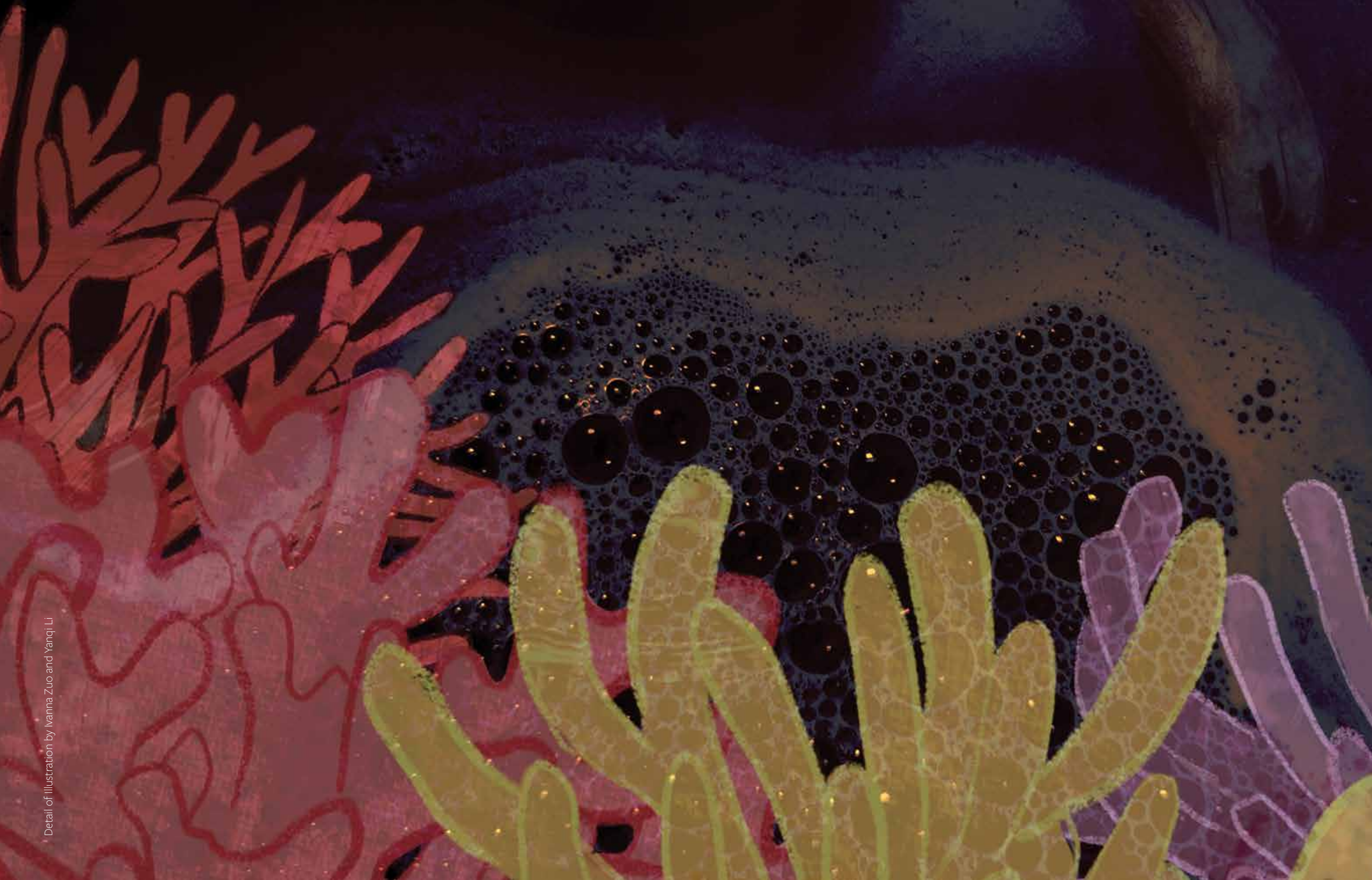
# Symbiosis

Symbiosis is the interaction between two or more organisms which provides benefits for both or all parties involved. Symbiotic interactions are ubiquitous throughout nature and provide natural design principles for engineering.

Many relationships involve microbes partnering with animals or plants in visually arresting and molecularly complex fashions. For example, mosses in boreal forests acquire one of their essential nutrients from a microbial partner. Yeti crabs harbor colonies of bacteria that provide sustenance at the bottom of the ocean. The concept of symbiosis extends to societal organizations, as well; physical distancing and mask wearing during a viral pandemic is a clear example of symbiosis.





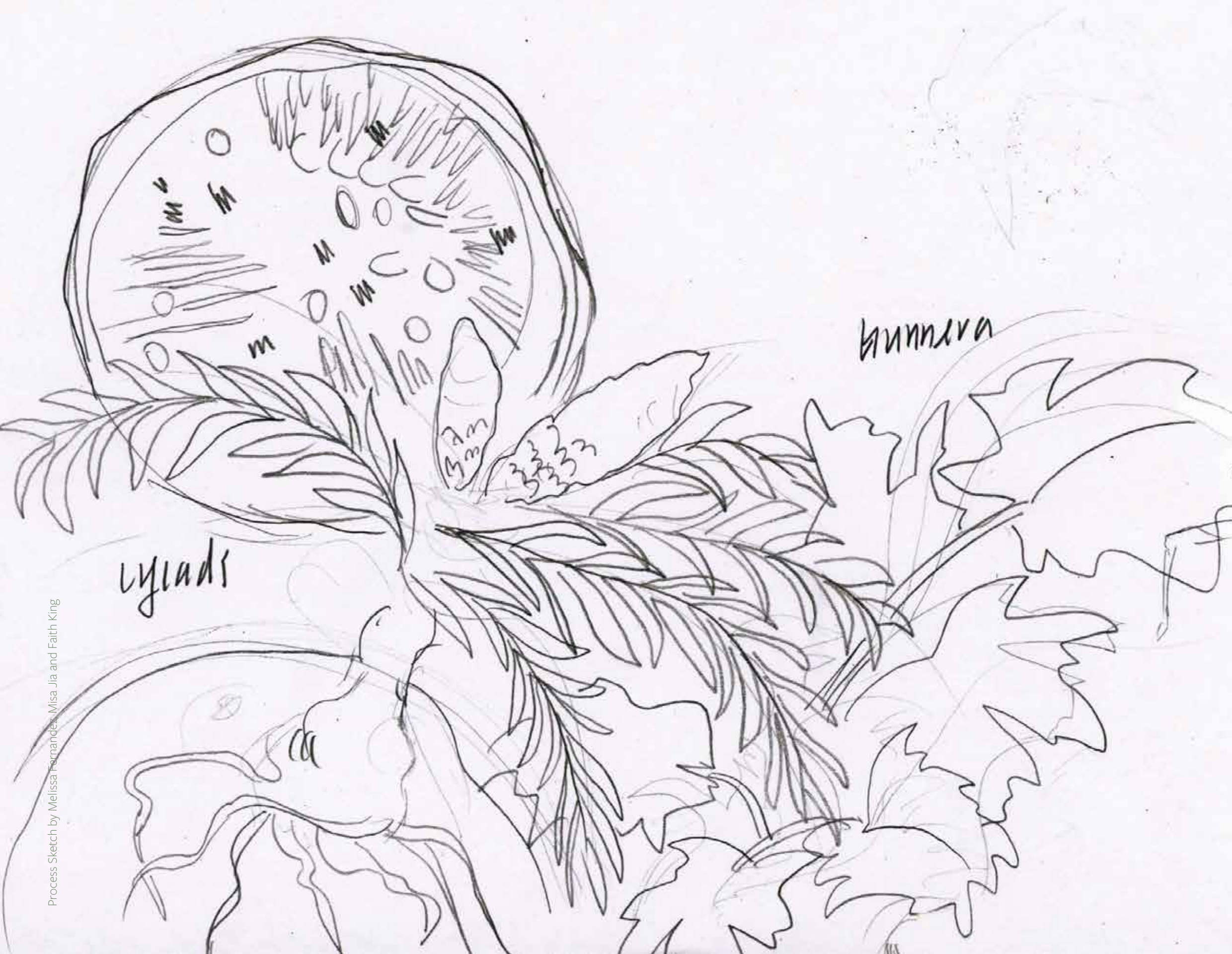


Detail of Illustration by Ivanna Zuo and Yanqi Li

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Process Sketch by Melissa Fernandez, Misa Jia and Faith King

## Introduction Jennifer May

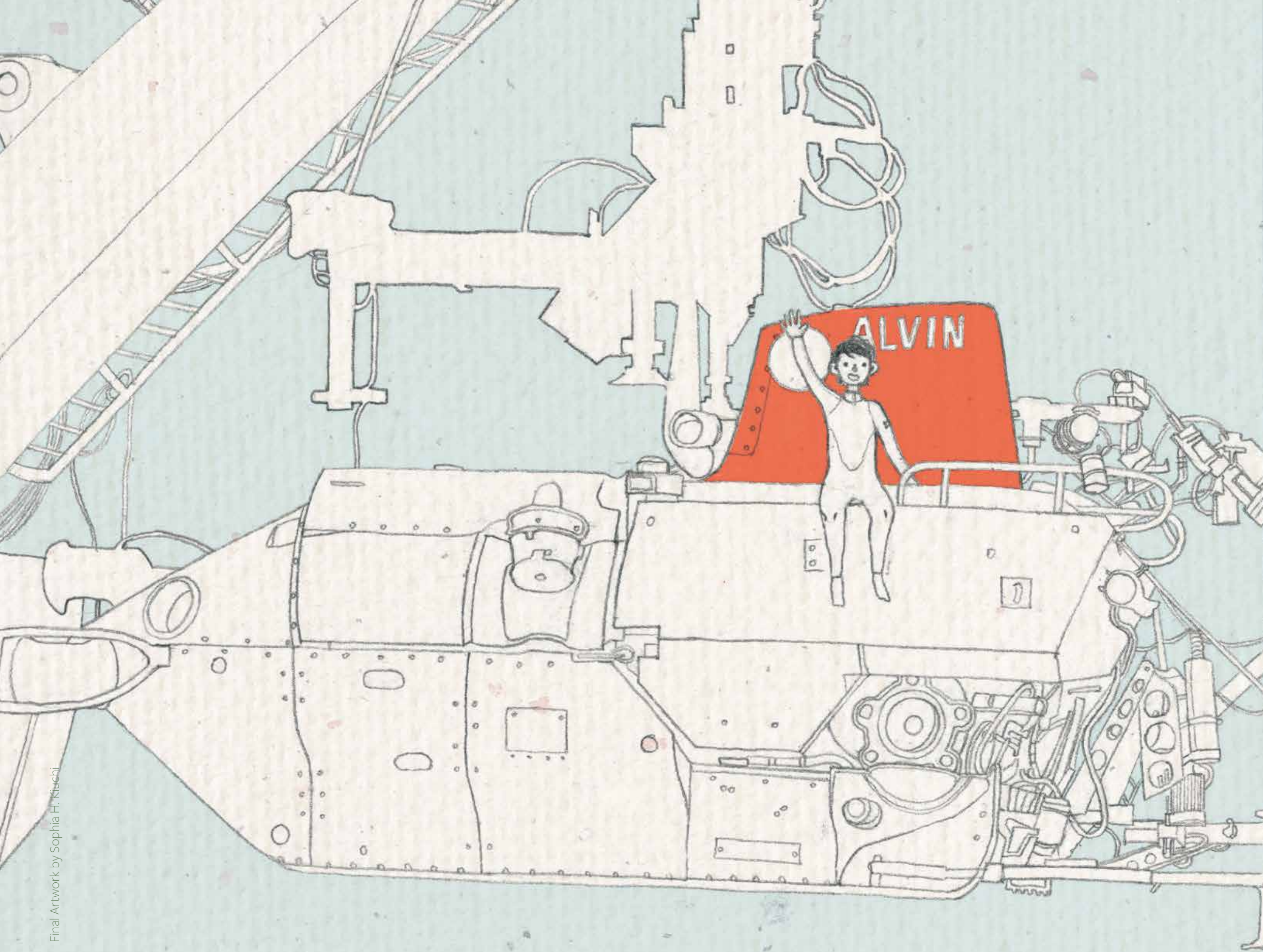
Executive Director, Designmatters Department

In the Fall of 2016, 14 ArtCenter College of Design students and I boarded a shuttle bus to Newport Beach to attend the “Discovering the Deep Blue Sea” symposium. The National Academies Keck Future Initiatives (NAKFI) had invited the students to attend the conference to act as visual documentarians to capture the questions, insights, and ideas of the 170 scientists, researchers, and experts in attendance. The symposium was organized to have the large group break apart into smaller and smaller groups until teams were formed around specific topics and ideas connected to ocean exploration and conservation. The students dispersed themselves among the teams, and as I floated among the

various meeting rooms, hallways and outdoor groupings checking in, it became apparent that the students were not merely documenting the conversations.

Through the act of visualizing, the students were becoming partners in ideation with the symposium participants. The expertise of the professionals and the creativity of the student designers were feeding off one another, making the ideas stronger, bolder, and more tangible. One team was discussing “soft robots” to handle fragile ocean creatures. The students in that team were sketching out what those soft robots might look like —singular forms based on kitchen colanders and jellyfish — and iterating the





Final Artwork by Sophia H. Kuchi

design with the scientists and researchers. Another team was proposing a deep-sea museum built underwater, which sounded almost impossible to envision, but the students created a 3D rendering of the idea, showing how it might be possible.

After the symposium, many of the students continued to work with their teams, which received grants from NAKFI to continue to develop and explore ideas. Students had opportunities to go on deep sea research vessels, participate in conferences and see their work published in scientific publications. ArtCenter partnered with symposium attendee Dr. Larry Pratt, from Woods Hole Oceanographic Institution, to work on a NAFKI funded project on data visualization of ocean eddies. And I connected with Dr. Chris DuPont, from the J. Craig Venter Institute, to discuss how we could collaborate. We started with a small project, a six-week assignment in an Illustration course called Image & Idea, led by faculty Esther Pearl Watson. Students created visual projects on the issue of plastics in the ocean. Based on the strong outcomes of this short assignment, JCVI invited ArtCenter to partner on a National Science Foundation grant proposal "Probing Molecular Interactions in the Nitrogen Fixing Cyanobacteria-feather Moss Symbiosis."

Designmatters is the social innovation department at ArtCenter, and one of the department's guiding principles is that innovation is found at the intersections of disciplines, sectors, expertise and perspectives. The topic of symbiosis, the exchange of resources for mutual benefit, fit perfectly within the philosophy of Designmatters. When we began planning the project in 2020, the topic of symbiosis became even more meaningful in the context of what was happening around the world, as people redefined how they sought connection and community. The faculty Esther Watson and Eric Nyquist created the course title "SINC: Symbiosis in Nature and Community," speaking to how the class would focus on visualizing scientific research on the topic of symbiosis and create a community based on the exchange of knowledge between scientists and designers.

The impact of this project goes beyond the thoughtful words and beautiful and creative outcomes shown in this book. The relationships built, new paths found, new ways of working together, and new knowledge and skills developed will continue to ripple out, inspiring and informing the work of Designmatters at ArtCenter, JCVI, the students, faculty, and scientists far into the future.



# Statement Dr. Chris Dupont

Associate Professor at JCVI

To say this was an experiment can feel reductive, but also highly appropriate. My educational background as a scientist included very little training in art, design, or visualization. Numerous students also noted their lack of exposure to science, even buying into the idea that science was something inaccessible. I felt genuine trepidation that bridging this cross-pollination gap would prove impossible; two fields just too far removed in their DNA for a new composition. In hindsight, my concern was entirely unjustified, as the course lived up to its thematic center of "symbiosis" — although far more canted toward mutualism. Symbiosis is the co-existence of living organisms, although this can be extended to schools of thought or societal

norms. It encompasses the range of interactions, from parasitic interactions where one organism benefits to the detriment of the other, to mutualism, where cooperation results in the benefit of both cooperates. Here, we observed that even minimal exposure to scientific expertise and materials triggered autodidactic learning in the design students, resulting in a host of strikingly beautiful and stirring projects. The science faculty also noted effects on their own thinking, from incorporating sketch note-taking to considering color theory in data visualization. Essentially, a mutualism was formed, which strongly suggests that integrating art and design with science and engineering curricula is a fruitful future path in education.



Watercolor Sketch by Constant Pearson

WEEK 02 / 230920

# the unique mutualism

## MOSSSES + CYANOBACTERIA

Chris Dupont

01 SYMBIOSIS

CLOSED + SUSTAINED BIOLOGICAL INTERACTION

PARASITIC (-+) COMMENSAL (~) MUTUALISM (++)

02 CYANOBACTERIAL SYMBIOSIS

photosynthesis & oxygenic

inherit

mother of all plants

thank u

N<sub>2</sub> gas → ammonia food

WITROGEN FIXATION

area of active growth

proteins

1 no moss, nothin'

2 moss activates protein

03 HETEROCYST

these are

they live in apartments within coralloid structures

protected!

BACT

activated with secret hand

05 IMPACT

ENDOSYMBIOSIS

non-photo synthetic cell

eat & enslave bacteria

formation of chloroplasts

Sketchnote by Amanda Ciesiel



# CORAL REEFS

CORALS ARE...

HUNTERS FARMERS BUILDERS

get some organic material from killing things

TREE OF LIFE



\* Phage are VIRUSES infect bacteria \*



Decorative proteins on phage stick to MUCUS

ALL MACROBES ARE HOLOBIONTS



Sugar from algae Kill corals → separate them



CORAL REEFS HOLOBIONTS ARE SO LIMITED TO SPACE



Sketchnote by Hannah Shin

## Faculty Statement Eric Nyquist, Esther Pearl Watson and Steven Weissman

Illustration Faculty, ArtCenter College of Design

Classes like SINC: Symbiosis in Nature & Community are important, not only for students, but also for the faculty and partners. By providing students projects that are data driven, along with the necessary grounding in that subject matter, these opportunities promote confidence in design and science partnerships, impacting students' career pathways and real-world collaborations between scientists and artists.

Outside of ArtCenter Illustration Department's visual expertise, JCVI speakers introduced students and faculty to a range of animal and plant microbe partnerships, such as microbiomes in coral reefs, the deep sea, and the human body. With this

information, students were able to create their own paths combining visual genres with scientific topics. Collaborating with peers to create posters, books, murals and comics, students worked with each other across different majors. We saw a positive exchange of ideas as students met the challenges of unifying aesthetics and concepts.

As faculty members, it was a rare opportunity to work with each other and the JCVI faculty who brought their own expertise to critiques and advisement. For us as instructors, optimal learning comes from a variety of experiences and diverse voices working together toward a range of solutions.





## Statement Ann Field

Chair, Illustration Department, ArtCenter College of Design

The most important part of an education in Illustration is being able to convey important information in clear, understandable and interesting ways, without getting in the way of the facts! Traditionally students work from their imaginations but with this project in particular it was incumbent upon the students to listen and learn and truly understand and grapple with the material before they let loose with their illustrative

style. I love this! Why? Because as illustrators we need to be part of the dialog of change, and part of the dialog of information and truth, and part of the dialog of understanding and communication. On the flip side, I noticed that the scientists were delighted to have a talented Illustrators with fresh eyes (and ears!) to absorb and then visualize what they were endeavoring to explain and quantify.



“

*To be able to work alongside and bounce ideas off of other artists and designers — as well as the scientists — was wonderful. I've always been fascinated with science, and I was so inspired that we got to combine art with science.*

– Melissa Fernandez, ArtCenter student

Sketch by Lili Todd

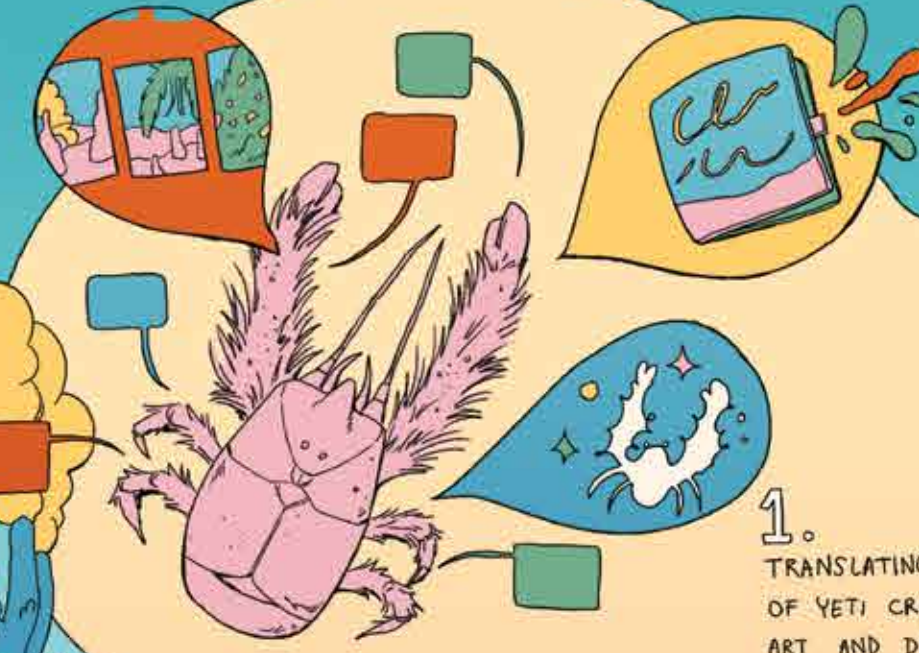


## Project Brief

Combining art and science for a graphically engaging final project, this Designmatters studio invited ArtCenter students to explore, translate and conceptualize a project based on the current scientific research on symbiosis. Students heard firsthand from scientists about the intricate details of symbiotic partnerships that exist in animal and plant life. Students then transformed that knowledge into a compelling illustrative project, communicating the scientific concepts to an appropriate target audience.



1. TRANSLATING THE SCIENCE OF YETI CRABS THROUGH ART AND DESIGN



2. INSTRUCTOR STEVE WEISSMAN PRESENTED A NOTE-TAKING LECTURE PROVIDING STUDENTS WAYS TO SYNTHESIZE INFORMATION



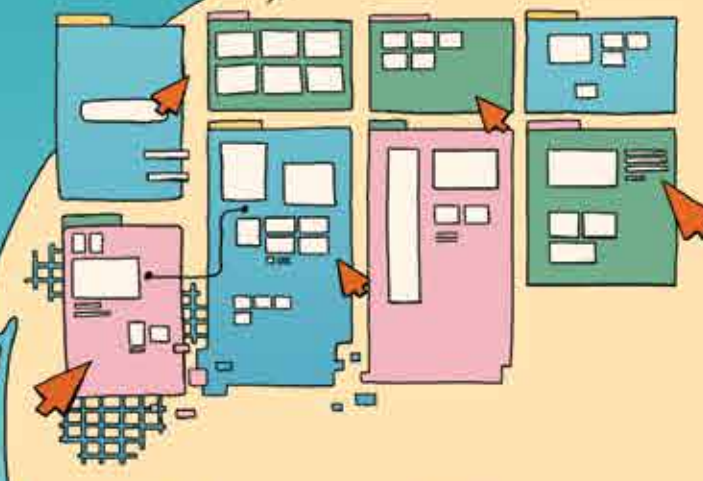
3. STUDENTS HEARD MULTIPLE PRESENTATIONS BY NOTABLE SCIENTISTS WHO WERE STUDYING VARIOUS SYMBIOTIC RELATIONSHIPS



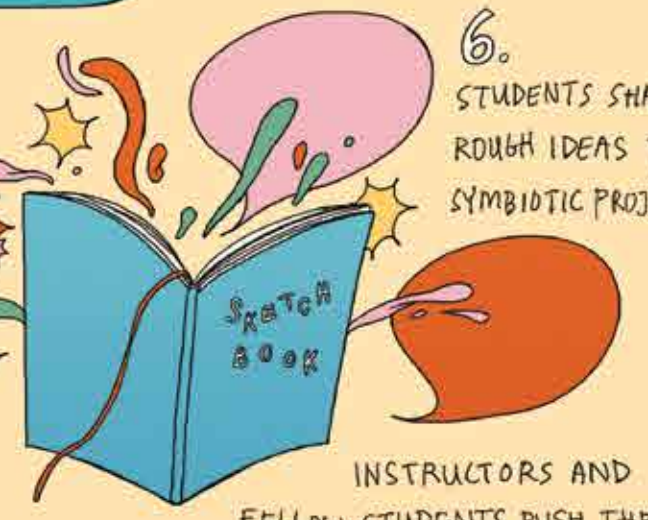
4. AFTER EACH PRESENTATION, STUDENTS ASKED QUESTIONS AND CREATIVELY CAPTURED INFORMATION IN THEIR JOURNALS



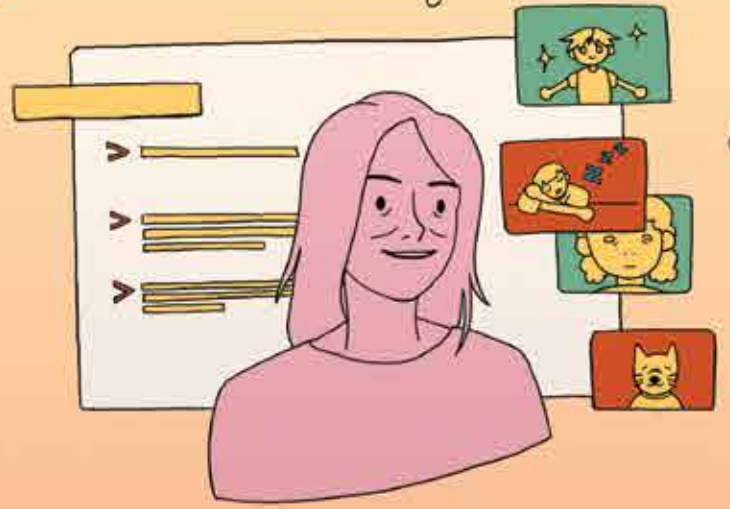
5. STUDENTS SHARED THEIR WORK, JOURNAL ENTRIES, AND MORE ON THE BLUESCAPE PLATFORM



6. STUDENTS SHARED THEIR ROUGH IDEAS FOR THEIR SYMBIOTIC PROJECTS. INSTRUCTORS AND FELLOW STUDENTS PUSH THEIR DESIGN THINKING TO NEW LIMITS.



7. KATHRYN NYQUIST GAVE STUDENTS AN OVERVIEW ON HOW TO EFFECTIVELY PRESENT VIA ZOOM



8. STUDENTS PROPOSED THEIR PROJECTS AND GOT CONSTRUCTIVE CRITIQUE TO GAIN MOMENTUM ON THEIR PROJECTS



9. STUDENTS CREATED PROTOTYPES AND MOCKUPS AND PRESENTED THEIR WORK TO CONCLUDE THE CLASS





## A brief summary Studio Process

The studio kicked off with a discussion on how design can help communicate a scientific story or fact and how to represent scientific facts appropriately. Students shared their initial project on a yeti crab, translating the science of this undersea creature into communication vehicles appropriate for their target audiences.

During many of the early class sessions, students were fortunate to hear multiple presentations by notable scientists who were studying various symbiotic relationships. Students recorded the information using sketchnotes, many of which are showcased throughout this book.

Through the class lectures and their own research, students came to a deeper understanding of the symbiotic relationships found in nature — which set the foundation for their final projects.

After hearing all the science presentations, students delved deeper into their initial symbiotic relationship concepts, often contacting the scientists for advice or feedback as it related to that particular research topic. The scientists were generous with their time and insights, making sure that students would present the science in appropriate and genuine configurations.

From rough sketches, students created prototypes and mock-ups. They worked closely with instructors, one-on-one, to revise drafts of expository text and storytelling chapters. Again, the scientists were eager to hear the student's progress and offered encouragement and insight. Even when a certain avenue met with a dead end, the students realized the value of failure to open doors to new ideas.





# al reef ymbiosis



## Statement Dr. Forest Rohwer

Professor of Biology, San Diego State University

*“I suspect that whatever cannot be said clearly is probably not being thought clearly either”* (Peter Singer, 2016, The Economist).

Every animal and plant host form assemblages with billions of viruses and microbes. Collectively, these assemblages are called wholobionts. The viruses and microbes determine wholobiont health. In some cases, the microscopic inhabitants kill the plant or animal (e.g., disease). More commonly, the viruses and microbes make the wholobiont stronger.

Understanding how relationships between macrobes, viruses, and microbes change over time is difficult because of the vast biodiversity. Individual human wholobionts, for example, harbor 10,000s of different viral species. New technologies, like large scale DNA sequencing, mean that we can generate billions of data points about how the wholobiont response to changing environmental conditions (e.g., dieting for the human wholobiont). And to understand this data deluge, mathematical models and computers are used. As everyone knows, however, math really doesn't speak to most people and art is often a better way to

communicate and understand complex systems like wholobionts.

Projects like SINC are so important because it forces scientists to understand their work well enough to explain it to artists. In turn, the artists, must understand the subject well enough to convey the information to other non-scientists. The scientist gains a much deeper insight into their work through this process, ultimately improving the science. In a very real way, the artist is challenging the scientists to think clearly. At the same time, these collaborations facilitate non-scientists understanding of complicated subjects like wholobionts. In turn, this better understanding helps scientists and non-scientists make more rational decisions, as well as intellectually revel in the beautiful complexity of nature.





# DR. MARCELO FREIRE



"The Forest in Your Mouth"  
Symbiosis: Relevance to Human Health

Leonardo da Vinci  
vitruvian man  
"EXPLORER"  
3D scanner for human body

Human sketch-noting  
Advanced

## HISTOLOGY: study of cells



GUT MUCOSA



## NEUTROPHILS

- 10 billion produced/day
- patrolling characteristic
- phagocyte function..

Elie Metchnikoff  
drawings of immune cell  
phagocyte



## ANTONI VAN LEEUWENHOEK

→ put own mouth plaque under microscope



OCEAN of bacteria inside mouth

Human microbial landscape  
Reveals organ specificity clusters



Different areas of the body colonized by diff types of bacteria

HUMAN-MICROBE SYMBIOSIS IS ESSENTIAL TO HUMAN LIFE:  
Window of opp. for microbiota modulation grows as a child grows

POP Bacteria:  
e. coli  
staphylococcus aureus

**Hygiene Hypothesis**  
→ people in the past never opened mouths in paintings b/c of bad oral health. - types of food less diverse  
→ removed diseases from mouth  
→ chronic conditions ↑ since 1980's

## Dysbiosis

- condition of having imbalances in microbial communities either in or on body
- associated w/ many diseases
- microbiome collapse detrimental effects to the host



NEUTROPHIL



## ORAL MICROBES IMPACT SYSTEMIC HEALTH

- metabolism → TYPE 2 DIABETES
- LUPUS → Reproduction
- CANCER → pregnancy outcomes

Microbial Dysbiosis cause many oral diseases  
→ CANES

Was able to correct through therapy.



## DIABETIC MOUSE

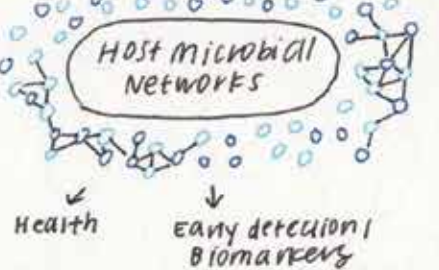
Healthy unhealthy (diabetic)

chronic conditions can cause more tissue loss in teeth than organisms w/out those conditions  
Irreversible disease.



## Human Oral Interactome

- Saliva Testing  
→ used to detect disease
- overall health (levels of cortisol, etc. type of food you should eat, etc.)



## FUTURE THERAPEUTICS:

- probiotics
- microbiome transplant
- small molecules

CONTACT:  
mfreire@jcvl.org  
mfreire

Exposure to local honey = Exposure to diff antigens better for asthma  
No chemicals, no bs.

# Statement Dr. Marcelo Freire

Associate Professor of Genomic Medicine and Infectious Disease at JCVI

The arts & sciences go together as they both require imagination coupled with action. Our course consisted of multidisciplinary sessions to open the spectrum of creativity, allowing the students to dream with different realms and even microscopic worlds.

We spoke about microbes that colonize our planet and species. We discussed the symbiotic relationships that shape human health and disease. We inspired each other to visualize data in a friendly and useful way. During

our classes we translated science into different mediums, and through artistic expression we experienced factual science transformed in inspiration.

It was incredible to be a part of this team and see the students learn science and tell stories in artistic ways. Collectively, we invited science to be a part of our everyday lives — whether you are in a class, seeing a mural, sitting in a café, reading a book, or teaching your child — it felt that we brought science to life. The students taught us a lot.



# Statement Dr. Shana Goffredi

Professor of Biology, Occidental College

I have often found great inspiration in those that can combine art and science, so I jumped at the chance to participate in the ArtCenter and JCVI partnership. As we all retreated indoors due to the covid-19 pandemic, interacting with the ArtCenter students was a bright light in my life for many months. It's easy for scientists to stagnate and get caught in our same routine, especially during the crazy days of 2020. The students gave me a new perspective and stim-

ulated my own creativity and I have thought more vividly and precisely about specific research projects in my own laboratory. These months have been challenging. Science has come to an almost all-time standstill, but the students made the broader impact of my research, and science in general, really come to life. Thanks to everyone involved in the project for the hard work and motivation. It was a wonderful experience.

**symbiosis = innovation**  
(how they look, how they're built, how they live)

**SEA HARMONY**

**MICROSCOPY** way to visualize the animal

**TRANSMISSION ELECTRON** like fingerprints.

DIFFERENT PARTS OF SKIN = different Geographic Locations

FOR EVERY ANIMAL that goes extinct, so does the microbiome

SHANA GOFFREDI

What we know is a **drop** what we don't know is an **ocean**

think of 2 elephants sitting on you & then crawling into the fridge...

that's living in the **DEEP SEA**

IN 5 DAYS, they consume ALL of their bacterial symbionts

**SUPERPOWER CLAWS** like a **comb**

FRESHLY MOLTED YETI CRAB looks like... jelly, plastic, short, 252K 252K

**"BUDDHIST"** don't take from others FOR FOOD

**BONE WORM** KINDA LOOKS LIKE CAULIFLOWER

each female has 100 males

**VAMPIRE VIBRIOS**

dead whale ⇒ Community

We accept bacteria when young to influence tissue development ☺

- blood diet lacks essential nutrients
- make: nematodes, flatworms, annelids, copepods, isopods
- mouth, scale, OR BILLS

MONTEKEY CANYON IS THE UNDERWATER GRAND CANYON

CARDIO DECTES

COLLABORATION WITH MARINE AQUARIUM

**ACE OF OSEDIX**

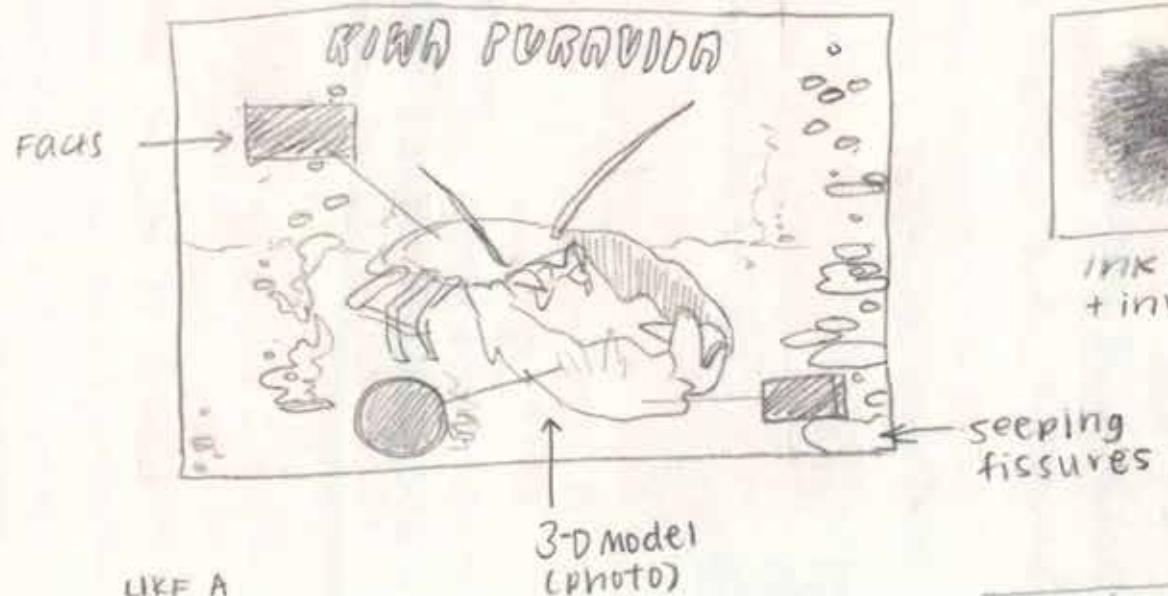






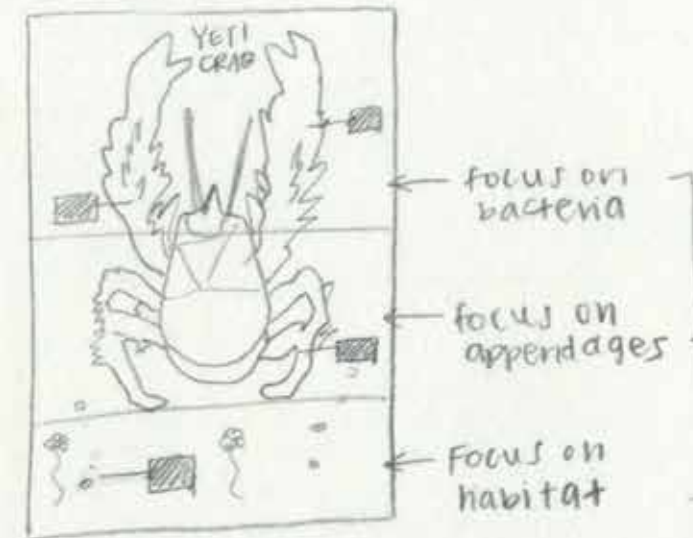
INFOGRAPHIC / ANATOMY

TEXTURE (claw)



INK + water + invert on ps

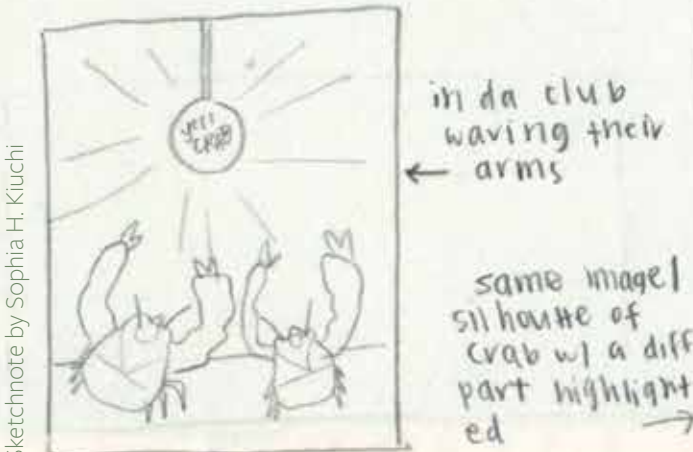
LIKE A SURGERY TABLE?



each section can be in a different medium



Primary focus is the arm textures of hair and bacteria



same image / silhouette of crab w/ a diff. part highlighted



under the lense of a microscope (info. might not be available tho.)

“

Together we all learned an incredible amount about symbiosis from the JCVI team, and we used that as a stimulus to create imaginative and profound artworks. The relationship between art and science is itself a symbiotic relationship. Each field feeds the other with inspiration.

- Eric Nyquist, instructor



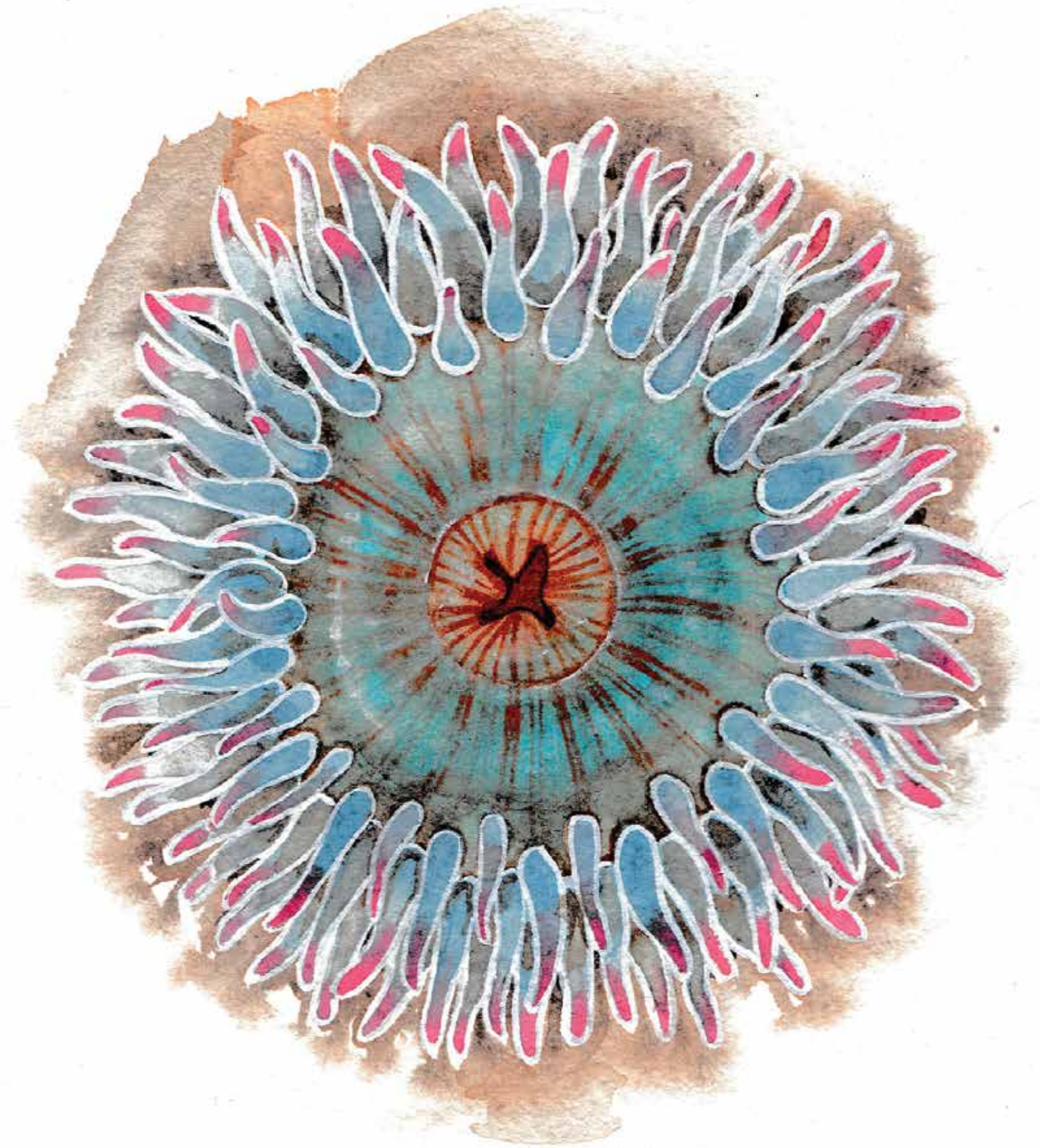
# Watercolor Sketches of Southern California Constant Pearson

Presented as an art book

A personal meditative-like journey through three distinct Southern California landscapes, this book presents photography along with artistic interpretations. Artwork focuses on shapes, colors and patterns found in nature that reflect an emotional connection for the artist. The three regions include marine coastal, conifer forest and Joshua Tree National Park. Some artistic images are realistic representations, while others are poetic abstracts.





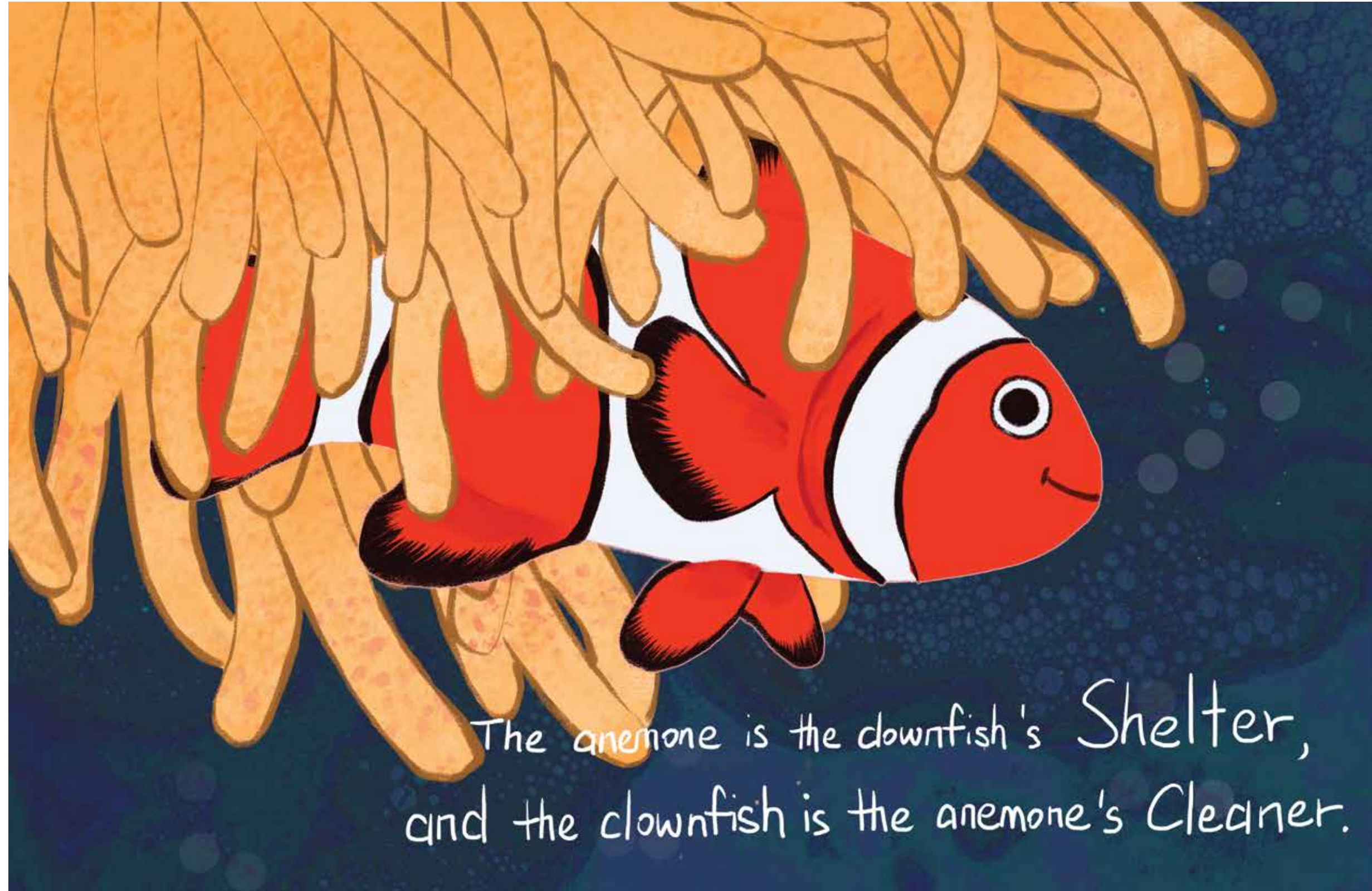




## The Adventure Under the Sea Ivanna Zuo & Yanqi Li

Children's Pop-Up Book

Combining the charm and magic of 3D pop-ups with colorful illustrations, this children's book is designed for readers age 8 and up who will enjoy the undersea adventure story as they learn about symbiosis. The protagonists, Cici and Bobo, meet the animals and plant life of a coral reef and discover how coral and algae keep their ecosystem in balance. The book strives to instill a sense of wonder and awareness that can lead to a desire to protect the ecosystems. The book includes a science fact page so readers can continue their exploration.



The anemone is the clownfish's Shelter,  
and the clownfish is the anemone's Cleaner.







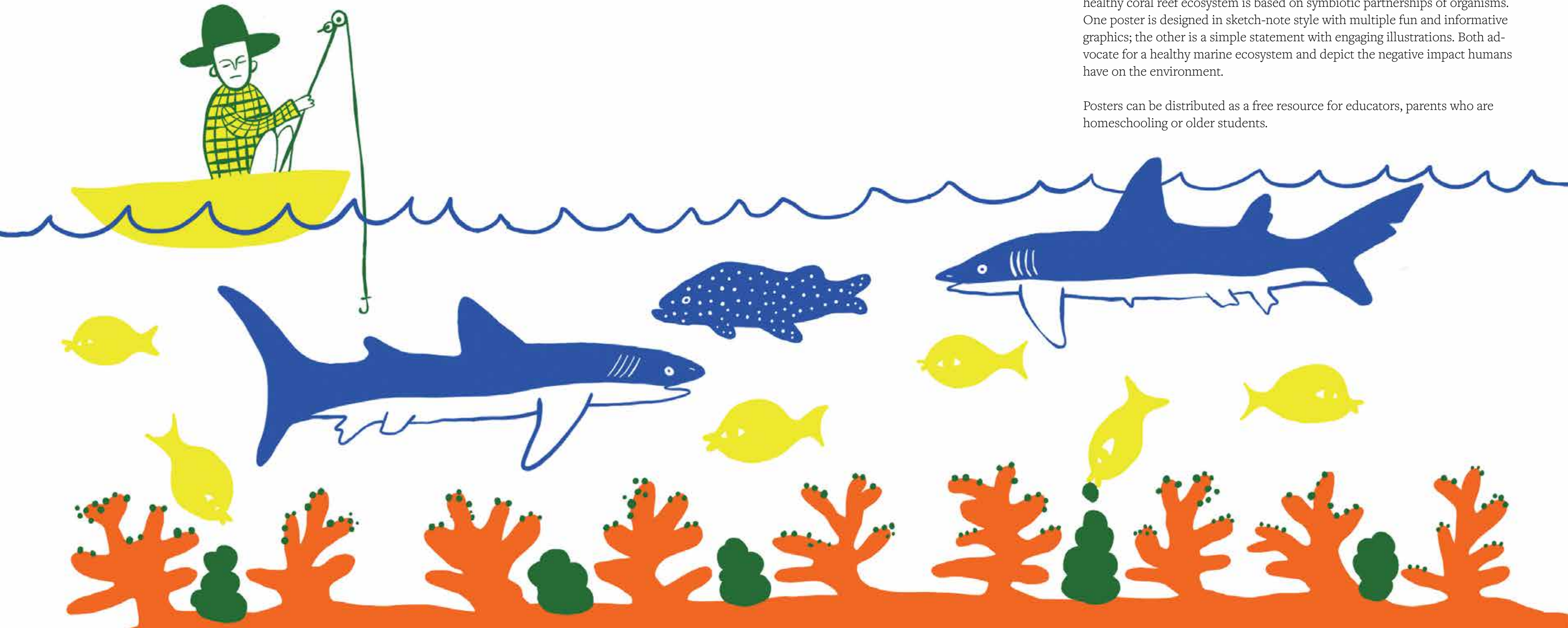
# Coral Reefs

## Lili Todd

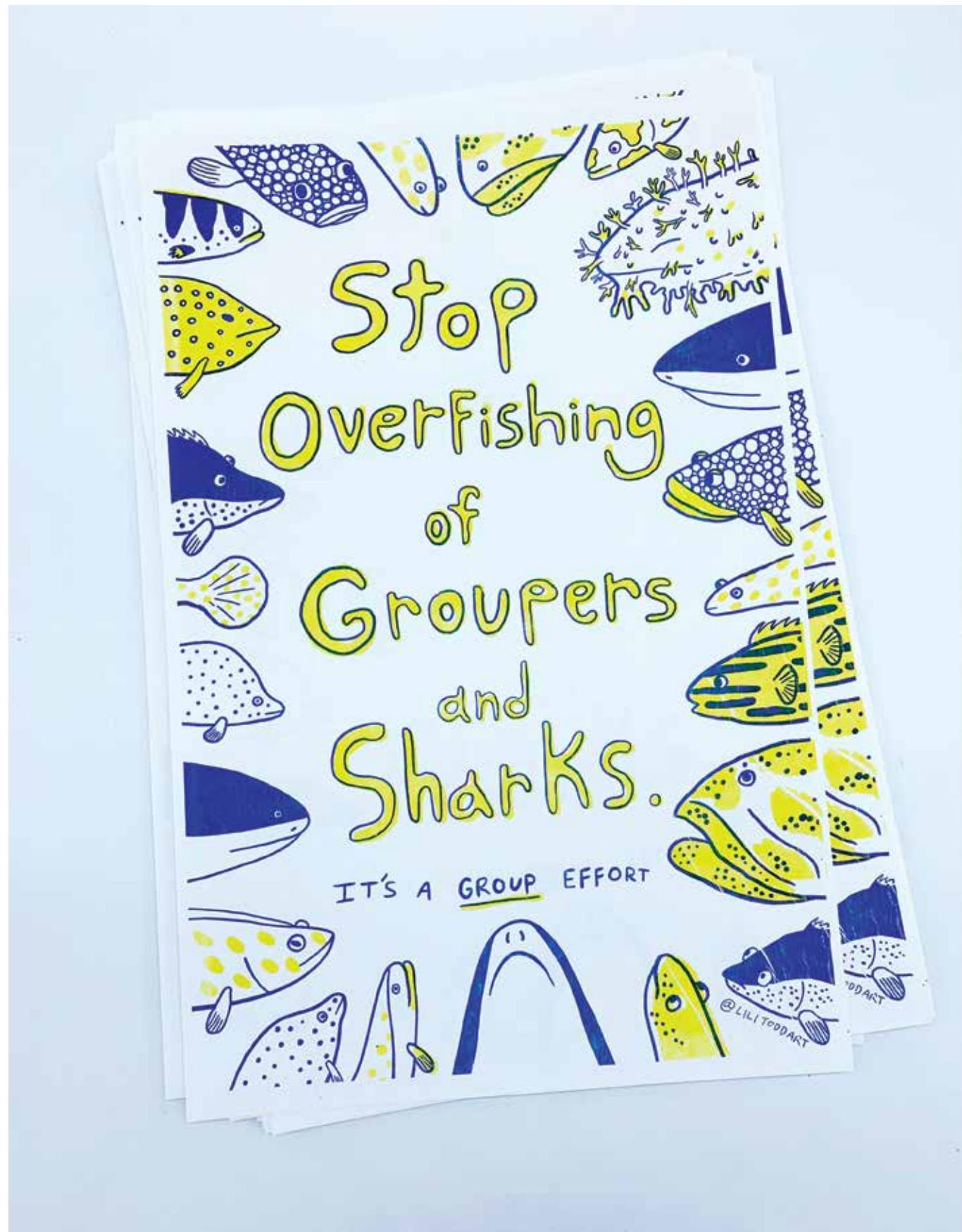
Presented as Posters

Promoting empathy for the natural world, these posters communicate how a healthy coral reef ecosystem is based on symbiotic partnerships of organisms. One poster is designed in sketch-note style with multiple fun and informative graphics; the other is a simple statement with engaging illustrations. Both advocate for a healthy marine ecosystem and depict the negative impact humans have on the environment.

Posters can be distributed as a free resource for educators, parents who are homeschooling or older students.









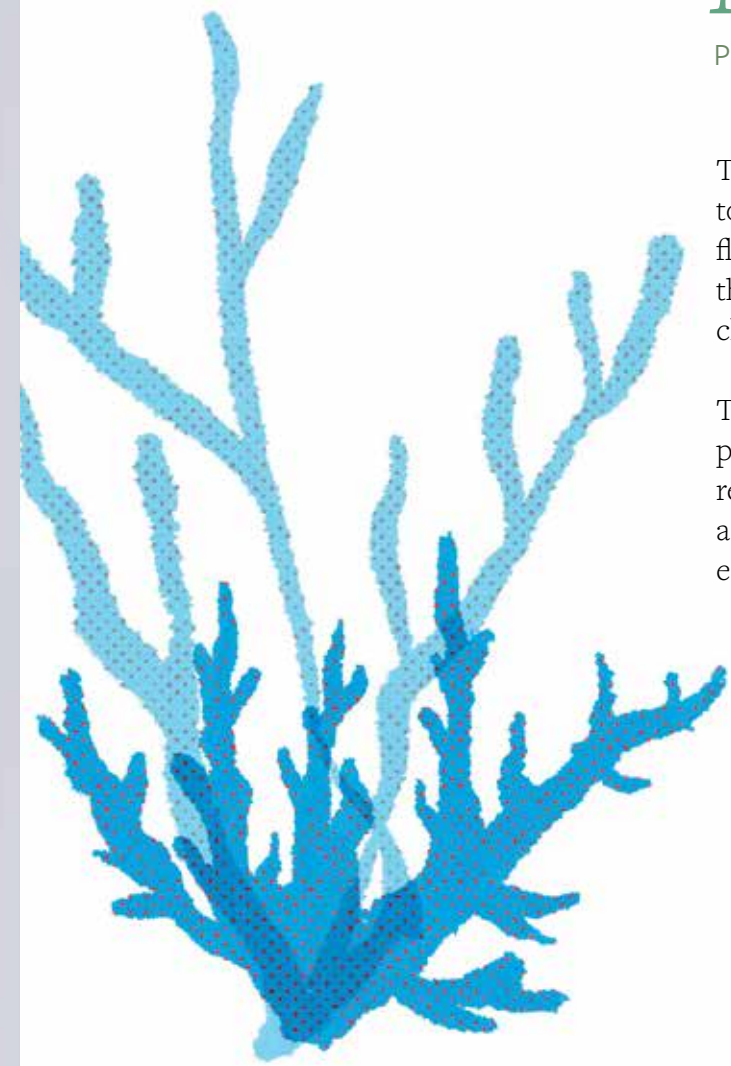


# Symbiosis as a Community Structure Madison E. Griffin

Presented as a book

This book highlights the unique nature of symbiosis while encouraging readers to take action to promote a more responsible stewardship of the planet. The flip side of the book jacket doubles as a check-list style poster; readers can use this poster to help them reflect on their sustainability goals and learn how small changes can lead to big differences.

The book has two sections: one is a detailed description of various symbiotic partnerships. The second section outlines how humans have a parasitic relationship to earth, and offers way to minimize further degradation, such as using sustainable materials, being responsible for waste materials, and eating less meat.





### SUSTAINABLE MATERIALS

Sustainability, whether in materials, energy, or practices means a limited negative impact on natural resources and communities; they avoid depleting or degrading the environment because they create few stresses on the environment, society can safely rely on them well into the future. Eco friendly fabrics are made from sustainable materials that are often organic, recycled, or easy on the earth. Consider recycled cotton, organic hemp, and organic linen. It can be tough to know what to look for when it comes to sustainable materials in packaging. You'll want to look for packaging made of recycled source materials and manufactured with renewable energy. This includes boxes made from recycled and biodegradable content

like recycled cardboard or paper. Furniture tends to be some of the most environmentally impactful products out there. Most furniture brands rely on imported materials to construct their furniture pieces. And in most cases, they do not share adequate information on the origin of that material. The most essential sustainable materials though are the ones you already own. Don't buy products you don't need or meet the sustainable requirements if you can avoid it. Living a sustainable lifestyle is a privilege so if there are opportunities in your life to change

### RESPONSIBLE WASTE MANAGEMENT

From leftover food to old kitchen supplies and trashed packaging, households produce much more waste than their assigned quota to reduce climate change. As The World Counts records, this figure crosses the two billion tons mark every year. That is over sixty tons of waste every second, excluding the contribution from restaurants, hotels, and fast food chains. Waste removal should include daily pick

ups, using biodegradable trash bags, and encouraging the use of waste autoclaves in residential properties for disposing of medical related waste. Property owners should also insist on residents following a strict waste sorting guideline. Fine tuning these procedures will reduce waste disposal costs by reducing the time and cost of and labor for collecting, sorting, and treating waste, and the entire recycling process.

### PLANT BASED DIET

Eating a plant based diet is not just good for our health, it is good for Earth's health. In fact, shifting away from animal based foods could not only add up to forty-nine percent to the global food supply without expanding croplands but would also significantly reduce carbon emissions and waste byproducts that end up in our oceans and as seafood byproducts.

### Yeti Crab and Bacteria

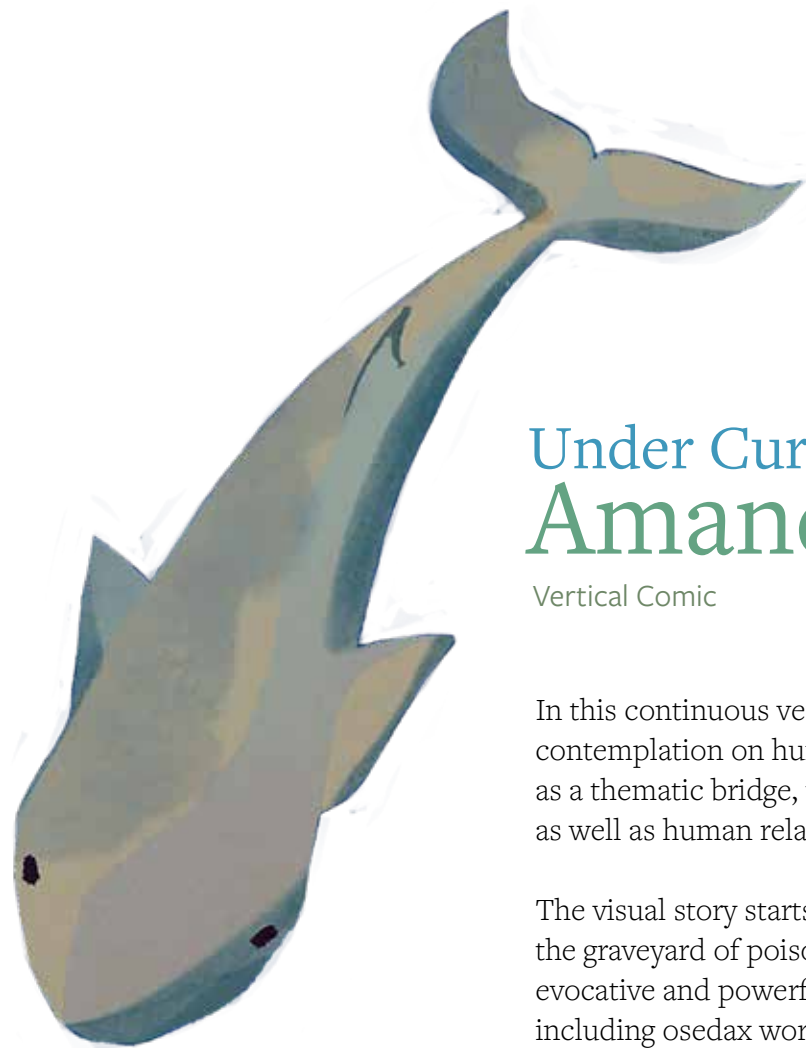
Living along the deep seafloor are the strangest creatures that have ever been discovered. The environment is so extreme that it was thought for hundreds of years that there was little possibility of any life on the seafloor. What scientists have discovered is that it is teeming with life and most of the seafloor is still unexplored. Currently what is being researched is the unique symbiotic relationships that exist only because of their unique pairing. Discovered in 1977 off the coast of Easter Island, was a species of crab that is considered the first of its kind. The Yeti Crab lives hovering the deep seafloor vent, waving its arms about to provide nutrients to its arm farm of bacteria. This species is also known as the [Dancing Yeti], because of this signature move that flows fresh water and nutrients over the bacteria that live along with the long thin hair that covers the body of the crab. The crab then eats this bacteria and only this bacteria. This is only one example of the myriad of strange symbionts in the ocean. It is important to nurture and respect these relationships because for every animal that goes extinct so too does their unique microbiome and their associated microbial community.











## Under Currents Amanda Oesef

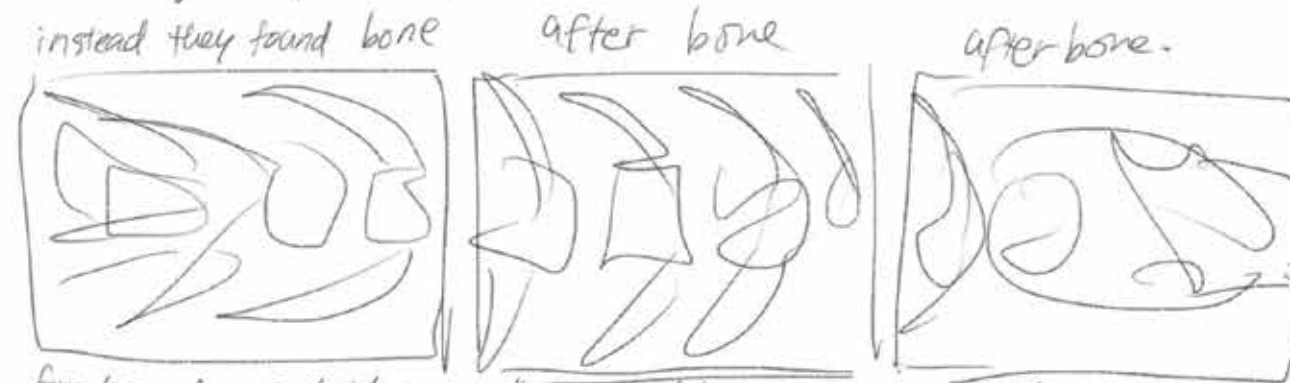
Vertical Comic

In this continuous vertical comic, scientific concepts fuel abstract contemplation on human nature and the poetry of living things. Using whales as a thematic bridge, the comic explores the rich ecosystem of a whale carcass, as well as human relationships with whales throughout history.

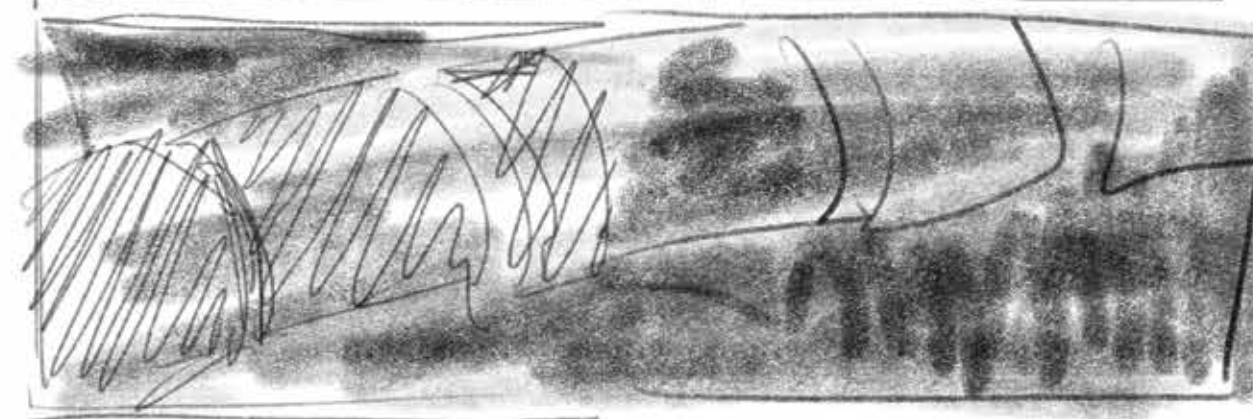
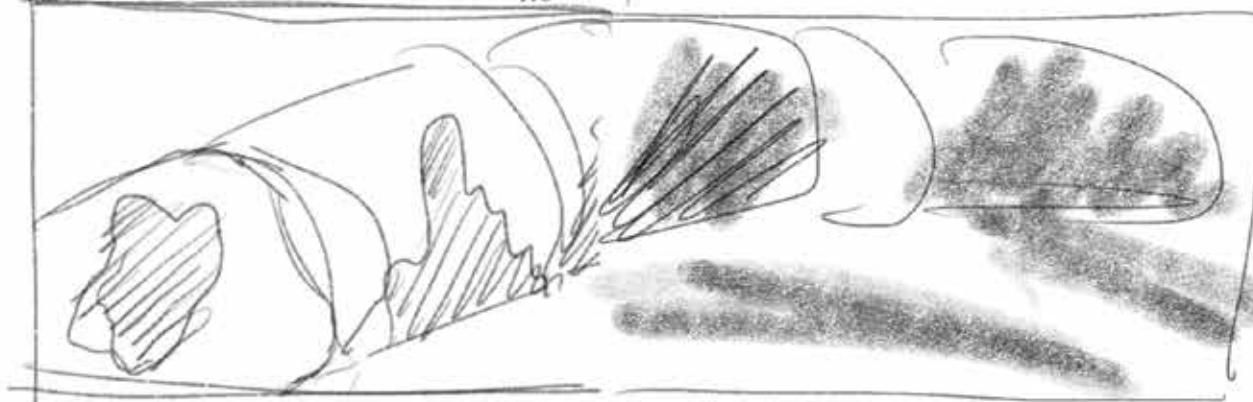
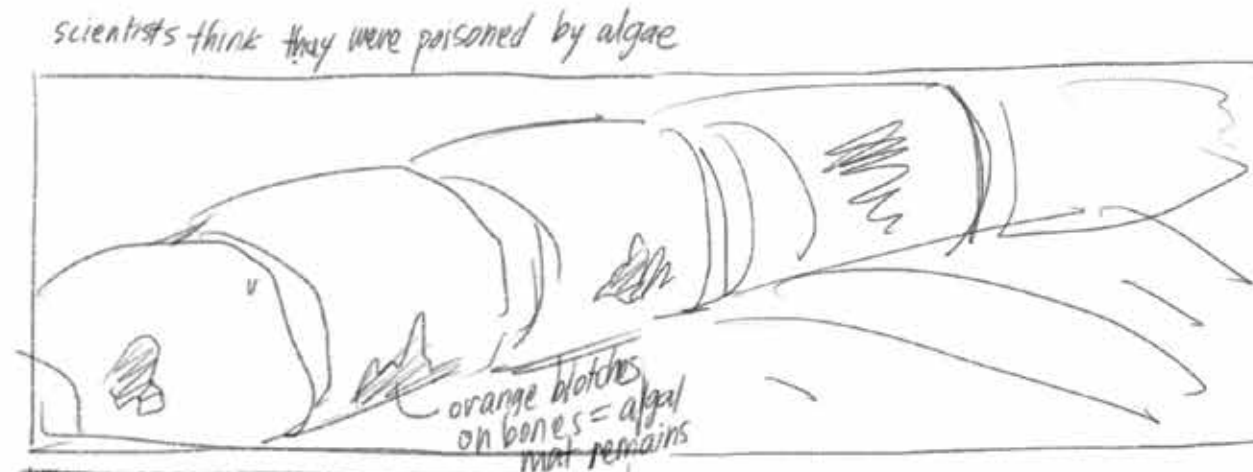
The visual story starts with a scientist in Chile's Atacama Desert driving to view the graveyard of poisoned whales. This action propels the story, which features evocative and powerful graphics. Bold images seamlessly flow into each other, including osedax worms feasting on whale carcasses, a process that sustains life even after death.

The storyline also features scenes contrasting aboriginal whaling practices with the commercial whaling that nearly decimated whale species in the late 1800s and early 1900s.

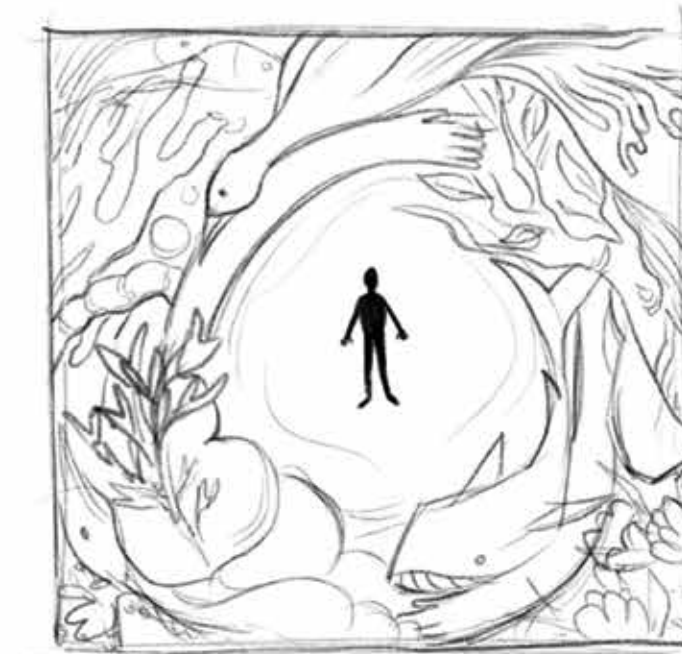
located in Chile's Atacama Desert, the "graveyard" was first discovered by a construction crew looking to expand the highway.



four layers of mass strandings, well-preserved bones of many species and ages.



we forget.



we are all a part of something.



# Symbiotic Universe of the Kiwa Puravida

## Sophia H. Kiuchi

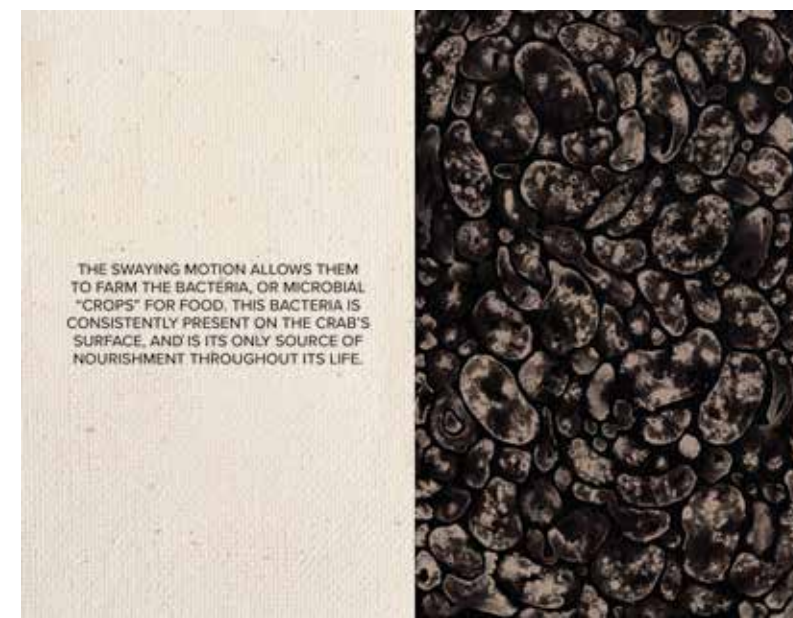
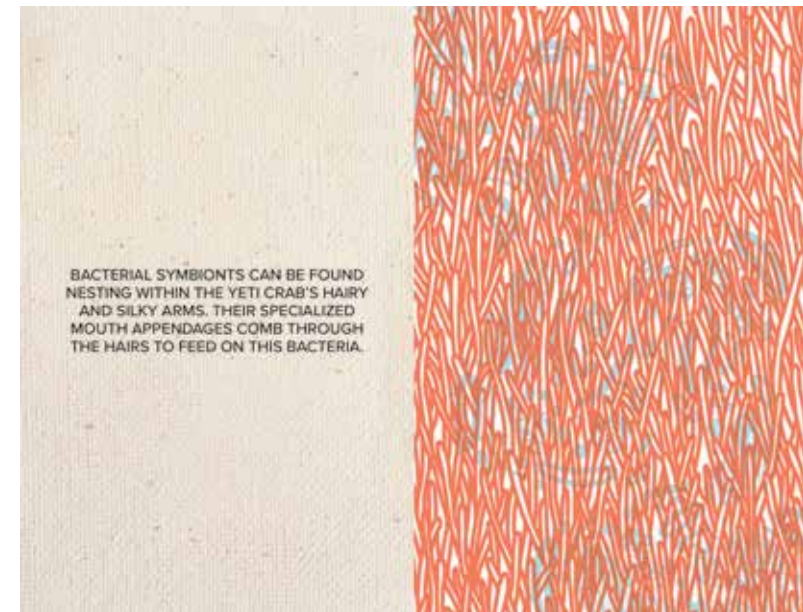
Zine

Textured graphics and vibrant colors tell the story of one yeti crab's relationship with the world, presenting a powerful example of symbiosis. Each page is composed with a different artistic method, such as graphite, ink, watercolor, and digital. An interactive element invites readers to use a red magnifying glass to find a crab hidden among the kelp. Text relates the intricate connections the crab has with its environment and advocates protection of this species, as well as all ocean life.





HOWEVER, IT IS STILL UNCLEAR ON HOW THE BACTERIA IS REFRESHED WHEN THE CRAB UNDERGOES ITS MOLTING CYCLE, WHICH OCCURS ROUGHLY SEVEN TIMES IN THEIR LIFETIME. THEIR ARMS GET LONGER AND THEIR BODIES GROW BIGGER AS THEY FILL OUT THEIR NEW EXOSKELETON.







## Cyanobacteria and Nutrients

Each bacterium interacts through the pathways of nutrient exchanges, including sugars and oxygen.

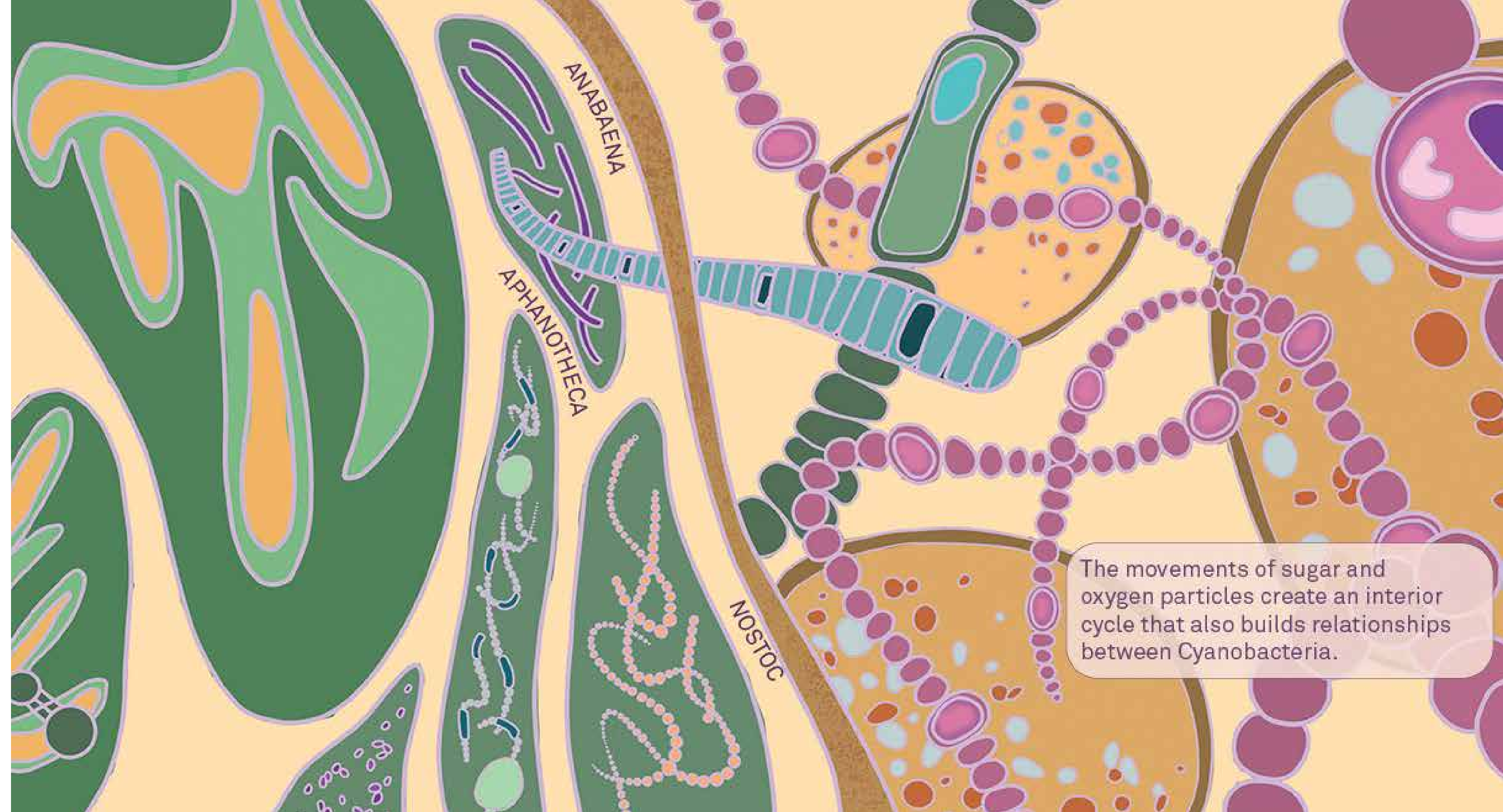


## Cyanobacteria: Giver of Life Melissa Fernandez, Misa Jia, Faith King

Graphic & Digital Mural

This panoramic visual represents the history of cyanobacteria, its symbiotic relationship with moss, and the important life-giving nutrients it provides. Artwork seamlessly transitions from concept to concept, from cellular representations to larger life forms. Bold, rich imagery gives the piece a deeply cohesive overview of nuances, details and important elements of cyanobacteria.

This long panel illustration can be altered for coloring books, murals, digital scrolls and other applications.

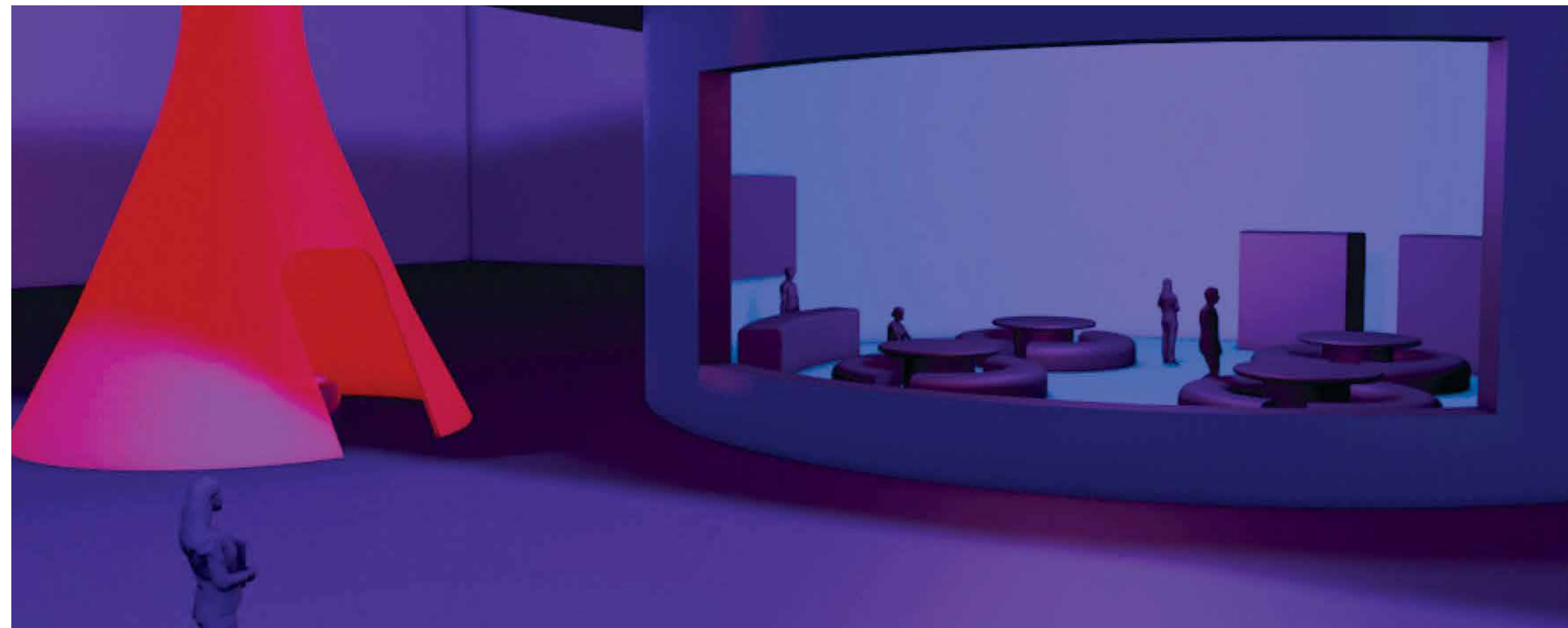




# Symbiosis Lab[S]tory Hannah Shin

Coffee Shop Design

This architectural concept for a science-themed café offers guests opportunities to learn symbiotic concepts while leisurely enjoying beverages with friends. As a destination experience geared for 16-25 year olds, the café takes its cue from a science lab and guests can wander in and out of four “flasks.” Posters depict specialty drinks that reflect various scientific principles.





# LAB[S]TORY



OVERVIEW



2ND FLOOR



FLASK ROOM

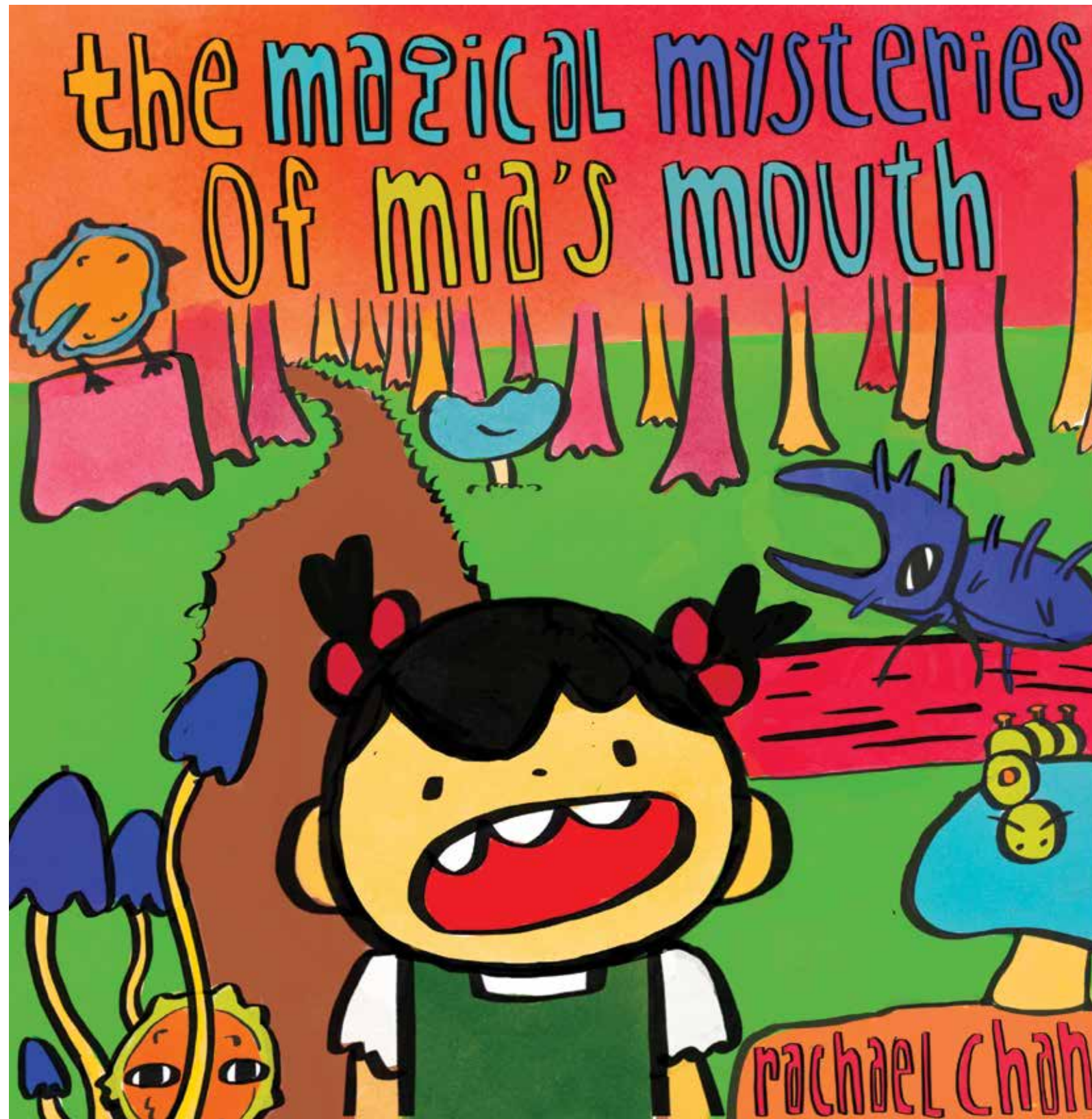


BEAKER CAFE



BEAKER CAFE ENTRANCE





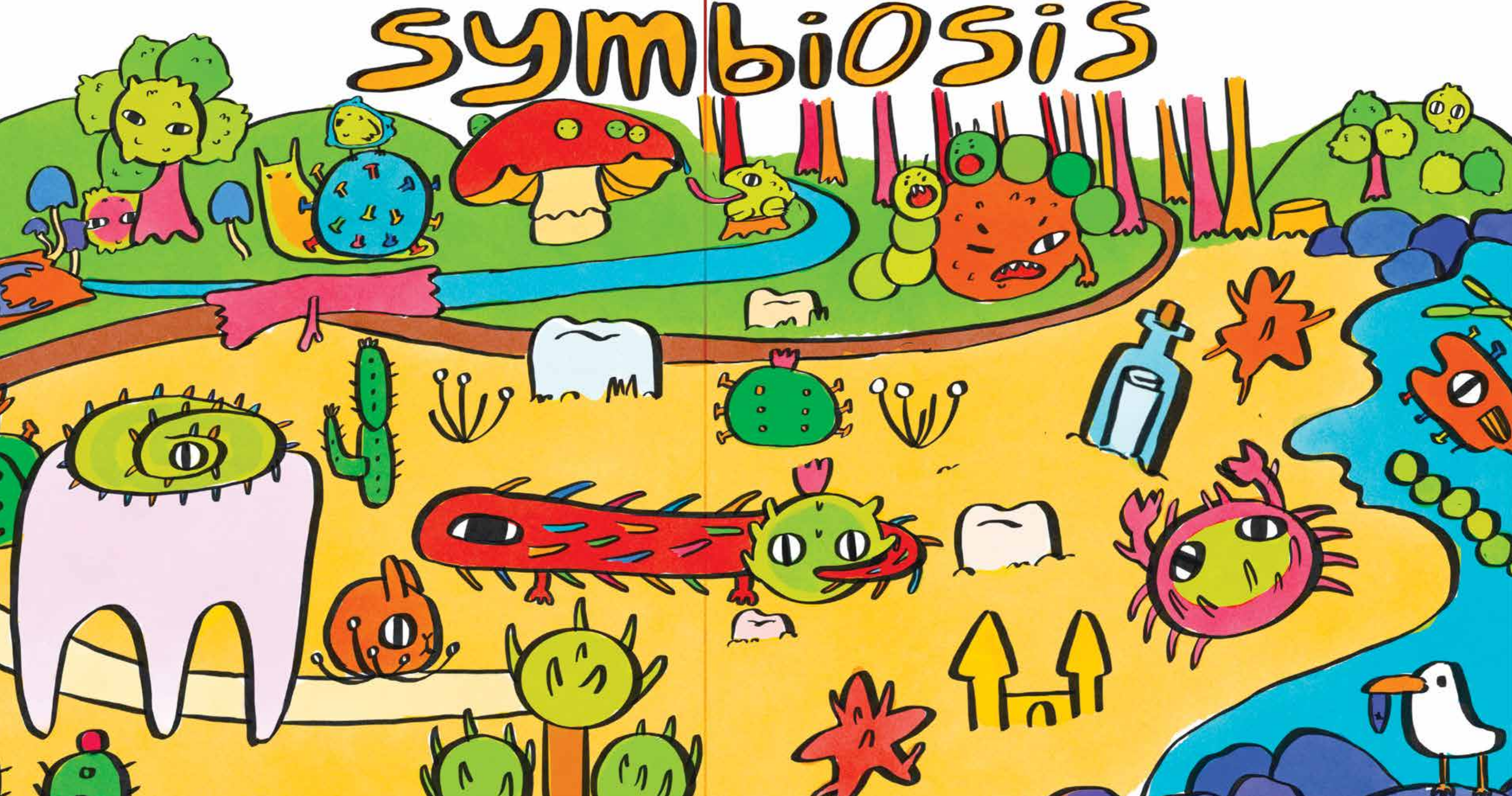
## The Magical Mysteries of Mia's Mouth Rachael Chan

Children's Book

This colorful book seeks to excite young readers (ages 4-8) about science and the fascinating microbial diversity found within human bodies. The storyline follows an endearing main character, Mia, as she learns about the small things that live inside her mouth. Mia is magically transported into the world of the mouth, where she encounters immune-building bacteria and strange landscapes with microscopic creatures in an environment bustling with symbiotic relationships. When Mia hears her mother calling her to dinner, she waves goodbye to her new friends and returns to her world with a deeper appreciation of the complexities of symbiosis.



# Symbiosis



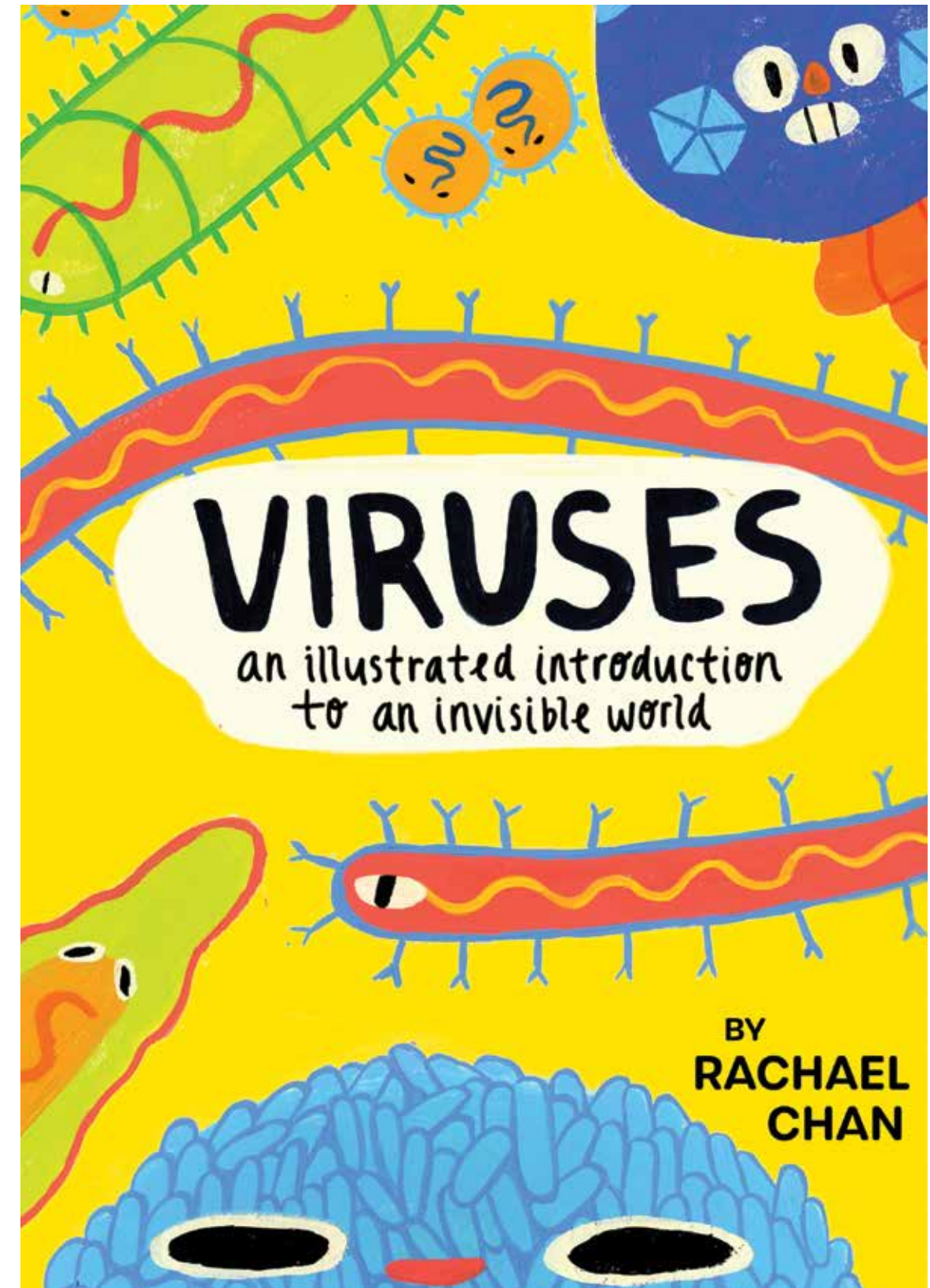


## Designmatters Fellowship with JCVI Rachael Chan

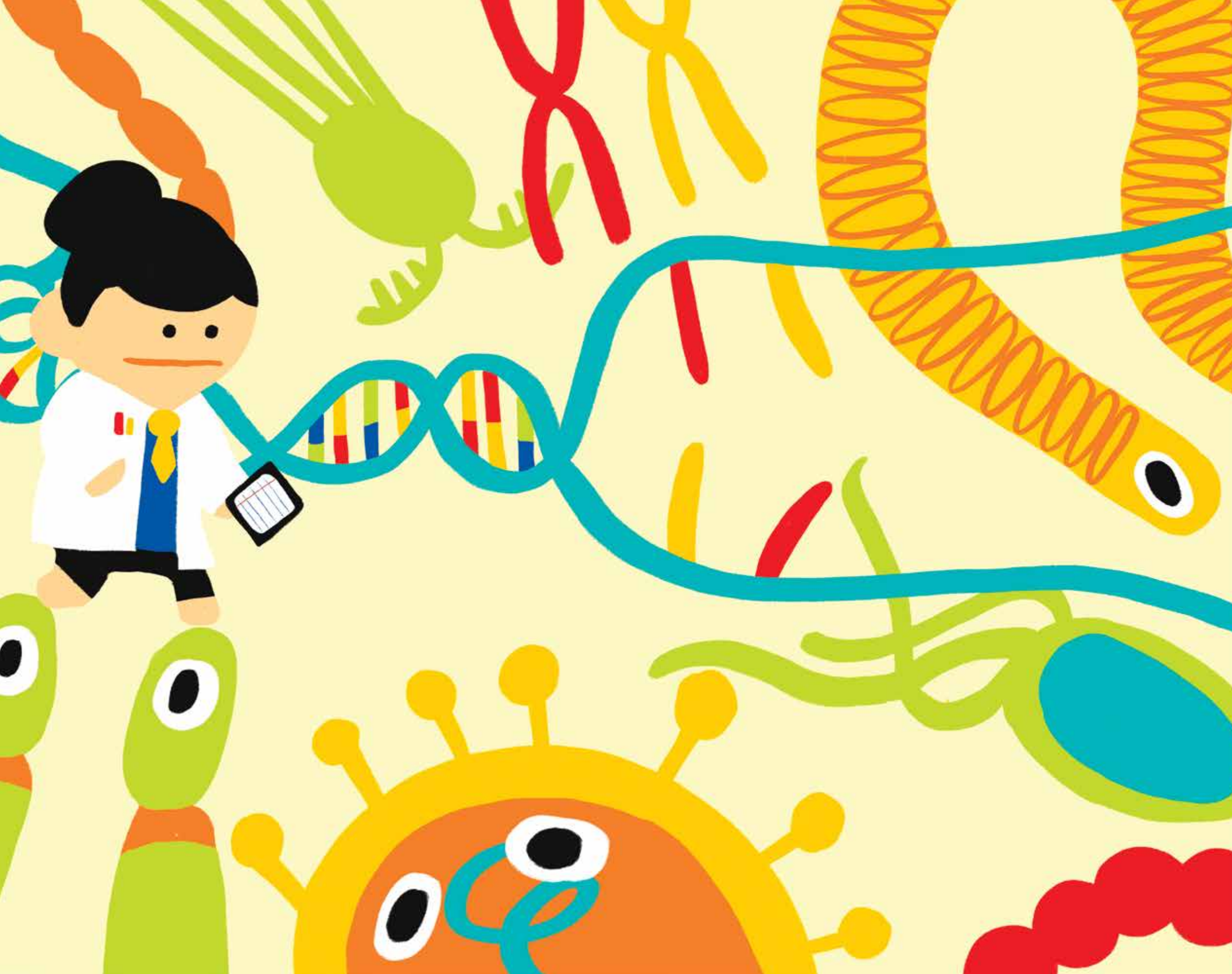
After the Fall 2020 class, Illustration student Rachael Chan was awarded a Designmatters Fellowship with the J. Craig Venter Institute for the Spring 2021 term. Rachael continued to work with the scientists and researchers at JCVI on visual projects, exploring new and timely scientific topics.

“I would describe myself as a very curious and inquisitive person. In the fall of 2020, I saw there was a transdisciplinary course called SINC: Symbiosis in Nature and Community. The name itself really intrigued me, so I decided to take the class. The scientists from JCVI gave us lectures about the symbiosis in our world, from the macro level to the tiny, tiny micro level. At first, I found it really terrifying, because it had been a while since I studied a subject other than art. But once I got used to the jargon, and I became confident

enough to ask questions, I found a new interest in the intersection between science and art. In the class, my main project was writing and illustrating a children’s book on the oral microbiome. I know that a very complicated topic isn’t common subject matter in the children’s book world, but I love the idea of taking a super complex, specialized subject and trying to make it more accessible to a general public, especially a younger audience. Being able to write an illustrated children’s book about something that I didn’t learn much about in school was very exciting. I really enjoyed the back-and-forth conversations with scientists, and it was totally a symbiotic relationship: I was learning so much and getting inspired by science, and they were learning so much and getting inspired by art. I truly believe that the intersection of science and art breeds new innovation that we







wouldn't have been able to think of before, because we were taking people from two very specialized fields and bringing them together to create new innovation.

Since I enjoyed the process of writing and illustrating a children's book in the class, I decided to take that concept and bring it into my Designmatters Fellowship as my main project. But this time, the subject that I decided to write and illustrate about was (drumroll, please) viruses — another very complex subject and also something that was really central in our lives during the class. I felt that since this complex subject was brought to the general public so suddenly and often so confusingly, that there was a lot of misinformation about viruses spreading. I wanted to learn about the world of viruses and virology myself, and debunk a

bunch of misconceptions and myths that were circulating. Through my research, I learned how complex the world of virology is, and how there are so many different subjects within virology that can be explored and then shared in order for the general public to develop a better understanding. My primary goal with this book is to show how science can be made more accessible to the general public, especially younger generations. And then also show the beneficial intersection between art and science — that science books don't always have to be filled just with text and very technical infographics."

Rachael's experience with JCVI culminated in October 2021, when she was invited to install her mural "Exploring Genomics" on-site at JCVI's San Diego campus.





“

*We had this great opportunity to learn from the scientists themselves, and I wanted to take advantage of that experience. It's really refreshing to not always be so focused on art, but to learn how to speak different languages.*

- Constant Pierson, ArtCenter student





Artwork by Rachael Chan

### Designmatters

Jennifer May, Executive Director  
Leigh Hoffman, Faculty Director  
Kimberly Velazco, Program Manager  
Garret Scullin, Senior Coordinator

### Partner

J. Craig Venter Institute, La Jolla

### Host Department

Illustration

### Instructors

Eric Nyquist  
Esther Pearl Watson  
Steven Weissman

### Teaching Assistant

Audrey Murty

### Students

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Melissa Fernandez  
Madison E. Griffin  
Xiaoxuan Jia (Misa)  
Faith King  
Sophia H. Kiuchi  
Yanqui Li  
Amanda Oesef  
Constant A. Pearson  
Hannah J. Shin  
Lili Todd  
Yijun Zuo

### Guest Lecturers

**Dr. Christopher Dupont**  
Associate Professor of Microbial and Environmental Genomics at JCVI  
**Forest Rowher**  
Professor of Biology, San Diego State University  
**Dr. Shana Goffredi**  
Associate Professor of Biology, Occidental College  
**Dr. Marcelo Friere**  
Associate Professor of Genomic Medicine and Infectious Disease at JCVI  
**Kathryn Nyquist**  
Global Creative Marketing Manager, Netflix









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