Kanan K’ak’náab Ma’ Su’up’il

Ku taasik te’ex

Chukte’ob

Tumen Robby Thigpen
yéetel Hillario Poot Cahun

Ts’e’ek meenta’ab tumen Madison Heltzel

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Chukte’ob

Tumen

Robert C. Thigpen yéetel Hillario Poot Cahun

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Le jaatsil k áanalte’ yo’osal u kananil tuláakal ba’ax ku kuxtal ichil k’ak’náabe’ meenta’ab tumen k etailo’ob yano’ob tu nojnajil Universidad Intercultural Maya de Quintana Roo yéetel le Múuch'il Puksi'ik'al Maya.

Ts’eek: Sakchak Espátula (*Platalea ajaja*), Bakja’ Cucharón (*Cochlearius cochlearius*), nojoch Garceta (A*rdea alba*) yéetel Bakja’ Tigre Gorjinuda (*Tigrosima mexicanum*) Je’el u béeytal u yila’al bix u je’elsikuba, bix u xíimbal yéetel bix u chukik u kayilo’ob ku yaantalo’ob ichil le chukte’obo’. Boona’ab tumen: Madison Heltzel.

The Mangroves

By

Robert C. Thigpen with Hillario Poot Cahun

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This edition of our conservation biology book on Mangrove Ecosystems was created with the help of our friends from the Universidad Intercultural Maya de Quintana Roo and the Puksi'ik'al Maya group.

Cover: Roseate Spoonbill (*Platalea ajaja*), Boat-billed Heron (*Cochlearius cochlearius*), Great Egret (*Ardea alba)*, and Bare-throated Tiger Heron (*Tigrisoma mexicanum*) can be seen resting, walking and hunting fish that live in the mangroves. Illustration: Madison Heltzel

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NIB ÓOLALILO'OB

Taak k ts'áik nib óolal ti' u meyaj u xoknáalilo'ob Universidad Intercultural Maya de Quintana Roo táakpajo'ob ichil le xookil "Taller de Traducción I". Te' xookila' tu kanajo'ob yo'osal sutts'íib beyxan bix u jóok'óol túumben t'aano'ob ku ku meenta'alob ti'al u tso'olol miats t'aanilo'ob ichil u t'aan kaaj.

Jach chuupo'on yéetel ki'imak óolal ikil al wojeltik yaan to'on u yáantaj le maya xoknáalo'ob je'ex ak etmeyajo'ob. Leti'obe': Guadalupe Soledad Catzín Briceño, Esmeralda Beatriz Cauich Hau, Sandy Amayrani Chab Sel, Genny Georgina Collí Chuc, Rosa Carolina Dzib Suaste, Danae de Atocha García González, Tania Daniela Herrera Ek, Samuel Martínez Hernández, Alba Yamili Mas Canul, Suleiny Lorena Nahuat Hau, Víctor Manuel Noh Dzib, Betzaydi Alely Pat Blanco, Josmar Iván Sabido Canul, Rodrigo Tamay Yam, Raúl Alberto Tuz Chan, Regina del Rosario Tuz Tun, Rosa Andrea Peña Peralta.

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We are very proud to have these Mayan students as colleagues. They will be Maya leaders of tomorrow and we are grateful for them. They are: Guadalupe Soledad Catzín Briceño, Esmeralda Beatriz Cauich Hau, Sandy Amayrani Chab Sel, Genny Georgina Collí Chuc, Rosa Carolina Dzib Suaste, Danae de Atocha García González, Tania Daniela Herrera Ek, Samuel Martínez Hernández, Alba Yamili Mas Canul, Suleiny Lorena Nahuat Hau, Víctor Manuel Noh Dzib, Betzaydi Alely Pat Blanco, Josmar Iván Sabido Canul, Rodrigo Tamay Yam, Raúl Alberto Tuz Chan, Regina del Rosario Tuz Tun, Rosa Andrea Peña Peralta.

OKSAJ TS'ÍIB

In yáax xak'al meyaj yo'osal chuk kay tu ja'il Caribee' tin meentaj tu tséel ajchuk kayo'ob ku kajtalo'ob Belice. Le máako'oba' tu yilajeno'ob bey juntúul uláak' u kajnáalil Cayoe', ma' tu yilajeno'ob bey juntúul ajxak'al ku taal Estados Unidose'. Uchik in ba'alitik in k'áatchi'ob, tu'ux kin k'a'abéetkunsik nu'ukulilo'ob meyaj ku taalo'ob ti' occidente miatse', taal tin pool jump'éel tuukulil, jump'éel beejil tu'ux je'el u páajtal in kaambal ti' tu yo'osal le ba'axo'ob u yojel le ajchuk kayo'obo', le je'ela' leti' le p'ata'an ti'ob tumen u yúuchben ch'i'ibalilo'ob. Le kaambalilo'oba' tu meentajo'ob in k'ajóoltik jump'íit yo'osal u baatsilo'ob, bix u meentiko'ob le chuk kayilo', beyxan u bixil u ts'áabal xook te' kúuchil je'elo'. Le je'elo'oba' mixtan ka'ach in kanik wa mina'anen láalajk'iin tu yéetelo'ob ichil le k'ak'náabo'.

Le ajchuk kayo'oba' u k'ajóolo'ob le kúuchilo'ob tu'ux ku meyajo'oba', le je'ela' je'exbix juntúul máak jach u k'ájóol juntúul u etaile'. Be'elajak k'iine', le kúuchilo'ob tu'ux ku chuk kayo'ob le máako'oba' táan u máansiko'ob talamilo'ob ku taalo'ob ti' táanxel tu'uxil, je'exbix u k'expajal le k'iinilo'obo', u k'askúunajil le ja'ilo'obo', u jach ya'abtal u meyajta'al le kúuchilo'obo', u xiixel le plaastiko'obo' ku k'askúunsik tu'ux ku kuxtalo'ob u yik'elo'ob le ja'o', yéetel uláak' talamilo'ob. Kex le ajchuk kayo'ob u k'ajóolmajo'ob le kúuchilo'ob tu'ux ku meyajo'obo', u nojtuukulo'obe' mixtan u tsa'ayal u na'ato'ob bix u yaantal le táanxel tu'ux talamilo'oba'. Lebeetike' le áanalte'oba' meenta'ano'ob uti'al u mu'uk'ankúunsik le naajil tuukulo'ob yéetel u na'tsil t'aano'ob le ajchuk kayo'obo'. Beytuno' yaan u yaantal ti' leti'ob u páajtalil u jóok'olo'ob táanil ti' le talamilo'oba'. Beyxan le túumben t'aano'ob ku chíikpajalo'ob te'ela' meenta'ano'ob yéetel u nu'ukulilo'ob u na'tsil t'aano'ob, le je'ela' yaan u yáantaj ti'al u kaajal u yutsil iliko'ob ba'ax meentik u yaantal le talamilo'oba', yo'osal xan ichiluba'obe' ka u meento'ob meyajilo'ob ti'al u jéeltiko'ob le be'elajak k'iin toopilo'oba'.

Kin ts'áik u nib óolalil ti' le ajchuk kayo'ob yéetel ti' u baatsilo'ob uchik u k'amikeno'ob ti' u kuxtalo'ob. Wa ma' yo'osal le kaamabal ti' k'amaj te' kajtalilo'oba' be'elajak mina'an le nojmeyaj je'ela'. Beyxan taak in nib óoltik tulaakal le ku táakpajalo'ob ichil le nojmeyaja', le je'elo'oba' ku taalo'ob ti' jejeláas kúuchilo'ob way yóok'ol kaabe', wa ma' xan tu yo'osalo'obe' be'elajak mixba'al yane'.

¡Tik láakalo'one' Kanan k'ak'náabo'on ma' su'up'il, beyxan te'ex te' súutukila'!

Robert Thigpen
Jo'olpóopil
Kanan k'ak'náab ma' su'up'il

U báak'pachkuxtal le chukte'obo' ti' yano'ob ti' tuláakal kúuchilo'ob *tropicales* way yóok'ol kaabe'.
Juntúul *Rongwe* (abejaruco sak kaal (*Merops albicollis*) tu chukte'ilo'ob u nojk'ak'náabil Índico.
Oochen ch'a'ab tumen Agnes Makumai, Bahía de Gazi. Kenia EA.

PREFACE

My first research in the area of Caribbean fisheries was largely informed by working as a side-man with the artisanal fishers of Belize. The fishers treated me more like a relative from Cayo than they did a marine scientist from the states. Approaching my questions in marine biology using social scientific research methods provided a unique perspective through which I was able to learn about and from these fishers' ancestral knowledge. These experiences also gave me insight into things about their families, the local fishing mechanisms, and even the local education systems that I could not have learned without being immersed in their daily work at sea.

These fishers know the ecosystems in which they live and work intimately, indeed in the same way one is familiar with a close and trusted friend. Today the fisheries to which these fishers are so tightly related are being affected by external influences such as climate change, point source pollution, overexploitation, single use plastics as well as destruction of nursery and juvenile habitats to name just a few. While these fishers know these ecosystems well, their intellectual heritage does not fully account for these new negative external pressures, their causes, and the science describing them. These books are designed to blend local fishers' knowledge and their local languages with the language and concepts of science so they are better equipped to discuss these issues in the languages *they use*. In turn, the new concepts and words in the context of their home languages will help them communicate their strategies for protecting their families' food security and the marine ecosystems on which they depend in a clear and concise manner with fishery managers, policy makers, and conservationists.

I would like to thank the fishers and their families for accepting me and allowing me into their lives. Without the education I received from these communities, this project would not have been possible. I also want to thank our international team of volunteers, were it not for them making these ideas a reality would not be possible.

Together we are Marine Conservation without Borders and now you are too!

Robert Thigpen
Executive Director
Marine Conservation without Borders

Mangrove Ecosystems are ubiquitous in tropical marine ecosystems across the globe.
A Rongwe [white-throated bee-eater (*Merops albicollis*)] in mangroves on the Indian Ocean.
Photo by Agnes Mukami, Gazi Bay, Kenya EA.

U KÁAJBALIL

Uchik in meentikinba xka'ansaj ya'abkach ja'abo'obe', in wojel le talamil ku máansik le paalal xoknáalo'ob ken u k'amo'ob xook ichil jump'éel táanxel lu'umil t'aanil.

Ya'ab taatatsilo'obe' ku tukultiko'obe' asab ma'alob wa u paalo'obe' ku p'atik u na'tsil t'aano'ob ken okoko'ob xook yo'osal u k'amiko'ob ka'ansajil ichil yaanal t'aano'ob Íngles. Chen ba'ale', yaan ajxak'alo'obe' ts'o'ok u yiliko'obe' le ba'ax je'ela' jump'éel tuusil. Le xoknáalo'obo' asab ma'alob ka u k'amo'ob le yáax jaatsil xooko'obo' ichil u na'tsil t'aano'ob.

Le ken u káajs u bin xook juntúul pale' yaan ba'alob túumbeno'ob ku yilik, jela'an u yilik tak u xoknáalo'ob wa u ajka'ansajo'ob. Le bix u ts'áabal le xooko' jump'éel ba'ax ma' u k'ajóolmaji'. Ti' le maya yéetel uláak' masewal miatsilo'obe' ku yúuchul jump'éel k'eexil ichil bix u tsikbal, u ts'áikuba k'ajóoltbil, bix u núukik k'áatchi'ob, etc. Le je'ela' talam ti' leti'ob. Ba'ale' wa ka ts'áabak ti'ob xook ichil u na'tsil t'aano'obe' leti'obe' asab ma'alob kun bin u ch'a'ikob bej ti' le túumben ba'alo'oba' tumen yaan u tsa'ayal u k'a'abéetkunso'ob le ba'ax ku taasiko'ob ichil u ch'i'ibalilo'obo' ti'al u kaambalo'ob.

Maya wíinik'obe' ku yiliko'ob bix u múulkuxtalo'ob yéetel jéets'kunaj yéetel tuláakal ba'ax yaan tak wóolkabil. Tumen tuláakal le ba'axo'oba' ku k'a'abéetal ti' to'on ti'al k kuxtal tu beel. "*Kanan K'ak'náab Ma'su'up'il*" xane' ku yilik u páaybe'enil u múulkuxtal máak yéetel le wóolkabilo', lebeetike' táan u kaxtik bix u ts'áik ka'ansajilo'ob yo'osal u kananil k'ak'náab. U xu'uk'il le meyaja' leti' u meentik nu'ukulilo'ob ka'ansaj ichil ka'ap'éel t'aan yo'osal u kananil k'ak'náab. Le meyaj je'ela' ku asab ts'áik páajtalil te' máasewal xoknáalo'obo' uti'al u na'atiko'ob yo'osal le túumben ba'alo'oba'. Beytuno' yéetel u kaambalo'ob ichnaje' yaan u asab táakpajalo'ob ichil meyajilo'oba'. Le xoknáalo'obo' yaan u tsa'ayal u ma'alobkúunso'ob le nu'ukulilo'oba', yaan u tsa'ayal u meento'ob k'áatchi'ob yéetel u ts'áaj u tuukulo'ob xaan ti'al ka ma'alob xi'ik tu beel. Beyxan ¡yaan u asab yaabiltik máako'obi'! yéetel le je'ela' yaan u yiliko'ob u páaybenil u kaláanta'al tuláakal yo'osal le k'ak'náabo' tumen leti' kun k'a'abéetal to'on sáamal.

Ki'imak óolal,

Felicita Cantun
Puksi'ik'al Maya múuch'il
Yo Creek, Belize

MAYA INTRODUCTION

Having been a teacher for many years, I am aware of the struggles children face when, in their first years of schooling when they are taught in a language that is foreign to them.

Many parents and communities believe their children will get a head start in education when their children bypass their home language and go straight to English. However, research suggests otherwise. Peer reviewed research consistently show that students benefit from using their home language; especially in the first years of their education.

When starting school, children find themselves in a new classroom, many of their classmates are strangers, as is their teacher. This type of structured way of learning is alien to them. In addition for the Maya and other indigenous groups there is an abrupt change in the language of interaction, so the situation can be quite complicated. However, by using the student's home language, schools can help children navigate this new environment and bridge their learning at school with their learning experience's they bring from home.

The Maya strive to live in harmony with all the elements of the universe. Each and every one of these elements is important for our very survival. *Marine Conservation without Borders* is also aware of the importance of living in harmony with nature, so they have embarked on an ocean literacy project to create bilingual conservation biology teaching materials that are available in the students' first language. This project ensures a better understanding of the curriculum content and a more positive attitude towards the subject. Moreover, students are more likely to engage in the learning process. It will allow students to make suggestions, ask questions and answer questions, and create and communicate their new knowledge with enthusiasm. Most importantly, it will help to affirm their cultural identity! This in turn has a positive impact on the way they see the relevance of protecting our natural resources is to our future.

Ki'imak óolal,

Felicita Cantun
Puks'ik'al Maya Group
Yo Creek, Belize

OKSAJTS'ÍIB

Ti' ajka'ansajo'ob

K'am ki'imak óolal ti' le nu'ukul meyaj ku k'aaba'atik "Kanan k'áak'náab ma'su'up'il". Jump'éel nojki'imak óolal ka ts'áik to'on ikil a táajpajal ichil le mayaj k meentik uti'al k e'esik ti' paalal yéetel táankelemo'ob bix je'el u páajtal u yaabiltiko'ob yéetel u kaláantiko'ob tuláakal kuxtal yaan ichil k'áak'náab.

Le nu'ukul meyaja' je'el u páajtal u k'a'abéetal ti' xoknáalo'ob ti' 7º tak 9º jatsilxooke'.

Xu'uk'il. K yáax xu'uk'ile' leti' k ka'ansik yo'osal bix u kanáanta'al ba'ax ku kuxtal ichil k'áak'náab. K a'alike' le xooko' yaan u ma'alobtal yéetel jump'éel ka'ansajil ichil ya'ab t'aano'ob. K a'alike' le máako'ob yéetel u jejelas t'aano'obo' yaan ti'ob jejelas talamilo'ob. Beytuno', k ch'a'ik le ba'ax ku taasik le máako'ob ichil u baatsilo'ob yéetel u kaambalo'ob ichnaj. Le je'ela' páaybe'en uti'al k e'esike' tuláakal le ku táakpajalo'ob ichil le meyaja' yaan ba'ax ku taasiko'ob yo'osal ba'ax ku yúuchul be'elajak yéetel sáamal ichil le kuxtal te' k'áak'náabo'.

Bix unaj u k'a'abetkúunsa'al le nu'ukul meyaja'. Le nu'ukul xooka' meenta'ab bey jump'éel áanalte' ka k'a'abéetchajak ti' le ajka'ansajo' ti'al u meentik u tsoolil u xook. Je'el u páajtal a ba'alitik ti'al u meyaj teche', ba'ale' il a wil a ts'áik jump'éel e'esajil ti' le xoknáalo'obo'.

Ichil junwáale' yaan a wilik jump'éel jaatsil ts'íibta'an ichil ka'ap'éel t'aanil íingles yéetel káastelan. Je'el u páajtal a yéeyik makalmáak ken a meyajti', je'el u páajtal a meyajtik tu ka'ap'éelil wa a k'áate'.

Káajs tuláakal le jaatsilo'ob yéetel jump'éel téeskunaj, meent u líik'il u yóol le xoknáalo'obo'. Ts'áaj jump'éel e'esajil yaan ba'ax u yila' yéetel le jaastil ken a ka'anso' yo'osal a meentik u yajal u tuukul le xoknáalo'obo'. Il a wil a meentik tuláakal táanil. Le ma'abents'íibo' k'a'abéet u bisik tuláakal le nu'ukulilo'ob kun k'a'abéetal tech ti'al a ts'áik le jaatsilo'.

Nib óolal uchik a wéemsik u nu'ukulil ka'ansaj yo'osal u kanáanil k'ak'náab. Áanto'on k ma'alobkíinsej, ch'a' junsúutuk ti'al a núukik le k'áatchi'oba'. Beyxan k k'áatik ka a'al to'on bix binik tech yéetel le nu'ukul xook ken ts'o'okok a meyaj. Yaan a wilik jump'éel correo electrónico tu'ux je'el u páajtal a túuxtike'.
¡Nib óolal!

https://www.surveymonkey.com/r/MCWBencuestalibrodelectura

"Le máaxo'ob yaakunsmij yéetel ku yaantalo'ob tu tséel lo nojk'áak'náabo', ichil tuláakal u nojtuukulo'obe' táakpaja'an le je'ela'" — Hermann Broch

INTRODUCTION

A Word to the Teachers

Welcome to Marine Conservation without Borders' Conservation Science Educational Resource. We are delighted to have you aboard with us in this global effort to teach our children and youth how to love and protect our marine resources for the future.

This material is recommended for 7^{th}-9^{th} grade students.

Objective: It is our main goal through these booklets to provide students with knowledge about our oceans' environments at the same time that they are learning a new language.

How to use this Material: These booklets are meant to be a foundation to further guide the Teacher/Student classroom pace and settings. Feel free to adapt it to accommodate your location and resources, make sure that each student has their own copy.

Each page presents a short lesson containing the same information written in both English and Spanish. You may choose to teach one language or the other; or both if it seems suitable to you.

Always begin each lesson with a positive, encouraging greeting, and an interesting fact related to the theme or topic of discussion. Prepare the materials and the board ahead of time. The board should include the new vocab, the e-links, the Topic/Theme, and poster images in case you have no internet available to display a video.

Thank you for downloading our conservation education materials. Please take a few minutes to take a survey for us to help us improve our conservation educational instruments. We would also appreciate any additional comments you might have after using our material. There is an email address at the end of the survey to send us additional information.
Thanks!

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"Those who love and live by the sea can hardly form a single thought on which the sea would not be a part." — Hermann Broch

LE CHUKTE'OBO'- MANGROVES

Múuch'tsay yéetel wóolkab 1

Xookil: Chukte' – Kúuchil kuxtal
Xu'uk'il: Na'at xookil.
Túumben tsolt'aan: Chukte', báak'pachkuxtal, kúuchil yáanalja', ch'íich'il ek'k'anáab, Dormidero.

U Páajtalil noj Tuukulil: Le chukte'obo' jump'éel báak'pachkuxtal ya'ab ba'alob yaan ti'. Yaan ti'ob xexet'o'ob yáanal ja' beyxan yóok'ol ja'. Le yaan yóok'ol le ja'o' jump'éel u najil ch'íich'o'ob jáal ja'. Le je'ela' ku k'a'abéetal ti'ob uti'al u je'esikuba'ob ken ts'o'o'kok u máansiko'ob k'iin. Le chukte'ob xano' kúuchilo'ob tu'ux le u ch'íichil ja'e' je'el u páajtal u yaantal u mejenilo'obe'. Wa mina'an le chukte'obo' le ch'íich'o'oba' mina'an kúuchil uti'al u yaantalo'ob.

K'áatchi'ob

1. Ti' makalmáak báak'pachkuxtalil ku táakpajal le chukte'obo'.
2. Makalmáak u jach k'a'abéenil ti' u kúuchil kuxtal u ch'íich'il le ek'k'ak'náabo'.
3. Tu'ux ku síijil yéetel ku kuxtal u ch'íich'il le ek'k'ak'náabo'.
4. ba'ax yéetel ka tukultik ku tséentikuba'ob le ch'íich'o'oba'.

Meyajts'íib.

1. Chen ts'o'okok le múul ts'iikbal t'aan yo'olal le k'áatchi'obo', beet u boonil u kúuchil kuxtal- chukte'ob- u ch'íich'il le ek'k'ak'náabo'. Je'ex bix le ch'íich'o'oba' jach k'a'abéet ti'ob le kúuchila' uti'al u kuxtalo'ob. ***U jeel mayaj***- Meent jump'éel xe'exe'ek oochelil ka lechkúuns te' kúuchil xooko'.
2. Wa ka yaantal tu'ux yaan jump'éel chukte'e', xeen a wilej yéetel meent jumpé' meyaj yo'osal ba'ax ta wila

Connectivity and the Environment 1

Theme: Mangroves-Natural Habitat
Objective: Reading Comprehension
New Vocabulary: Mangrove, Ecosystem, Underwater Habitat, Shorebirds, Rookeries

Critical Thinking Skills

The mangroves are a complex ecosystem with plant structures both underwater and above the water. The above water part of the mangroves are a principal habitat for shorebirds, acting as safe places to sleep and rest after a long day of fishing. The mangroves are also places for shorebirds to have babies and rear their young (rookeries). Without the mangroves, these birds will have no place to live.

Questions

1. What type of ecosystem do mangroves belong to?
2. What is the principal habitat for the shorebirds?
3. Where do the shorebirds nest and have their babies?
4. What do you think these birds feed on?

Activities

1. After discussing the questionnaire with the class, draw a picture of the natural habitat-mangrove- of the shorebirds. Show how these birds depend on this particular environment to survive. ***Extra*:** make it into a collage and display it in the classroom.
2. If you live near a mangrove, visit the area and write a detailed description of what you see.

Le sakxiik' playero'ob wa pihuiuí'oba' (Tringa semipalmata) yéetel le kóomkojo'oba' táan u je'elsikuba'ob ti' le ka'anantsilil ku máansiko'ob ikil u janalo'ob ichil le luuk' ku chíikpajal ken éemek le ja'o'.
Kúuchil: Punta Ratón, Choluteca, Honduras.
Oochel: Oliver Komar, Zamorano University-Panamerican School of Agriculture.

These Black-bellied Plover (*Pluvialis Squatarola*), and Willet (*Tringa Semipalmata*). They are taking a rest from feeding in the mud flats that are exposed during low tide. Location: Punta Ratón, Choluteca, Honduras.
Photo: Oliver Komar, Zamorano University- Panamerican School of Agriculture

Múuch'tsay yéetel wóolkab 2

Xookil: Chukteo'ob - jajabil ti' tu'chaja'ankab-$C0_2$
Xu'uk'il: Na'at xookil
Tumben tsolt'aan: Dióxido de carbono ($C0_2$), k'exlabáankil k'iin, su'uts'kinajil ja', ajsi'pil, jajabil ti' tu'chaja'ankab, jeltúumben óol.

U páajtalil noj tuukulil: Le chukteo'obo' ku jáapiko'ob dióxido de carbono yéetel ku jo'osiko'ob iik'il (O). Jump'éel le nojtalamilo'ob te' k'iina' leti' u jach chokotal tuláakal yóok'ol kaab, le je'ela' táan u meentik u k'áajtal u ja'il le k'ak'náabo'obo'. Jump'éel ichil le ba'axo'ob meentik le talamila' leti' le CO_2, le je'ela' ku taal ti' u tóoka'al jajabil ti' tu'chaja'ankabo'ob, je'exbix le ku taalo'ob ti' boxyiits lu'um yéetel chúuk. K'a'abéet u jáawal k meyaj yéetel le jajabil ti' tu'chaja'ankabo'ob yéetel k'a'abét u káajal k meyaj yéetel ba'alo'ob ku taalo'ob ti' jeltúumben óolo'ob. Kex ka ik p'at k meentik le ba'ax je'el sáamala' láayli' ya'ab CO_2 kun p'áatal te' ka'ano'. Jump'éel tun u meyaj le chukte'obo' yéetel uláak' pak'áalo'obe' leti' u jáapiko'ob le CO_2 yéetel u ts'áiko'ob iik'il. Le chukte'obo' ku jo'osiko'ob le chúuk ti' le iik' kak ch'a'ik'tiko' tumen ku k'a'abéetal ti' leti'ob ti'al u ch'aiko'ob óol. Leti'obe' jach u meyajo'ob lelo'. Le je'ela' leti' jump'éel u ba'axten k'a'abéet k kanáantik le chukte'obo'.

K'áat chi'ob

1. Bix je'el u béeytal a ts'olik ba'ax u su'uts'kinajil ja'e'.
2. Bix u lúubul le ya'ab dióxido de carbono ti' le mejen chukteo'obo' yéetel u wóolkabilo'.
3. Bix je'el u béeytal k kaláantik le chukteo'obo'

Meyajts'íib: Oken internet ti'al a kaxantik táabsajoochelo'ob ti'al a wilik bix le' chukteo'obo' yéetel báak'paacho'ob ka'ax jo' wa lajun ja'abo'ob paachil, ku ts'o'okole' ka wilik bix yanilo'ob be'elajake'. Tsikbalnen tu yo'osal le je'ela' yéetel a wetxooko'ob. il a wil a túuxtik jump'éel ts'íib ti' u jala'achilo'ob a kaajal tu'ux ka we'esik ti'ob ba'ax ta kaxtaj te' interneto'.

Connectivity and the Environment 2

Theme: Mangroves-Fossils Fuels- CO_2
Objective: Reading Comprehension
New Vocabulary: Carbon Dioxide, Ocean Acidification, Fossil Fuel, Renewable Energy

Critical Thinking Skills: They also take in carbon dioxide (CO_2) and create oxygen (O). One of the pressing issues of modern times is climate change, which is increasing temperatures globally and is also causing ocean acidification. One of the principal culprit is CO_2, which is produced by the burning of fossil fuels, such as oil-based products and coal. We need to reduce our dependence on fossil fuels and begin our transition to renewable energy sources. Even if we were to stop using fossil fuels tomorrow, we would still have a lot of extra CO_2 in the atmosphere. One role of mangroves, like all plants, is to take in CO_2 and create O. The mangroves take the C out of the air we breathe and use it for energy. The mangroves are very efficient at this. This is just one of the reasons we need to protect the mangroves.

Questions

1. How would you describe acidification in the oceans?
2. How does excess of CO_2 affect the mangroves and its environment?
3. How could we help protect the mangroves?

Activities: Use the internet to find a video of the natural mangrove surroundings near you from 5-10 years ago and compare it to today. Discuss the differences with your classmates. Try to send a letter to your local authorities pointing out your findings.

Le chukteo’ob je’elo’oba naats’ ti Cartagena de india , Colombia, ma’ chen ku ts’áik tu’ux u yaantal le ajchuk kayo’obo’ yéetel u ts’áik jump’éel ma’alob kúuchil ti’al u yaantal ik’elo’ob ku k’a’abéetal ti’ letio’ob ti’al u kuxtalo’obi’. Ku tselik xan tuláakal le xixelchúuk ku p’atiko’ob le kisbuuts’o’obo’. Oochel: Robby Thigpen.

These mangrove forests near Cartagena de Indias, Colombia not only provide homes for local artisanal fishermen and provide a healthy ecosystem for the sea creatures they want to catch to thrive. They also clean the carbon from the exhaust many cars, trucks and buses in the city. Photo: Robby Thigpen

Múuch'tsay yéetel wóolkab 3

Xookil: Chukte'obo yéetel báak'pachkuxtal
Xu'uk'il: Na'atil xook
Túumben tsolt'aan: Xma' baakililo'ob, o'olkijkayo'obo, xa'ak'bil lu'um, jiits'

U Páajtalil noj Tuukulil: U múuch' mootsil le k'áaxo'ob yáanal le ja'o' jump'éel báak'pachkuxtal jela'an. Le chukte'obo' jach ku yáantaj ti' le mejen kayo'ob yano'ob te'elo' beyxan ti' le xma' baakilo'obo yéetel le o'olkijkayo'obo'. Beyxan jump'éel kúuchil tu'ux ku tséentikuba'ob le jejeláas kayilo'ob ku chuka'alo'ob yéetel ku ko'onolo'ob te' Caribeo', je'elbix le sakbox pargoo' (Lutjanus griseus). Le kayo'ob ku chuka'alo'ob ti'al koonbilo'ob te' Caribeo' ku máansiko'ob wa jayp'éel k'iinil u kuxtalo'ob ti' le chkte'ilo' wa ti' le ja'il pradera'obo'. Wa mina'an le chukte'obo' wa ja'il pradera'obo' le u meyajil chuk kay te' Caribeo' mixtan u béeytal.

K'áatchi'ob:
1. Tsikba'alte'ex yo'osal ba'ax ka na'atike'ex ti' "u much'ootsil le k'áaxo'ob yáanal ja'o'"
2. Ba'axten ka tukultike' le o'olkijkayo'obo' ku yaantalo'ob ichil le xa'ak'bil lu'umo'.
3. Yéetel a t'aano'obe', tsol ba'axten le' chuk kay te' caribeo' je'el u sa'atal wa mina'an le' chukte'obo'.

Meyajts'íib: Meet jump'éel xak'al ta kaajal ti'al u béeytal a wojeltik jaytúul máak ku yáanta'alo'ob tumen le le sakbox pargo'o' wa uláak' kay. k'áatchi'inen yo'osal: buka'aj, u tojol, tu'ux ku bisa'al, u ma'alobil, yéetel uláak' ba'axo'ob páaybe'en a wojeltik.

Connectivity and the Environment 3

Theme: Mangroves- Ecosystems
Objective: Reading Comprehension
New Vocabulary: Invertebrates, Substrate, Mollusks, Collapse

Critical Thinking Skills: The below water root system are a very unique ecosystem. The mangles add lots of cover for small fish and invertebrates to hide in and around, and substrate for mollusks and other organisms to attach themselves to. They are also an important nursery area, a juvenile habitat, and a feeding area for many of the commercially important species of the Caribbean such as the gray snapper (*Lutjanus Griseus.)* Every commercially important species in the Caribbean spends at least one phase of its life in the mangrove mangles and/or in the seagrass meadows. Without the mangrove mangles and seagrass meadows, the fisheries of the Caribbean will collapse.

Questions
1. Discuss what you understand about the "below water root system".
2. Why do you think mollusks attach themselves to the substrate?
3. In your own words explain why the fisheries of the Caribbean would collapse without the mangrove mangles.

Activity: Conduct a research on your city to find out how much dependence there is on the consumption of red snapper or any other special species of fish locally. Include these topics: Availability, average cost, import, export, quality, restrictions, and demand.

Le mejen pargo'oba' (*Lutjanus apodus*) táan u báabo'ob ichil le' chak chukte'oba' (*Rhizophora mangle*) u ti'al u kaxantiko'ob u yo'ocho'ob. Le je'elo'oba' ku jaantiko'ob mejen xma'baakel ik'el ja'ob je'exbix cangrejo yéetel ik'el ja' ku yaantalo'ob ichil moots. Beyxan je'el u béeytal u báabo'ob jach séeb ichil le mootso'obo' uti'al ma' u jaanta'alo'ob tumen nukuch kayo'ob. Kaajil: Belice. Oochel: ©Antonio Busiello.

These juvenile Schoolmaster snappers (*Lutjanus apodus*) swim among these Red Mangrove (*Rhizophora mangle*) roots looking for food. Juvenile *L. apodus* eat small crustaceans like crabs and amphipods that live on the roots. They can also swim quickly into the root system to avoid being eaten by larger fish.
Location: Belize. Photo: ©Antonio Busiello

Múuch'tsay yéetel wóolkab 4

Xookil: Chukte'ob – P'íital.
Xu'uk'il: Na'atil xook.
Tumben tsolt'aan: P'íital, Mukul iik'

U páajtalil nojtuukul: Le chukte'obo' yaan xan u jeel u meyajo'ob: u kanáantiko'ob le peteno'ob yéetel le numkoyabo' ti' le p'íital ku beetik le chak ik'alo'obo' yéetel le k'a'ankach ja'obo'. U moots le chukte'o'obo' bey jump'éel wóol mootse', le je'elo'oba' ku yáantiko'ob u much'táambal le lu'umo', uti'al ma' u jubchajal ichil le k'ak'nabo' ikil u ts'áik le k'a'ankach ja'obo' yéetel le chak ik'alo'obo'. Beyxan yaan iik'o'ob tsaypachta'an yéetel k'a'ankach iik'o'ob yèetel chak ik'alo'ob. Jump'éel mukul iik'e' ku yúuchul ken jo'osa'ak u ja'il le k'ak'náab yo'okabilo' tumen k'a'ankach iik'o'ob. Le chukte'obo' ku yáantik u kanáant le peteno'obo' yéetel le numkoykab ti' u beel le ja'o', ti' le p'íital beyxan ti' uláak' talamilo'ob yaan ichil le mukul iik'o'.

K'áatchi'ob

1. Bix a tukultik tech u k'askúuntik le p'íital le chukte'ob yaano'ob naats' tu jáal le k'ak'náabo'obo'.
2. Ka tukultik wáaj le wíiniko'ob je'el páajtal u yáantiko'ob le kúuchil chi' k'ak'náabo'ob uti'al ma' u máansiko'ob le p'íitalo'. Bixi'
3. Ts'o'ok wáaj a máansik jump'eel chak ik'al tu jáal jump'éel k'ak'náab. Bix je'el a tsolik bix uchik a máansike'.

Meyajts'íib: Beet jump'éel pikju'unil oochel ti' jejelas chukte'ob ti' u lu'umil chi' k'ak'naabo'ob tu ba' súutulil yóok'ol kaab. Mik tu'ubuk tech a táakbesik a ti'alo'. E'esj u yoochel "bix ka'ach yanik yéetel bix ts'o'okik ka ts'o'ok le chak ik'alo'. Ketlanbes yéetel u jeel oochelo'obo' tak jalun ja'ab u jach úuchbenilo'ob.

Connectivity and the Environment 4

Theme: Mangroves-Erosion
Objective: Reading Comprehension
New Vocabulary: Erosion, Tidal Storms and Surge

Critical Thinking Skills: The mangroves also have another function. They protect the islands and mainland from erosion caused by hurricanes and other storms. The mangrove mangles are just like other root systems, they help hold the soil together, thus keeping the land from washing into the sea during strong storms and hurricanes. There are also tidal storm surges associated with heavy winds and hurricanes. A tidal storm surge is when the sea is pushed onto the land by the fast winds. Mangroves help to protect the islands and mainland from this rush of water and the erosion and other problems associated with tidal storm surges.

Questionnaire:

1. How do you think erosion affects the mangroves near the sea shores?
2. Do you think men can help the mangroves from suffering erosion? How?
3. Have you ever been in a storm at the sea shore? What words could you use to describe it?

Activity: Make an album with pictures of different mangroves in shore lines around the world, be sure to include yours. Show the "before and after the storm" scene. Compare also with pictures from some 10 or more years ago.

Barbara yéetel Johnnye’ táan u paktiko’ob jump’éel xóot’ jáal ja’ tu’ux ts’o’ok u yúuchul p’íital ti’ le chukte’o’. Le jáal ja’o’ ts’o’ok u jach cháalal, beytuno’ le ja’il áako’obo’ mixtan u páajtal u ts’áiko’ob u je’ob te’elo’.

Barbara Vilarmau yéetel Johnny Hustado Aguilare’ u ajkananilo’ob Refugio de Vida Silvestre Laguna Urpiano tu jáalja’il Caribe tak Costa Rica. Ti’ u k’iinil u ts’áaj je’ le ja’il áako’obo’ leti’obe’ ku máan u kaláanto’b le kúuchilo’obo yo’osal ma’ u yokolta’al le je’obo’. Ku ch’úuktiko’ob u xíitil le je’obo’ tumen wa ma’e’ je’el u yokolta’alo’be’ wa je’el u jaanta’alo’obe’. Le cháalal meenta’ab tumen úuchik u tse’elel le chukte’ te’elo’ yéetel yo’osal u talamil ku taasik le u chokotal yóok’ol kaabo’ jach yaj ku taasiko’ob ti’ le ja’il áako’obo’ yéetel xan ti’ u jeel kajtalilo’ob tuláakal yóok’ol kaab. Tumen: Robby Thigpen.

Barbara Barrera Vilarmau and Johnny Hurtado Aguilar are the overseers of Refugio de Vida Silvestre Laguna Urpiano on the Caribbean coast of Costa Rica. The coastline has creeped in so far that the sea turtles that they protect cannot lay their eggs here anymore. During sea turtle season they perform nightly sea turtle patrols to protect the eggs from poachers. They keep and relocate any eggs they find into an area that is safe from poachers and watch over the sea turtle eggs until they hatch. Erosion from the removal of mangroves and erosion from climate change induced sea level rise are serious threats to sea turtles and communities across the globe.

Múuch’tsay yéetel wóolkab

Meyaj ti’al meentbil táankab
(*Ti’al najil xooko’ob nats’o’ob ti’ jáal ja’*)
Ko’one’ex meentik jump’éel vivero ku taal ti’ chak chukte’.

Nu’ukulilo’ob:

U neek chak ibinja’: lelo’oba’ je’el u páajtal u mo’olol tuláakal le ja’abo’.
Juntúul xoknale’ k’a’abéet u taasik óoxp’éel wa jo’p’éel u neek’ le ibinja’o.

Sáasil chúujo’ob, jóojochitak, (óoxp’éel wa jo’p’éel ti’ xoknáal).

U jíil Nojtuk’.

- U xa’ak’bil lu’um le chukte’o’,
- Ch’óoy.
- K’osob.
- Ja’

Máak’anil: Kaxt jump’éel kúuchil ta najil xook bey tu’ux bo’oye’. Yéetel le k’osobo’ xot chúumuk tak tu ka’anlil le sáasil chúujo. Ichil jump’éel ch’óoye’, xa’ak’t le tsop luuk’ yéetel u jíilil le nojtuk’o’. Chup tak chúumuk ti’ jejeláas chúuj yéetel le lu’um ta xa’ak’tajo’. Ts’áaj jump’éel pak’áal ti’ jejeláas sáasil chúuj. Ts’íibt le chúujo’ob yéetel u k’iinil uchik u yúuchul le paak’alo’ yéetel u k’aaba’ le xoknáalo´. Ts’áajlant le chúujo’ob ti’ bo’oyo’. Joya’at le pak’áalo’ob sáansamal yéetel ch’ujuk wa ch’óoch’ ja’ tak kan wa jo’ wi’inalo’ob táanil ti’ u pa’ak’al ti’ lu’um. Yéetel a ajka’ansaje’ wa xka’ansaje’, k’áate’ex u yáantaj le u jo’olpóopil le kaajo’ uti’al u yáantike’ex a kaxte’ex jump’éel kúuchil bey tu’ux u páajtal a pak’ike’ex le ibinja’obo’, je’ebix xan ba’ax k’iinil yéetel bix ken a beete’ex.

(*Ti'al najil xooko'ob náachtako'ob ti' jáal ja'*)
Ko'one'ex meentik jump'éel vivero yéetel che'ob yano'ob ichil k kaajal

Nu'ukulilo'ob:

- Plántulas U pak'alil che'ob sijnáalo'ob ta kaajal (óoxp'éel wa jo'p'éel ti' xoknáal).
- Sáasil chúujo'ob, jóojochitak, (óoxp'éel wa jo'p'éel ti' xoknáal)
- U lu'umil paak'al.
- Xe'ek'a'an tu'ba'al (je'el u páajtal u beeta'al yéetel u yaalab ba'alo'ob séeba'an u k'astal ti' otoch).
- K'sob.
- Ja'.

Máak'a'anil: Kaxt jump'éel kúuchil tak ta najil xook bey tu'ux bo'oye' chen ba'ale bey ka juulnak xan u sáasil le k'iin kex junsúutuk. Yéetel le k'oso'obo', xot chúumuk tak tu ka'anlil le sáasil chúujo'obo'. Ichil jump'éel ch'óoye', xa'ak't le lu'um yéetel u xe'ek'a'anil tu'ba'alo'. Chup tak chúumuk ti' jejeláas chúuj yéetel le lu'um ta xa'ak'tajo'. Ts'áaj jump'éel pak'al ti' jejeláas sáasil chuuj. Tsíibt le chuujo'ob yéetel u k'iinil uchik u yúuchul le pak'alo', ba'ax che'il yéetel u k'aaba' le xoknáalo'. Ts'aláant le chúujo'ob te' kuuchil kaxk'ajo'. Joya'at le pak'alo'ob sáansamal yéetel ch'ujuk ja'. Le pak'alo'obo' yaan u pa'ak'al ti' lu'um chen nojochajko'ob tak 45-50 CM u ka'analil. Yéetel a ajka'ansaj wa xka'ansaje', k'aate'ex u yáantaj le u jo'olpóopil le kaajo' uti'al u yáantike'ex a kaxte'ex jump'éel kúuchil bey tu'ux je'el u páajtal a pak'ike'ex le ibinja'obo', je'ebix xan ba'ax k'iinil yéetel bix ken a beete'ex.

Connectivity and the Environment

Outdoor Activity:
(*For schools located close to the sea coast*)
Building a red mangrove nursery
Materials:

Mangrove propagules (seeds). These can be collected all year round from the parent mangrove tree. Collect 3 to 5 per student.

Empty 2-liter soda plastic bottles (3 to 5 per student).

Coconut coir or fiber.

Muddy soil substrate from the mangrove forest.
Bucket.
Scissors.
Water.

Procedure: Choose an area in your school with enough shade. Cut the top half of the plastic bottles with scissors. In a bucket, mix the muddy soil with the coconut coir in a ratio of 2:1. Fill half of each plastic bottle with the mixture. Place the red-brownish part of one propagule in the soil of each bottle. Label the bottles with date of sowing and student name. Place the bottles in the shaded area previously identified. Water the propagules daily with fresh or brackish water for a period of 4 to 5 months before outplanting. Together with your teacher, ask for collaboration with local authorities to identify the best places and times to plant the mangroves. On the day and place indicated, place the propagules in the substrate the same way you did in the plastic bottles, leaving a distance of approximately 35 cm apart from each other.

U Páajtalil noj Tuukulil
Critical Thinking Skills

Wa ku xu'upul le manglaro'obo', Yaan wáaj u yáantaj wa ma' ti' yo'osal u chokotal tuláakal yóok'ol kaab. Ba'axten.

If mangroves became extinct, would the global climate change be affected positively or negatively? Why?

Ya'ab ch'i'ibalilo'ob je'ex le sakbox pargoo' (*Lutjanus griseus*) k'a'abéet ti'ob le manglaro'ob ti'al ka yanako'obo'. Beytuno' wa ka xu'ulsa'ak le manglaro'obo' yaan u yaantal talamil ti'al u jóok'ol táanil máak.

Many commercially important species, like the gray snapper *(Lutjanus Griseus),* depend on the ecosystems created by the mangroves. Explain how the economy would suffer if the mangroves were reduced.

Ts'áaj óoxp'éel e'esajilo'ob tu'ux le manglaro'obo' ku yáantiko'ob kuxtal ichil ja'.

Give three examples of the mangroves as providers for the marine life.

Wa mina'an manglaro'obe', mina'an áantajil ti' le talamilo'ob ku taasiko'ob le chak ik'alo'obo'. Bix kun yaantal talamil ichil le kaajilo'ob naats'o'ob jáal ja' wa ka xu'ulsa'ak le manglaro'obo'.

Without mangroves we lack protection from hurricanes, erosion and other problems caused by them. How is the sea shore population's safety affected when we lose the mangroves protection?

Ya'ab núukoilo'ob (le k'áatchi'obo' je'el u yaantal asab ti' jump'éel u núukilo'obe'))
Multiple Choice (some questions have more than one answer)

1. Makalmáak ti' le je'elo'ob asab yaan ti'ob talamilo'ob yo'osal u cháalal le lu'um tumen mina'an manglaro'obo'.
   a. U ch'íichilo'ob jáal ja'.
   b. U k'aak'as kayilo'ob u taamil le ja'o'
   ch. Jchuk kayo'ob
   ch'. Otocho'ob naats'o'ob

1. Which of the following would be most affected by erosion in the mangroves?

a. Beach birds
b. Deep sea predators
c. Local fishermen
d. Nearby homes

2. Ba'ax je'el u meentik u xu'ulul u yaantal le *Lutjanus griseuso'*.

a. U xu'ulul u ch'íich'ilo'ob jáal ja'.
b. Jump'éel chak ik'al
ch. U xu'ulsa'al manglaro'ob
ch'. U kanáanta'al manglaro'ob

2. What could cause a drastic fall on the population of *Lutjanos griseus*?

a. Lowering the population of the sea birds
b. A hurricane
c. The destruction of the mangroves
d. The conservation of the mangroves

3. Ba'ax ku meentiko'ob le manglaro'ob yéetel u *gases atmósfera*.

a. Ku meentiko'ob u yaantal CO_2
b. Ku jo'osiko'ob C ti' le atmosferao'
ch. Ku jo'osiko'ob O_2 ti' le atmosferao'
ch'. Ku meentiko'ob u yaantal O_2.

3. What do mangroves do to the gases in the atmosphere?

a. Produce CO_2
b. Take C from the atmosphere
c. Take O_2 from the atmosphere
d. Produce O_2

U k’askúunajil u báak’pachkuxtal le chukte’obo’ jump’éel talamil yaan tuláakal yóok’ol kaab. Beytuno’ le uláak’ báak’pachkuxtalo’ob naats’o’ob ti’ob ku k’skúunta’alo’ob xan, tuláakal le ba’axo’ob ku kuxtalo’ob te’elo’ ku muk’yajo’ob yo’osal le talamila’. Je’el u páajtal u yila’al juntúul Nyange Nyange (U bakja’il arrecife occidental (*Ardea gularis*,Bosc, 1792) táan u xíimbal ichil u k’áaxil le chukte’obo’ ikil u kaxtik janal. Le xiixel *plástico* beyxan jump’éel nojtalamil ku k’askunajil ichil le kuxtalila’. U xiilel le *plástico* ku máano’ob yóok’ol le ja’o’ je’el u páajtal u yila’alo’ob tu xno’oj le oochela’. Oochel: Agnes Mukamai, Bahía de Gaza, Kenia.

Destruction of mangrove ecosystems is a worldwide problem. The extended damage to the adjacent ecosystems are the equally destructive everywhere and the families whose food security is dependent on healthy ecosystems are always negatively impacted. A Nyange Nyange [western reef heron (*Ardea gularis*, Bosc, 1792)] can be seen walking in the recovering mangrove forest looking for food. Plastics are also a global catastrophe negatively affecting the food web. Floating microplastics can be seen floating in the top right of the image. Photo: Agnes Mukami, Gaza Bay, Kenya EA.

Sáaskunt'aan

Aj k'ocha'an [culprit] adj. / s. m. yéetel f. Máak ts'áaja'an u kuuch ti' jump'éel toop wa jump'éel si'ipil, wa juntúul máak ku taka'al u pool yo'osal jump'éel nojtalamil.

Báak'pachkuxtal [ecosystem] s. m. Noj kúuchil beeta'an tumen wíinkil kuxa'an yéetel tuláakal u un'ukulilo'ob kuxa'antako'ob wa ma' kuxa'antako'ob, le je'ela' jets'a'an ti' junxóot' lu'umil.

Chak ik'al [hurricane] s. m. Jump'éel talam iik' ku k'aaba'atik noj iik' ku síijil yóok'ol choko ja' wa síis ja', u yiik'ale' ku chukpachtik jump'éel chichil ti' 74 mph. Ti' le xamano' u yiik'ale' ku suut kúulpaach ti' le p'iisib k'iino', ka'alikil ti' le noojolo' ku suut tu keet ti' le p'iisib k'iino'.

Chukte'ob [mangrove] s. m. Che' wa pokche' *tropical* wa *subtropical*, muk' óol ti' le ta'ab ku nojochtal te kúuchil jáal ja'o'. Le lu'umo'oba ku k'ajóolta'ano'ob tumen yaan ti'ob ch'óoch' ja', xma'iik' lu'um yéetel u chich juul k'iin. Ti'al u páajtal u kuxtal yáanal le kobolo'oba', le che'oba' ts'o'ok u kaniko'ob táakpajal ichil le je'elo'oba', yo'osal le je'elo ku meentiko'ob jejeláas ba'alo'ob ti'al u kuxtalo'ob, je'exbix u le'obe' ku ta'iko'ob ta'ab; u neek'o'obe' ku ch'íijilo'ob ichi táanil ti'al u xíitilo'ob; u mootso'obe' jela'antan ti' uláak' che'ob. Ya'ab ichil u muuts le che'oba' ti' yano'ob yóok'ol le ja'o', le je'ela' yo'osal u yáantajo'ob ti'al u yutsil wa'atalo'ob yóok'ol le luuk'il ja'o', beyxan yo'osal túubiko'ob le ta'abo', ku jáapiko'ob iik'il yéetel jump'éel ba'ax yaan ti'ob ku k'aaba'atik *pneumatóforos.* Le chuk te'obo' ku yáantajo'ob ti' le wóolkabilo'. Ku kanantiko'ob le chi' k'ak'náab ti' le chak iik'o'obo' yéetel le p'íitalo', ku biilal bey u núup'ul xiixo'ob, ku utskíinsik u joolmalil le ja'o' yéetel ku biilal bey u kuuchil tseen ti'al jejeláas kayo'ob, ba'alche'ob mina'an u baakelo'ob yéetel ula'ak' ba'alo'ob yaan u kuxtalo'ob. Le t'aan chukte'o' ku ts'áabal ti' u nukuch k'áaxil ibinja' wa k'áaxil ketbesa'an tumen chukte'ob.

Dióxido de carbon [carbon dioxide] s. m. Gas asab tat ket le iik'o', lela' ku jóok'ol ikil u much'ikuba'obxe'ek'ta'an ti' jump'éel masak'il iik' yéetel ka'a masak'il Iik'il. Ku beetal ti' u jóopbal ba'alil yaanti' carbono (ts'a'an le jajabil ti' tu' chaja'ankabo'ob), ti' yóomankil, u k'aastal ba'alilo'ob yéetel u ch'a' iik' ti' le wíinkil Iik'il. Le CO_2 ku jáapa'al tumen le che'obo' ikil u meentiko'ob *fotosíntesis*, le je'elo'oba' ku sutiko'ob iik'il. Le CO_2 jump'éel le jachmeentik u yaantal le éek'buuts'ilo'. Beyxan ku meentik su'uts'kinajil k'áak'náab tumen ku beetik ik'al iik' cheen xa'ak'pajak yéetel le ja'o'.

Jajabil ti' tu' chaja'ankab [fossil fuel] s. m. Jajabil ku taal ti' ba'alo'ob *hidrocarbonados* ku síijilo'obway lu'ume' le je'elo'oba' ku yaantalo'ob chen yéetel u yáantaj le yóok'olkaaba'. Le jajabil ti' tu' chaja'ankabo'ob leti'ob le chúuko', boox yiits lu'um, sujuy iik', *arenas de alquitrán* yéetel juuch'a'an box yiits lu'um. Ku ya'ala'ale' leti' le je'elo'ob meentik u jach chokotal le yóok'ol kaaba'. U tóoka'al le ba'alo'oba' ku beetik u ya'abtal *dióxido de carbono* (CO_2) ichil jump'éel ja'ab.

Jeltúumben óol [renewable energy source] s. f. Óol ku ch'a'abal ti' ch'i'ibal mixtan u xu'ulul je'exbix le k'iino', iik', muuk'ja', uk'umo'ob, k'iinal ja'ob, Ma'xu'ulmuk', ichil u jeelo'ob. Beyxan k'ajóoltan bey óol ma' éek'i' tumen jelkunaj ti' óol ku taal ti' le tóok Jajabil ti' tu' chaja'ankabo'ob, mixtan u k'askunsik le wóolkabo'. Ts'éets'ek ichil le je'elo'oba' ku chíikpajalo'ob u yóolil le k'iino', u yóolil u múuk' iik', u yóolil u muuk' ja', u yóolil u muuk' ja' yáanal lu'um yéetel Kokoxjajabilo'ob.

Jiits' [collapse] s. m. Lúubul wa chich xéet'el, wa chúuka'an k'askuunaj ti' jump'éel wóolayil, wíinkilil, molay wa je'ex makalmáak ba'axe'.

K'exlabáankil k'íin [climate change] s.m. K'eexil k'iin ku yúuchul te' wóolayil k'iinil te' lu'umo' ichil jump'éel súutuk ya'abil k'iin. Lela' ku yúuchul tu yo'osal le ba'alo'ob ku beetik le wíiniko', lebeetike' ku chokotal yóok'ol kaab, tu yo'olal xan u yáalal le CO_2 ku jóok'ol tumen jach ya'ab u tóoka'al le jajabil ti' tu' chaja'ankabo'. U na'akal tak 2ºC le ti'ibil ooxil wóolkabo' je'el u páajtal u yúuchul jump'éel k'exlabáankil k'íin jach k'aase'. Ku ya'alik le *Fondo Mundial para la Naturaleza (WWF)*, le ja'asben k'iino'ob ti' tu láakal le yóok'ol kaabo' táan u bin u ya'abtalo'ob jach séeba'an. Tu yo'osal le ba'al je'ela' ku yíibil le kúuchilbato'obo', ku ya'abtal u yáal le k'ak'náabo' yéetel u jeel ja'asben k'iino'ob talamtako'ob.

Kóom koj *playero* [short-billed dowitcher] (*Limnodromus griseus* Gmelin, 1789) s. m. ch'íich' ku yaantal jáal ja' yéetel ku xíimbal táanxel tu'ux, u nojchile' ma' jach chichani' ba'ale' ma' xan jach nojochi', ku máansik ke'elil ichil le táax ts'op luk' tu chi´ le k'ak'náabo', wa ti' ch'óoch' áak'alche.

Kuchil wenel ti' ba'alche' [rookery] s. m. Kuuchil ku k'a'abéetal beey otoch ti'al ts'ée'ets'ek ch'íich'o'ob yéetel ba'alche'ob ku chu'ucho'ob ichil ja', ku k'u'ankil ti' múuch'o'ob wa ku múuch'kunkuba'ob ti'al u tséeno'ob.

Kúuchil yáanalja' [underwater habitat] s. m. Kúuchil wa xuul yáanal le yóok'kabil ja' tu'ux ku kuxtal ik'elo'ob, ba'alche'ob wa u jeel ba'alo'ob. Ichil le je'ela' ku chíikpajalo'ob kuxa'an ba'alo'ob wa ma' kuxa'an tu báak'pachil.

Mukul iik' [storm surge] s. f. pl. U líik'il u ka'anlil le ja'o', ku beetik u yaantal búulkabil, le je'ela' ku yúuchul ken yanak chak ik'al wa k'a'ankach iik'.

O'olkijkay [molluskus] s. m. /adj. Ba'alche'ob mina'an u baakelo'ob táakpaja'ano'ob ti' le múuch'il *Mollusca* (ti'al latín *molluscus,* "o'olkij, susulkil"), k'ajóolta'an tumen yaan ti' jump'éel wíinkilal susulkii, ma' bey uláak'o'b pixa'ano'ob tumen jump'éel u sóolil *calcio*. Tuláakal le o'olkilkayo'obo' yaan u poolo'ob; u ts'o'om jobnel ku yaantal tu puksi'ik'al yéetel u xet'wíinkilal ti' ch'a' iik', ka'a síijil, tajal janal yéetel ta'il; yéetel jump'éel muk' ook ku biilal ti'al u péeksikuba'ob. Beyxan yaan ti'ob jump'éel *sistema nervioso,* le je'ela' jump'éel bekan wíinkilal chuup yéetel k'asalo'ob, yéetel jump'éel u pak'il wíinkal ku pixik u ts'o'om jobnel. Ti' u ya'abil le ch'i'ibalilo'obo', le ta'ampose'en sóolo' ku jatsa'al tumen le oot'elo'. *Mollusca* leti' u ka'amúuch'il ba'alche'ob asab ya'ab táanil ti' le múuch'il *Arthropoda* tumen yaan ti' asab ti' 100 000 jejeláasilo'ob k'ajóolta'ano'ob. Ichil le je'ela' ku táakpajalo'ob *gasterópodos* (úuricho'ob, x-iisilo'ob), *cefalópodos* (calamar, pulpo, nautilos), *bivalvos* (almejas, ostras, mejillones), ichil u jeelo'ob. Le *cefalópodos* k'ajóolta'ano'ob bey le xma' baakel ba'alche'ob asab na'at óolo'obo', le je'elo'oba' jump'éel e'esajil bix u bin u kaambal yéetel u ch'íijil le ba'alche'obo'.

P'íital [erosion] s. f. U bin u xu'upul ba'alil ti' yóok'kabil lu'um ku beeta'al tumen iik', u meyaj lu'umil bat wa tumen le ja'o', je'exbix, le cháako', u beel ja', uk'umo'ob, yáalkab ja'ob, yáamo'ob yéetel búulkabilo'ob. Le p'íitalo' ku ts'áik u xu'upul le tuunicho' wa u jeel ba'alil ti' jump'éel kúuchil yéetel ku pulik tu jeel kúuchil.

U su'uts'kinajil le k'áak'náabo' [ocean acidification] s.f. Éemelil u pHi' u ja'il le k'ak'náabo', lelo' ku ye'esik u na'akalil u su'uts'il le ja' tak 30% je'exbix u ts'áik ti'al jump'éel ya'ab jeets'kunal ti' dióxido de carbono (CO_2) te' ka'ano'.

U ch'íich'ilo'ob ek'k'ak'náab [wading wirds] s.f. pl. U ch'íichi'lo'ob ja' ku táakpajalo'ob te' *Charadriiformes*, k'ajolta'ano'ob tumen u mooch'o'obe', u kaalo'obe', yéetel u kojo'obe' chowaktak, yéetel xan tumen talam ti'ob u xíimbalo'ob ichil le ja'o' wa tu'ux yaan luuk' u ti'al u bin u kaxto'ob u yo'ocho'ob.

Xa'ak'bil lu'um [substrate] s. m. Yo'okabil kúuchil ku ts'aik ti' jump'éel wíinkilil jump'éel tu'ux u kuxtal, u nojochtal wa u yaantal u yo'och.

Xma'baakil [invertebrate] s. m. /adj. Ba'alche' *multicelular* mina'an u t'o'ol pu'uch wa u t'o'ol paach. Le xma'baakilo'obo' ku beetiko'ob le múuch' asab ya'ab ti' ba'alche'il yóok'ol kaab, naats' ti' 97% ti' tuláakal u jejeláas ba'alche'ilo'ob le lu'uma'. Ku yokolo'ob ichil le je'elo'oba' le *Porifera* (esponjas), *Cnidaria* (corales, mesudas, anémonas), *Platyhelminthes* (táax nook'ol), *Nematoda* (gusanos cilíndricos), *Annelida* (nook'ol jaatsa'an bey le lukumo'ob ti lu'umo'), *Mollusca* (úuricho'ob, calamar y pulpo), *Arthropoda* (ik'elo'ob, amo'ob, cangrejos), *Echinodermata* (ek' k'áak'náab, pepinos k'áak'náab), iichil u jeelo'ob.

Glossary

Carbon Dioxide, **CO_2** [dióxido de carbono] n. A gas that is denser than air and is formed by the combination of one carbon atom and two oxygen atoms. It is produced in combustion of materials containing carbon (including fossil fuels), in fermentation, decay of organic materials, and in respiration of aerobic organisms. CO_2 is absorbed from the air by plants in photosynthesis, while oxygen is produced as a by-product. CO_2 is one of the main causes of the greenhouse effect. It also causes ocean acidification as it forms carbonic acid when it dissolves in water.

Climate Change [k'exlabáankil k'íin] n. A periodic change in the Earth's climate system over a long period of time. The most recent change is caused by human activities such as burning fossil fuels that lead to global warming due to increasing levels of atmospheric CO_2. An increase of 2°C in global average temperatures may lead to catastrophic climate change. According to World Wildlife Fund (WWF), increasing temperatures are causing the frequency and intensity of severe weather events around the world, resulting in melting glaciers, rising sea levels, and new weather patterns.

Collapse [jiits'] v, n. A severe failure or breakdown, or complete destruction of a system, structure, business, institution, or something else.

Culprit [aj k'ocha'an] n. Someone who is responsible for a problem or for committing a fault, or that is accused of a crime.

Ecosystem [báak'pachkuxtal] n. A complex system of living organisms, their abiotic and biotic environment, and all their relationships and interactions in a particular unit of space.

Erosion [p'íital] n. The gradual wearing down of material from the Earth´s surface caused by wind, glacial processes, and water, e.g., rainfall, runoff, rivers, streams, currents, waves, and floods. Erosion includes the weathering of rock or other material in one location and their transport to another point.
Fossil Fuel [jajabil ti' tu' chaja'ankab] n. Fuel derived from hydrocarbon materials of biological origin formed in the Earth by natural processes. Fossil fuels include coal, petroleum, natural gas, tar sands, and heavy crude oil. They are considered the biggest driver of climate change as their burning produces several billion tons of carbon dioxide (CO_2) per year.

Hurricane [chak ik'al] n. Type of storm called a tropical cyclone that originates over warm tropical or subtropical waters and which has winds that reach a speed of 74 mph. In the northern hemisphere winds rotate counterclockwise, while in the southern hemisphere the rotation is clockwise.

Invertebrates [xma'baakil] n. /adj. A multicellular animal without a vertebral column or backbone. Invertebrates form the most numerous group of animals, as they contain approximately 97 percent of all animal species and include many phyla, including *Porifera* (sponges), *Cnidaria* (coral, jellyfish, anemones), *Platyhelminthes* (flatworms), *Nematoda* (roundworms), *Annelida* (segmented worms such as earthworms), *Mollusca* (snails, squid, octopus), *Arthropoda* (insects, spiders, crabs), *Echinodermata* (starfish, sea cucumbers).

Mangrove [chukte'ob l] n. A tropical or subtropical salt-tolerant tree or shrub that grows in the coastal intertidal zone along estuaries, in salt marshes, and on muddy grounds. These areas are characterized by having saline water, daily tides, anaerobic soil, and intense sunlight. To survive under these conditions, mangroves have developed several adaptations, such as leaves that excrete salt, vivipary which means that seed germination begins while still being attached to the parent tree, and their characteristic aerial root systems. Many species have roots that are exposed over the water to provide structural support in the soft sediment, exclude salt, and absorb oxygen from the air through specialized respiratory root structures called pneumatophores. These contain breathing pores or lenticels. Mangroves provide diverse ecosystem services. Among others, they protect shorelines from hurricanes and erosion, serve as sediment traps, improve water quality, and serve as nursery areas for reef fish, invertebrates, and other species.
The term mangrove also applies to forests or vegetation of such plants.

Mollusks or Molluscs [o'olkijkay] n. Invertebrates belonging to the large and diverse phylum *Mollusca* (from the Latin *molluscus*, "soft") characterized by having a soft unsegmented body which in most species is completely or partly covered by a calcium carbonate shell. All mollusks have a head; a visceral mass containing the heart and organs of respiration, reproduction, digestion, and excretion; and a muscular foot used for locomotion. They also have a nervous system, a true coelom, i.e. a body cavity filled with fluids, and a mantle or dorsal body wall covering the visceral mass. In most species, the calcareous shell is secreted by the mantle. With more than 100,000 described species *Mollusca* is the second most diverse animal phylum after *Arthropoda*. Mollusks include gastropods (snails, slugs, conch), cephalopods (squid, octopus, nautilus), bivalves (clams, oysters, scallops, mussels), and a few obscure groups. Cephalopods are considered to be the most intelligent invertebrates and an example of how the process of acquiring knowledge and understanding has evolved in animals.

Ocean Acidification [u su'uts'kinajil le k'áak'náabo'] n. A decrease of the pH of ocean water that represents an increase in water acidity of approximately 30 percent, resulting from an increased concentration of carbon dioxide (CO_2) in the ocean.

Renewable Energy [jeltúumben óol] n. Energy that is obtained from renewable sources, including the sun, wind, tides, rivers, hot springs, biomass, among others. It is also known as clean energy because unlike energy derived from burning of fossil fuels, it does not produce environmental pollution. Some types of renewable energy include solar energy, wind energy, hydroelectric power, and geothermal energy.

Rookery [kuchil wenel ti' ba'alche'] n. The breeding ground of some birds and marine mammals that nest in colonies or congregate to breed.

Short-billed Dowitcher [kóom koj player] (*Limnodromus griseus* Gmelin, 1789) n. A medium to large, long-billed, migratory shorebird that spends the winter on coastal mud flats and brackish lagoons.

Storm Surge [mukul iik'] n. An elevation of sea level that produces a coastal flood and is caused by the strong surface winds and low atmospheric pressures associated with tropical cyclones.

Substrate [xa'ak'bil lu'um] n. A surface or underlying material that provides an organism with a place to live, grow, or obtain food.

Underwater Habitat [kuchil wenel ti' ba'alche'] n. The place or environment under the water surface where a species, species populations, or one or several communities live. These habitats include the abiotic and biotic components of the surrounding underwater environment.

Wading Birds [u ch'íich'ilo'ob ek'k'ak'náab] n. Aquatic birds, especially those belonging to the Order *Charadriiformes,* which are characterized by having long legs, necks, and bills which help with, wading or walking through water or mud in search for food.

Ajka’ansaj-Ajsutts’íib Hilario Poot Cahun ti’ u súutukil u ts’áaj xook ti’ sutts’íib. Universidad Intercultural Maya de Quintana Roo (UIMQRoo). Oochel: Salvador Chávez Canul.

Professor-Translator Hilario Poot Cahun in the Translation Workshop I. Intercultural Maya University of Quintana Roo (UIMQRoo). Photo: Salvador Chávez Canul.

U nojochil el ajxak'alo'obo' Robby Thigpen ku ts'áik k'ajóoltbil u xak'al yo'osal u meyajil chuk kay tak Caribe occidental, le je'ela' ichil jump'éel much'táambal ti' ajka'ansajo'ob tu kaajil Lookout en Cayo, Belice, Centroamérica. Oochel ch'a'ab tumen Celeste Castillo yéetel Alyssa Majil

Principal Investigator Robby Thigpen presenting his research on the artisanal fisheries of the western Caribbean at a teacher's workshop on Spanish Lookout Caye in Belize, Central America.
Photo by Celeste Castillo and Alyssa Majil.

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