

High School

JUNTOS ENVIRONMENTAL STUDIES IN THE WESTERN BORDERLANDS - INTERCULTURAL ENVIRONMENTAL STUDIES



.....

TEACHER'S GUIDE

Developed by Trica Oshant Hawkins
With Collaboration from Rocío Covarrubias

Produced by

Environmental
Education
Exchange

Funding provided by the Ford Foundation Mexico

JUNTOS
INTERCULTURAL ENVIRONMENTAL STUDIES
IN THE WESTERN BORDERLANDS



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With Collaboration from Rocío Covarrubias



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Funding provided by the Ford Foundation Mexico

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INTRODUCTION

Welcome Teachers!

Welcome to Juntos: Intercultural Environmental Studies in the Western Borderlands. The purpose of the Juntos is to offer science teachers throughout the region relevant ecology and environmental science lesson plans, support materials, and resource opportunities. Juntos' lesson plans present the basics of ecology, natural resource use, and environmental issues as prescribed by state and national science education standards. The uniqueness of the program is that the examples used to teach these concepts are based on our region's desert ecosystem. Ecological interactions are explained using Sonoran Desert plants and animals. Population dynamics are investigated using data from real Sonoran Desert organisms. The environmental issues presented are based on actual, regional, and contemporary issues. The Juntos Program also gives students the opportunity to make direct contact with scientists and other resource people in their communities and in the region. Juntos helps students *experience* relevant environmental science.

The development of Juntos was a long process involving teachers, scientists, administrators, community leaders, and a plethora of other environmental resource people. Individuals from every community on both sides of the U.S. / Mexico border and on the Tohono O'odham Nation were involved in either review of materials, content suggestions, administrative approval, or other contributions of resources and information. The goal of the entire process was to involve a diversity of individuals and organizations to ensure relevant and accurate content, curriculum alignment, and cultural sensitivity. The result is this tailored curriculum focusing on basic ecology, the Sonoran Desert, regional environmental issues, and the resolution of regional environmental problems.

This edition of Juntos was developed for use in high schools in the U.S. - Mexico border region between the communities of Nogales / Nogales and Yuma / San Luis Rio Colorado. This includes high schools on the Tohono O'odham Nation. In the U.S. (including the Tohono O'odham Nation) it is targeted for use in 9th grade general or integrated science courses or 10th grade biology courses. In Mexico, it is targeted specifically to augment the ecology elective taught in the third grade of secondary schools. Teachers from nearly every one of the 30 high schools in the region were directly involved in the development of this curriculum. They participated in preliminary "needs assessment" meetings, responded to interviews and surveys, reviewed preliminary materials, piloting activities, and providing feedback on materials.

As the name "Juntos" implies, this curriculum was developed and is being implemented *together*. Your participation and input is valuable and vital. Guidance, criticism, contributions, and suggestions are always welcome and appreciated. Being in three-ring binder form, Juntos is intended to be dynamic, allowing for growth and change. Please feel free to contact us at any time. Educating our youth about our environment is a huge commitment but one that can reap tremendous rewards for all.

We are truly in this together.

And finally, we'd like to once again thank the Ford Foundation Mexico for their generous funding of this project.

Thank you all for your participation,

Trica Oshant Hawkins

Rocío Covarrubias

ACKNOWLEDGMENTS

The development of *Juntos: Intercultural Environmental Studies in the Western Borderlands* would not have been possible without the cooperation and assistance of numerous agencies, organizations, and individuals throughout the region. Teachers attended meetings and respond to surveys; scientists took their time to locate and contribute relevant data, photos, maps and other resources; administrators took time to listen to presentations, review, and approve the program; and numerous other people provided valuable suggestions, resources, and guidance. This program has truly been accomplished *Juntos* - together.

While we have provided a list of cooperating agencies and organizations and a list all of the participating teachers, we would like to especially thank the following people for their contributions: Joe Joaquin, who provided guidance through the approval process on the Tohono O'odham Nation; Mariana Lazcano who initiated and helped to coordinate all of the original teacher and administrative meetings in Sonora, Mexico and who also helped in the development of the first outline for *Juntos*; Profr. Joaquín Enríquez, Subsecretary of Outreach and Educational Development for the Department of Education and Culture of the Government of the State of Sonora; Lic. Ernesto Talamante, Dean of Outreach and Educational Exchanges for the Department of Education of the Government of the State of Sonora; Gloria Montana and Kenneth Williams of the Tohono O'odham Legislative Council; Rosilda Manuel-Lopez, Education Director of the Tohono O'odham Nation; Ken Cronin and his staff in the Tohono O'odham Environmental Office; Peter Ruiz, Jefford Francisco, and Scott Bailey of the Tohono O'odham Natural Resource Department; Gary Olson and Faith Soto of the Tohono O'odham Solid Waste Department; Bill Cisco, Superintendent of Indian Oasis - Baboquivari District to TUSD; Sally Gall, wildlife biologist for the Buenos Aires National Wildlife Refuge; Gina Pearson, Organ Pipe Cactus National Monument for providing a baseline map; Ray Turner for providing valuable historical photographs; Víctor Quiroga, Pinacate Biosphere Reserve; Paul Crawford, International Sonoran Desert Alliance; Danny Lopez, Tohono O'odham Community Action; Greg Clark for his contribution of plant and animal photographs; Andy Small, Laura Key, and David Meissner of the EE Exchange for assisting with lesson plan development; Steve Cornelius and Nina Chambers of the Sonoran Institute, for contributions on introduced species; Yajaira Gray, Arizona-Sonora Desert Museum for contributing a "case study" on migratory pollinators; Nora Hurtado Arévalo, San Luis Rio Colorado; Federico Iglesias, San Luis Rio Colorado; Karen Sondak, science teacher, Rio Rico High School; Donna Sider, science teacher, Baboquivari High School; David Ortiz, Alto Golfo Biosphere Reserve; Profr. Roberto Salazar, Escuela Secundaria Estatal No. 22, San Luis Rio Colorado and Prof. Francisco Pon, Escuela Secundaria Técnica 62, Nogales, for assisting in the dissemination of draft copies and coordination of teachers' workshops.

We hope we have not overlooked anyone, if so, we of course apologize and are sincerely thankful. In reality, we are deeply indebted to everyone in the region who has supported and continues to support the *Juntos* project-an impossibly long list of names-thank you all.

We also want to acknowledge the *Juntos* Advisory Committee. Because other regional organizations are also involved in similar "*Juntos*" programs, the *Juntos* Advisory Committee was formed to ensure quality and consistency in the development of *Juntos* curricula. The *Juntos* Advisory Committee consists of individuals from the International Sonoran Desert Alliance, The Center for the Studies of Deserts and Oceans (CEDO), Organ Pipe Cactus National Monument, The Tohono O'odham Nation, The Arizona-Sonora Desert Museum, CREAS, the Upper Gulf Biosphere Reserve, and the Environmental Education Exchange. Together, these committed environmental educators are working to share resources and maintain communications in an effort to create relevant, culturally sensitive, and scientifically accurate programs about the Sonoran Desert Ecoregion.

And finally, we want to recognize the **Ford Foundation Mexico** who, by generously funding *Juntos: Intercultural Environmental Studies in the Western Borderlands*, has demonstrated their faith in this project, commitment to our communities, and dedication to this unique border region of the Sonoran Desert.

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HOW TO USE JUNTOS IN YOUR CLASSROOM

General Information

Juntos was developed to be "user-friendly" with ready-to-use lesson plans, background information fact sheets, student activity pages, and other classroom resource materials. The program is divided into four units, each including several lesson plans with a unifying theme. While the units and lesson plans build on the information in previous activities, some of them may "stand alone" and be used at your discretion to augment other class lessons. We suggest and hope you use them in the order provided but do not want to limit their use by making that a requirement. Only you, the teacher, can decide how they best fit into your curriculum. We are eager to hear how you use the lessons and are always open to suggestions to make them even more suitable to your needs.

Lesson Format

Each lesson includes the following information:

- **Lesson Overview** - provides a general review of the activity.
- **Learning Objectives** - outlines the lesson's specific, measurable learning objectives--what the student will learn from this lesson.
- **Time Needed** - states how much time is needed to complete the lesson.
- **Materials Needed** - includes all of the background readings, student activity handouts, and other "props" you will need for the lesson.
- **Curriculum Ties** - provides a reference for how the lesson aligns with the Arizona State and Tohono O'odham Education Standards (matrices outlining the specific performance objectives are provided in Appendix A).
- **Teacher Preparation** - describes the actions to prepare you and the classroom for the lesson.
- **Teaching Strategy** - proposes the step-by-step procedures to teach the lesson and conduct any associated activities. Each item under this heading has a highlighted, abbreviated summary of the procedure for quick reference.
- **Extensions** - offers suggestions to continue student learning about the specific topic through additional readings, activities, research, etc.

A special note about "Materials Needed" and the reality of existing classroom resources

We are aware that not all classes have the resources necessary to carry out the lessons as suggested in the lesson plans. With that in mind, we offer the following alternatives to teaching the lessons given specific limited resources.

Overhead projector. Many of the lessons include "Overhead Transparency Masters." We understand that not all classes have access to overhead projectors. We suggest that in such incidences, the material from the overhead transparency master (including all tables, blank lines, and graphs) be copied in advance on the chalkboard. The same teaching strategy could still be used but with the "filling in the blanks" being done on the chalkboard.

Copying "Student Activity" pages. We have provided teachers with a master copy of the *Juntos Student Workbook* which is a compilation of all of the student readings and activity pages for the program. We suggest that if possible, teachers use this master to make enough copies of the *Juntos Student Workbook* for each of their students. If such a large copying order exceeds a teacher's copying budget, it is suggested that teachers copy the student pages one unit or one lesson at a time. Teachers in Mexico will be provided copies of the *Juntos Student Workbook* for each of their students [graciously printed and disseminated by the Sonoran Secretary of Education and Culture (SEC)]. The "Student Activity" pages are an important element of the lessons. If for some reason copies of the student activity pages are not available, it is also possible for students to create their own "Student Activity" pages by hand-copying them. We suggest you provide a master on the chalkboard or on a piece of butcher paper posted on the classroom wall for students to copy.

Conveying Information to Students

Juntos employs several strategies to help you convey information to students. The following summarizes those strategies:

- **Teacher presentation of material through lecture.** This relies on you, the teacher, being very familiar with the material. We propose this strategy only minimally. Background information fact sheets are provided to acquaint you with the material.
- **Use of overhead transparencies with review of material by entire class (or for classes without an overhead projector, information for review is copied onto chalkboard for the class).** This strategy allows you to review the material verbally while viewing the information on the overhead (or chalkboard) and "filling in the blanks" with key vocabulary words. This also gives your students the opportunity to copy the information onto their "Student Activity" pages as they follow along with the review of the information.
- **Student investigation.** This is a strategy we have strived to integrate into the lessons. It involves students reviewing material, conducting investigations, and gathering, graphing and analyzing data. We have included study guides, data sheets, graphs and a variety of other student activity sheets that encourage independent student inquiry and teamwork.
- **Students presenting information to other students.** We have employed this strategy in several of the lessons to maximize the learning opportunities of the entire class and to build student skills in presentation of scientific information. This strategy allows students to gain in-depth knowledge about a particular topic as they review information and prepare a presentation for the class. It also gives them the opportunity to be exposed to information about similar topics through other students' presentations.

Alignment with Education Standards

The content and process of each activity in this document are intended to provide a means for you to meet your curriculum requirements using regionally relevant topics and examples. Throughout the development of this curriculum, we have strived to align the lessons with specific learning objectives and outcomes stated in district, state, and national education standards. Each lesson is cross-referenced with specific Arizona State and Tohono O'odham Nation Education Standards performance objectives. Additionally, matrices describing the performance objectives are presented in Appendix A.

Juntos Student Workbook

A *Juntos Student Workbook*, which includes all "Student Activity" pages, data sheets, and background readings, is provided with this curriculum. While Mexican students will each receive their own copy of the *Juntos Student Workbook* (thanks to the Sonoran Secretary of Education and Culture), U.S. teachers will be receiving one master copy of the *Student Workbook*. U.S. teachers are strongly urged to make one complete copy of the *Student Workbook* for each student (refer to "Copying Student Activity pages" on the previous page for additional information about this). The *Student Workbook* provides the opportunity to compile and organize all student activity sheets and other written or drawn works completed for the Juntos Program. The completed *Student Workbooks* may be used as a type of alternative assessment of student accomplishment for this program.

Student Evaluation

We are providing student evaluation forms for each of the first three units. As well, we hope you will use the "*Student Activity - Survey Form: 'Student Environmental Knowledge: What Do We Already Know About Our Desert Home?'*" (from the first lesson in Unit One) as a pre-test and post-test type of assessment for knowledge gained throughout the entire program. As mentioned above, the *Juntos Student Workbook* may also be used as an alternative assessment of student accomplishment for the program.

OVERVIEW OF ACTIVITIES

Unit One - The Border Environment: Our Sonoran Desert Home

Lesson 1 - Welcome to Juntos - What Do We Already Know About Our Desert Home?

This is the introductory activity for the Juntos program. Following a general introduction to Juntos and its unique features, students will complete an environmental knowledge survey to reveal what they already know about their desert home. Students will interview each other using a survey form (provided), then review their responses as a class. Upon completing this activity, you and your students will have a better understanding of your own environmental knowledge. The purpose of this activity is to generate interest in the Juntos program and to give students an idea of what constitutes environmental information, knowledge that is vital to our lives in this desert region. This activity may also be used as a pre-assessment to evaluate knowledge gained through the Juntos program.

Lesson 2 - Where in the World? - Natural and Cultural Geography of the Sonoran Desert Borderlands

This activity gives students the opportunity to gain information about significant geographical features of the Sonoran Desert border region. Using clues from a crossword puzzle (which includes reference indices to aid in map locations), students locate and identify significant natural, cultural, and political features on a provided map of the Sonoran Desert region. Students also complete additional map exercises further demonstrating the kinds of information maps may provide.

Lesson 3 - The Sonoran Desert Ecosystem - Sensing and Describing Biotic and Abiotic Factors

This lesson provides a review of basic ecological terms and focuses on the primary components of ecosystems: biotic and abiotic factors. The lesson includes an outdoor component that serves to get the class out into the environment in a focused and orderly manner and to encourage and hone observation skills of the students. The lesson begins with a review of ecology terms, after which the class ventures outside to make quiet observations of abiotic and biotic factors in their immediate environment. Observations are recorded on a provided data sheet. Students will also describe how the observed abiotic factors affect the biotic factors.

Lesson 4 - Abiotic Factors in a Desert Environment - Temperature and Evaporation of Water

In this activity, you and your students will investigate aspects of sunlight, an abiotic factor which has a great influence on our desert environment. Using the scientific method, students will conduct an experiment to determine the effect of sun and shade on the temperature and volume of water in a container. Two study sites will be set up, one in the direct sun and one in a shaded area. Graduated containers of water will be placed at both stations. A thermometer will be placed in each container. The temperature and volume of the water in the containers will be measured and recorded at intervals throughout the day. Students will make predictions, gather, graph, and analyze data, and articulate results. The purpose of the experiment is to demonstrate the dynamics of an abiotic factor that has great significance in our desert region. Extensions include calculations of evaporation in local waterways and a discussion of water transportation and storage in the desert.

Lesson 5 - Biotic Factors of the Sonoran Desert - Some Common Plants and Animals Sharing Our Desert Home

This lesson offers a variety of options for studying the life histories of some common plants and animals of the Sonoran Desert. The class is provided with a set of illustrated "cards" describing the life histories of selected plants and animals of the region. Depending on the needs of the class, you may select from a "smorgasbord" of activity ideas utilizing the cards in classroom instruction. The purpose of this lesson is to give you and your students the opportunity to learn more about our plant and animal neighbors of the desert. It is also a chance for you to tailor provided resource materials to the needs of your class.

Unit Two - A Dynamic Balance: Living in the Sonoran Desert

Lesson 1 - The Science of Connections - Ecological Interactions in the Sonoran Desert

Ecological interactions between organisms contribute to the dynamic balance in ecosystems. In this activity, students are

introduced to a variety of ecological interactions that occur among organisms--specifically Sonoran Desert organisms. The lesson begins with several "hands-on" examples which will allow students to observe real cases of ecological interactions (such as symbiosis, predation, and competition) using such props as insect galls, desert mistletoe, chewed leaves, or a variety of other examples (suggested in the activity). Following a review and discussion of the basic types of ecological interactions among organisms, students will receive "Sonoran Desert Interaction Cards" upon which are described different ecological interactions that actually occur among Sonoran Desert organisms. Students will work in pairs to review their "Sonoran Desert Interaction Cards" and complete a study guide about the interacting organisms. Students will share their findings with the rest of the class. By studying actual interactions between Sonoran Desert organisms, students will become better acquainted with both the interactions and the organisms involved.

Lesson 2 - Maxed Out: Population Growth and Biotic Potential

This lesson looks at the basics of population growth and gives students an opportunity to consider what populations could do given no limits to their growth. The lesson begins with a brief explanation about the difference between linear and exponential growth. Together, the class will calculate the biotic potential of selected Sonoran Desert plants and animals. Real life history data will be provided about the birth rates of several animals for students to use in their calculations. Students will also graph the data to visualize the J-shaped curve depicting exponential growth. Next, small groups of students will work together to calculate the population potential of several generations of a sample organism. Upon calculating several generations, student will graph their data. This lesson covers only the biotic potential of organisms-how their populations could "explode" without limits to their growth. The activity clearly illustrates that without limits to growth, populations would continue to grow and quickly upset the balance of any ecosystem.

Lesson 3 - Maxing Out has its Limits: Population Growth and Carrying Capacity

Once students understand the concept of biotic potential, they begin to realize that most populations do not continue to grow and grow unabated. This activity explores what happens to populations to keep their numbers from "exploding" and over-running the earth (or any given ecosystem). The lesson begins with an exercise that literally crowds more and more students into a small space (designated in the classroom). The students will quickly realize that the space is too small for the entire class to occupy. Using the limited space as an analogy to the planet (or a given space on the planet such as the Sonoran Desert), the class will consider what happens to organisms occupying the same area. The class will next review and discuss the factors that limit populations such as competition, predation, parasitism, and disease. The concept of carrying capacity will be introduced and graphically depicted with an S-shaped curve for students to visualize how limiting factors affect exponential growth. Students will next graph the population growth of an actual Sonoran Desert animal population. The class discussion will also focus on ways that different ecological interactions (studied in a previous lesson) affect population growth.

Lesson 4 - Human Population Growth - A Look at Our Own Numbers

This activity looks at the growth of human populations in our own Sonoran Desert border region. Real data about the human populations in various regional communities is provided for students to graph, analyze, and compare. Students will first work in teams to graph their assigned community's data. Each team will post their findings for the rest of the class to use as they next complete a study guide about population growth in the region. During the wrap-up discussion, the class will explore issues such as the variation in growth rate among the different communities, affects of growth on the environment and the quality of life, and human carrying capacity of the land. The activity culminates with a discussion about the various issues surrounding population growth in the region.

Unit Three - Our Border Environment Under Stress

Lesson 1 - The Changing Face of the Landscape

In the previous unit, students looked at the growth of plant, animal, and human populations in the region. This activity prompts students to consider the effects that population change over time has on the landscape (and the overall environment). Students will study maps, satellite imagery, landscape photographs, and other provided graphic images to observe changes in the landscape over time. Several sources are used, each with "before" and "after" dated references. Student teams will be assigned paired images that they will first discuss amongst themselves, then share with the rest of the class. After all of the

images have been presented to the class, they will be displayed at designated stations. The class will then rotate to the different stations and complete a study guide about the changes depicted in the graphics. An extension of this activity encourages students to investigate the existence of old family photographs of the area, and to return to and photograph those sites for comparison. Students may also choose to set up photo stations to document change in their own community.

Lesson 2 - Measuring and Monitoring Environmental Change

While the previous activity looked at ways to visually document changes to the landscape, these lesson overviews other strategies used by scientists to measure and monitor environmental change. Students will rotate through several stations to conduct investigations on air, water, land, and biological diversity. Each station is set up with materials, tools, and instructions for gathering information on a specific resource. At the air station, students learn about the different pollutants found in our air. They then make and set up devices to monitor the particulate matter in the air around their school (and community if desired). At the water station, students learn about and test the quality of several water samples brought into the class from different sources. At the land station, students investigate the qualities of soil samples from different areas in their community. At the biological diversity station (located outside), students measure the diversity and density of plant species in designated study plots. This activity exposes students to a variety of environmental measuring and monitoring techniques. Because of the scope of the investigations, is intended to take more than one class period and may even lead to the class conducting long-term monitoring projects.

Lesson 3 - Environmental Issues Investigations

This lesson provides students with the opportunity to gain valuable information about a variety of regional environmental issues. The class is provided a set of "Case Studies," each which documents a specific environmental issue recognized to be of concern in our Sonoran Desert region. Working in teams, students will select and investigate an issue their assigned case study. Students may also refer to the *Student Guide to Environmental Resources and Opportunities* to contact organizations and scientists working on these issues to gather additional information. Each team will prepare a presentation about their issue to share with the rest of the class. Each student will also complete an "Issues Investigation Form" about their environmental issue. Extensions include the opportunity to invite a guest speaker to the class to give a presentation about a selected environmental issue.

Unit 4 - Restoring the Balance

Lesson 1 - Restoring the Balance - Border Issues Case Studies

In this lesson, the class is provided with a set of case studies which overview actual strategies that humans have used to benefit the environment in our region. The case studies include specific examples of the establishment of biosphere reserves and other protected areas, habitat restoration, species reintroduction, water study projects, community actions, and other environmental projects that have been carried out by people in this region. Student teams will review their assigned case studies and discuss their findings to the class. Each student will also complete a study guide that reviews new vocabulary and asks questions about all of the case studies.

Lesson 3 - Juntos Class Project

This is the culminating activity of the Juntos program. It is intended to encourage continued involvement in environmental studies and projects as well continued contact with the students' communities. Students will first conduct a review and valuing activity. Then, based on everything they have learned, contacts they have made, and interests they have developed during the course of this program, students will select and pursue an environmental project. Students may choose to work in teams on different projects, or as a class on a single project. To facilitate this effort, this lesson includes questions to aid in brainstorming, class project suggestions, and strategies for creating a project action plan. The ultimate goal of this activity is to get students involved in projects, research, and environmental endeavors in their own school, community, and/or region.