

**National Science
Education Standards**

- * Standard C: *Life Sciences*— Structure and function in living systems.
- * Standard C: *Life Sciences* — Populations and ecosystems.
- * Standard F: *Science in Personal and Social Perspectives* — Populations, resources, and environments.
- * Standard F: *Science in Personal and Social Perspectives* — Risks and benefits.



I Depend on You. You Depend on Me.

OVERVIEW

Forests work as a team, where the players depend on each other to score. They are made up of thousands of organisms and non-living elements that are crucial in maintaining the its integrity. At present, **fragmentation** is one of the biggest problems facing our forests. In this activity the students will represent some of the forest's elements. Through the telling of a story the students will perceive how fragmentation affects the quality of life of all living things.

OBJECTIVES

Students will:

1. Understand that there is a close interdependency between humans and ecosystems.
2. Understand that uncontrolled development fragments our forests and is the main threat to them.

SUBJECTS

Science, Social Studies, English, Spanish

VOCABULARY

Deforestation, topography, erosion, interdependency

TIME

50 minutes

MATERIALS

Signs for the first circle:

Child (2), "Yagrumo", Birds (2), Seeds (2), Trees (2), River, Shrimp (2), Fish, Worm, Fungi, Recycling (2), Rain, Breeze.

Signs for the second circle:

Road, Housing development, Dam, Trash, Cats, Dogs, Heat.

BACKGROUND

All forests' components are intimately interrelated. This relationship is called **interdependency**. Every element of a forest (plants, animals, air, rivers, soil) contribute important functions to the system, some still unknown to humans. Let us take soil as an example, it is filled with hundreds of fungi, some not easily seen. Each one of them with the important function of restoring the soil's nutrients by processing the leaf litter on the ground. Another example is the many birds and bats who are responsible for dispersing seeds.

These relationships maintain the integrity of the forest, which is indispensable for our **quality of life**. Forests provide us with clean air and medicinal plants, they moderate temperatures, and they protect our mountains and planes from **erosion**. They also lower ambient temperature promoting the formation of rain.

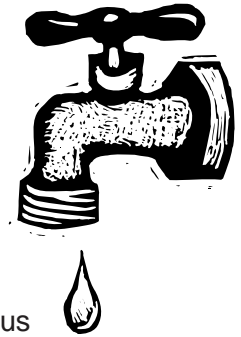
Still, our forests are under constant threat of human development. These developments not only affect the forests, but in the long run the effect is also felt on our society. A good example of this is the drought felt in Puerto Rico in 1994; thousands of people were without water. One the reasons for this was the sedimentation of the rivers caused by the intense deforestation around the rivers. This is one of the many examples we see in our daily lives.

It is of utmost importance to note that we only have a few forest areas of the necessary size to insure that they keep providing us with their indispensable services.

The effects of humans on forests and themselves:

Dam construction

Dams are necessary for storing and providing water for communities. The problem is the amount of dams built. It is necessary to maintain in optimal conditions the existing dams before we consider building new ones.



Organisms are affected in various ways when rivers are dammed. If the dam is too tall, it becomes an insurmountable obstacle to salt water species that need to go upriver to spawn, and also to species that need to go down river to complete their lifecycles. Shrimp are a good example. During reproduction, it is vital for the larvae to reach brackish water in 4 or 5 days; otherwise they die. Later, the juveniles go up river to finish their lifecycle. Some species are able to climb some dams; others do not. Dams also diminish the flow of water down river, negatively affecting aquatic, as well as other, organisms. Also, dams trap sediments that would normally go down river to the valleys affecting the fertility of the soils.

Road Construction

Roads are necessary to keep us in touch with others. In our island though, the road density is extreme. It is one of the highest in the world; Puerto Rico has 4 miles of road for each square mile of land compared to 1 mile for the USA. It would be more prudent to opt for mass transportation in an island with such high population density and a median of 3 cars per family.



BACKGROUND (continued)

In our forests, road construction leads to a breach in the continuity of the forest causing the interruption of movement of some organisms from one area to another. These roads also open a ready path to the incursion of exotic species such as dogs and cats that attack native species. Another factor that affects the forest is the air pollution brought in by the vehicles that transit the road.

Housing Development Construction

The accelerated growth of our population demands the building of new homes. Though there is no doubt about this need, the way it is satisfied is a problem. It is necessary to find new alternatives to the horizontal development for which areas are **deforested** and the land's **topography** is changed. Some alternatives are multi-level dwelling and offices, rehabilitation of older structures, and the construction of homes integrated with nature.

The construction of housing developments usually presupposes the deforestation of great expanses of land. The exposed soil is then vulnerable to strong rains that move sediments into our bodies of water. These sediments affect, not only the organisms in the aquatic habitat, but also reduce the capacity to store water in our dams. This problem became obvious in the drought of 1994. The sedimentation in the Carraízo and La Plata dams reduced our water availability.

Some of the effects of deforestation:

- ☆ The habitat of the organisms living in the trees is destroyed. Among the affected species are the birds, many of who are responsible for dispersing the

seeds necessary to grow new trees.

- ☆ The ambient temperature rises since there are no trees to provide the breeze and humidity needed for cooler temperatures.

Generation of Solid Waste

Our lifestyles generate an excessive amount of **solid waste**. Many of these solid wastes can be reused or recycled, but it is our habit to just throw them away. Our **landfills** cannot keep up with us. In Puerto Rico, 8,100 tons of industrial, commercial, and domestic solid waste are generated daily. It is about time that we modify our buying and use habits.

We manage irresponsibly our solid waste:

- ☆ If we toss them into the environment since we pollute and endanger the lives of the species that live in them, including ourselves.
- ☆ If we toss them into our bodies of water since many species might confuse the waste as food.
- ☆ If we toss them on the soil since dangerous waste affects the organisms responsible for the recycling of organic matter.
- ☆ If we do not reduce, recycle or reuse the solid waste we then need to deforest new areas to make new landfills.

ACTIVITY

1. Give each student a role and the corresponding sign that identifies the role. Only 26 students participate; the rest will be audience.
2. Ask the students that represent the roles of the first circle to form a circle holding hands in the following order: child-"yagrumo"-birds-seeds-trees-river-shrimp-fish-worms-fungi-recycling-rain-breeze-child.
3. Ask the students to imagine that they are part of the story your are about to read (See Annex #1 or #4, whichever applies). Each time an element is mentioned (elements appear in bold in the story) the students who plays that element should squeeze the hand of the students next to them. This makes the interaction physical.
4. Narrate the second part of the story slowly; change the tone of your voice accordingly. As you narrate the second part, the elements represented in the first circle will be replaced by new elements. These new elements are part of the circle but they do not hold hands with the other students. When the story is over, a break in the circle will be evident. This break symbolizes what happens in an ecosystem.

Order: roads and housing development go in – trees go out; dogs and cats go in – birds and seeds go out; dam goes in – shrimp and "yagrumos" go out; trash goes in – fungi, worms, and fish go out; heat goes in – breeze goes out.

CREDIT

This activity is adapted from Caribbean NF's Tropical Tree Trunk curriculum. Go to <http://www.fs.fed.us/> for more information about this environmental education curriculum.

5. Ask the students to observe the structure and composition of the final circle, and discuss their feeling about the activity:

- ☆ How does the first circle compares to the second circle?
- ☆ How did they feel when the story was being read?
- ☆ Do they believe human impact on the forest only affects the forest?

6. Discuss with the class the effects uncontrolled development has on our natural resource; use the background information provided. Emphasize the need to consider the possible impact on our forests when planning a development project.

EXTENSIONS

1. Read the fragment of "El Amor en los Tiempos de Cólera" (Annex #2) and answer the following questions:

- ☆ How is this fragment similar to the story in this activity?
- ☆ Where does it happen, in what place and time?
- ☆ How is it different to the story in this activity?

2. Read "Historia de la Eternidad" (Annex #3) and discuss with the students the following questions:

- ☆ What does this poem means to you?
- ☆ What do you think the author meant to say?

ASSESSMENT

Write two paragraphs. In the first one describe the ways you depend on forests; in the second one discuss how you think that development can be in harmony with forest conservation.

Return to my beloved forest

By Arlene Flecha

Translated & adapted by Betsy Payne

I remember when I was a **child** I used to visit a marvelous forest. My family and I used to spend Sundays in the Espiritu Santo River. The variety of trees and medicinal plants that covered the trails was impressive. I remember when my grandfather used to tell us that one time he alleviated his asthma inhaling the vapors of the **yagrumo** leaves.

Wow! We really enjoyed the sounds of the **birds**. Dozens of these would flutter on the **tree** branches taking **seeds** from one place to another. The **river** water was so crystalline that sometimes you could see some **shrimp** and **fish** resting on the bottom.

After swimming in the river we used to go exploring for creatures that live on the forest soil: worms, **fungus**, **insects**. Each one of them with their unique role of **recycling** the leaf litter with the help of the **rain** and the sun's energy; therefore returning the nutrients to the soil. My grandfather used to say that these organisms sustain the forest's life. I was impressed on how wise the forest was. All who lived there interacted part of one great team, and I felt part of it.

The air was so pure that I could feel my lungs expanding happily every time I breathed. My siblings and I were so mesmerized watching the **trees** dance to the rhythm of the **breeze** and to the melodious sound of the raindrops. Being there truly was paradise!

Ten years later I returned to my beloved forest with my child. Oh my! Nothing was the same. Someone decided to build a **housing development** in my precious forest. The **trees** that protected the river were cut down for the sake of an urbanization and a great **road**; a road through which **cats** and **dogs** reached the forest thereby eating the **birds** that used to live there. The birds no longer had where to live and the trees did not have anyone to transport their **seeds**. The water was no longer clear, it was muddy from the sediment that once was held by the tree roots. Also, a **dam** was built to provide water to the new residents. This was an impossible obstacle for the **shrimp** that would deposit their eggs on the pools. Gone were the **yagrumo**. I wonder how much money is being spent curing asthma?

The residents had thrown **trash**, soapy water and oil on the ground and wiped out the **worms** and **fungi** that were so helpful **recycling** the leaf litter. Eventually, all the pollutants would reach the river where they killed all the **fish**.

As I looked at what once was my dear forest, I felt an intense **heat**. There was no longer that fresh **breeze** the trees provided. Sadly, I looked into my child's eyes and thought...*what are we leaving our children?*

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America's Rain Forests

Regreso a Mi Bosque Querido

Por Arlene Flecha

Recuerdo que cuando era **niño** visitaba un bosque maravilloso. Mi familia y yo solíamos pasar los domingos en el río Espíritu Santo. Era impresionante la variedad de árboles y plantas medicinales que cubrían las veredas. Recuerdo cómo mi abuelo nos contaba de la ocasión en que se curó el asma inhalando los vapores de la hoja del **yagrumo**.

¡Wow! Disfrutábamos tanto del sonido de las **aves**. Decenas de éstas revoloteaban sobre las ramas de los **árboles** llevando sus **semillas** de un lugar a otro. El agua del **río** era tan cristalina que en ocasiones podía observar algunos **camaroncitos** y **peces** descansando en las charcas.

Luego de bañarnos en el río salíamos a observar la gran cantidad de pequeñas criaturas que poblaban los suelos del bosque: **gusanos, hongos, insectos**. Cada uno de ellos con su función única de **reciclar** la hojarasca con la ayuda de la **lluvia** y la energía del sol para devolver los nutrientes al suelo. Decía mi abuelo que estos organismos sostenían la vida en el bosque. Me sorprendía la sabiduría del bosque. Todo el que allí habitaba interactuaba como parte de un gran equipo y yo me sentía parte de él.

El aire era tan puro que al respirar podía sentir mis pulmones expandirse de alegría. Mis hermanos y yo nos embelezábamos observando la danza de los **árboles** al ritmo de la **brisa** y el melodioso sonido de las gotas de **lluvia** al caer sobre las hojas. ¡Estar allí era estar en el paraíso!

Diez años más tarde regresé a mi añorado bosque con mi hijo. ¡Dios mío! Ya nada era igual. Alguien decidió construir una **urbanización** en mi bosque querido. Los **árboles** que cuidaban el río fueron cortados para dar paso a una urbanización y a una gran **carretera**; carretera por la cuál llegaron **perros** y **gatos** al bosque quienes se alimentaban de las **aves** que originalmente habitaban en él. Ya las **aves** no tenían dónde habitar y los **árboles** no tenían quién transportara sus **semillas**. El agua ya no era cristalina, estaba llena de los sedimentos que una vez fueron detenidos por las raíces de los árboles. Además, construyeron una **represa** para proveer agua a los residentes de la urbanización. Esta es un obstáculo insalvable para los **camaroncillos** que venían a depositar sus huevos en las charcas. Ya no quedaban más **yagrumos**. Me pregunto cuánto dinero se estará gastando para curar el asma. Los residentes de la urbanización habían lanzado **basura**, agua con jabón y aceites a los suelos y acababan con los **gusanos** y los **hongos** que tanta hojarasca reciclaban. Eventualmente estos contaminantes llegaban al río donde mataban los **peces**. Mientras observaba lo que una vez fue mi bosque, sentía un inmenso **calor** ya no contaba con los árboles que tanta **brisa** me brindaron. Miré a mi hijo con tristeza y pensé: *¿qué le vamos a dejar a las generaciones futuras?*

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YO DEPENDO DE TÍ, TÚ DEPENDES DE MÍ

ANEJO #2

“... - Es lo poco que nos va quedando del río - le dijo el capitán...Florentino Ariza, en efecto, estaba sorprendido de los cambios, y lo estaría más al día siguiente, cuando la navegación se hizo más difícil, y se dió cuenta de que el río padre de La Magdalena, uno de los más grandes del mundo, era sólo una ilusión de la memoria. El capitán Samaritano les explicó cómo la deforestación irracional había acabado con el río en cincuenta años. Las calderas de los buques habían devorado la selva enmarañada de árboles colosales que Florentino Ariza sintió como una opresión en su primer viaje. Fermina Daza no veía los animales de sus sueños: los cazadores de pieles...habían exterminado los caimanes que se hacían los muertos con las fauces abiertas durante horas y horas en los barrancos de la orilla para sorprender a las mariposas; los loros con sus algarabías y los micos con sus gritos de locos se habían ido muriendo a medida que se le acababan las frondas, los manatíes de grandes tetas de madres que amamantaban a sus crías y lloraban con voces de mujer desconsolada en los playones eran una especie extinguida por las balas blindadas de los cazadores de placer.

Los días siguientes fueron calurosos e interminables. El río se volvió turbio y se fue haciendo cada vez más estrecho, y en vez de la maraña de árboles colosales que habían asombrado a Florentino Ariza en su primer viaje, había llanuras calcinadas, desechos de selvas enteras devoradas por las calderas de los buques, escombros de pueblos abandonados por Dios, cuyas calles continuaban inundadas aun en las épocas más crueles de la sequía. Por las noches no los despertaban los cantos de sirenas de los manatíes en los playones. En lugar de la algarabía de los loros y el escándalo de los micos invisibles que en otro tiempo aumentan el bochorno del medio día, sólo quedaba el silencio de la tierra arrasada.

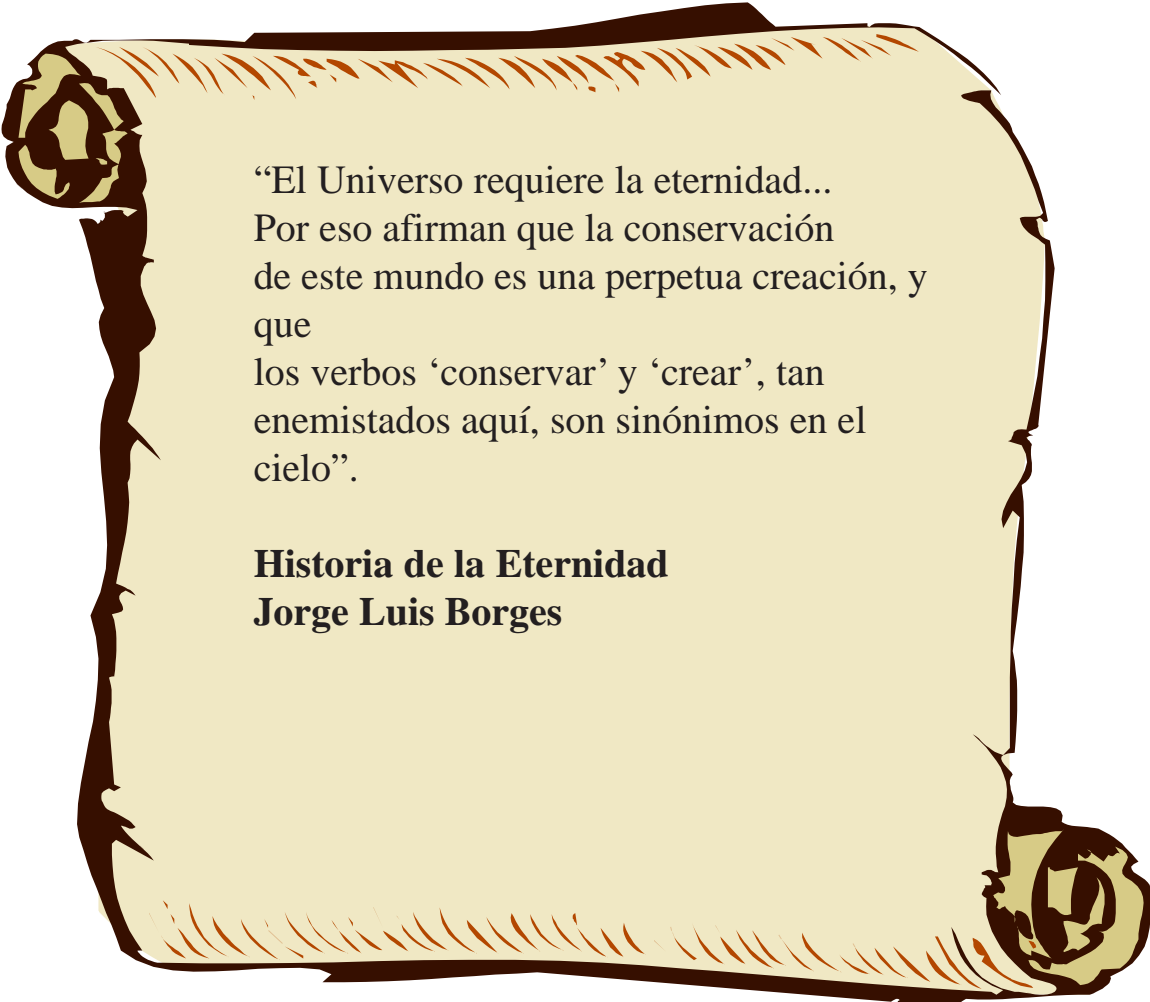
...Cuando los caimanes se comieron la última mariposa, y se acabaron los manatíes maternos, se acabaron los loros, los micos, los pueblos: se acabó todo...”

El amor en los tiempos del cólera

(Extractos)

Gabriel García Márquez

Annex 3



“El Universo requiere la eternidad...
Por eso afirman que la conservación
de este mundo es una perpetua creación, y
que
los verbos ‘conservar’ y ‘crear’, tan
enemistados aquí, son sinónimos en el
cielo”.

Historia de la Eternidad
Jorge Luis Borges

Annex 5

BRISA

BREEZE



**SEMILLAS
SEEDS**

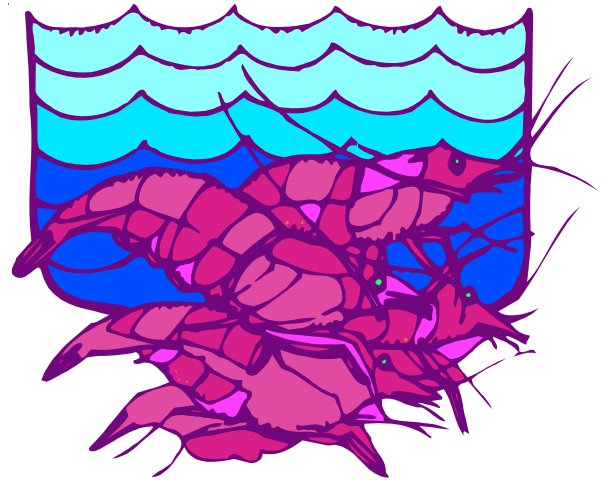


URBANIZACION



HOUSING DEVELOPMENT

CAMARONES



SHRIMP

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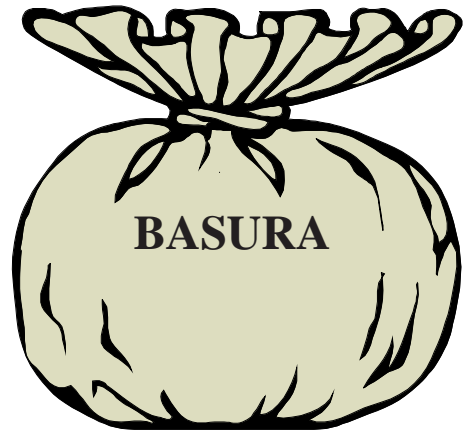
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Annex 5

PERROS



DOGS



BASURA



HONGOS



GATOS



GUSANO

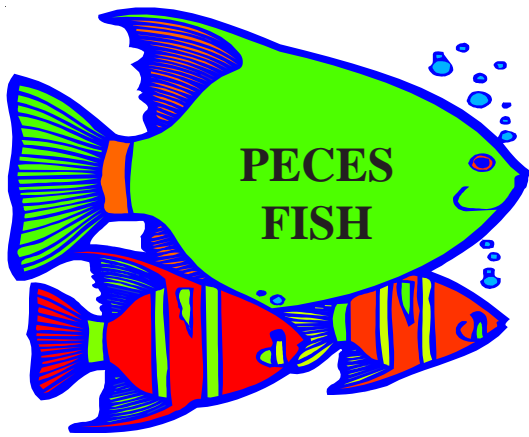


CALOR

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Annex 5



**RECICLAJE
RECYCLING**



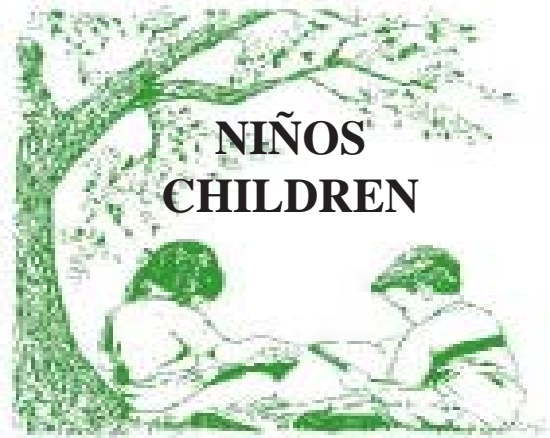
ARBOLES TREES



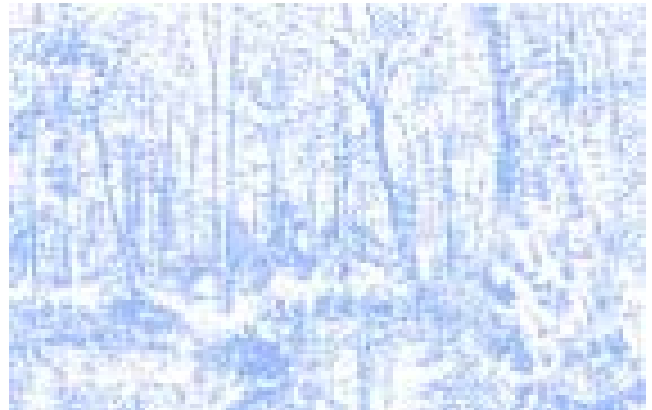
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Annex 5



**NIÑOS
CHILDREN**

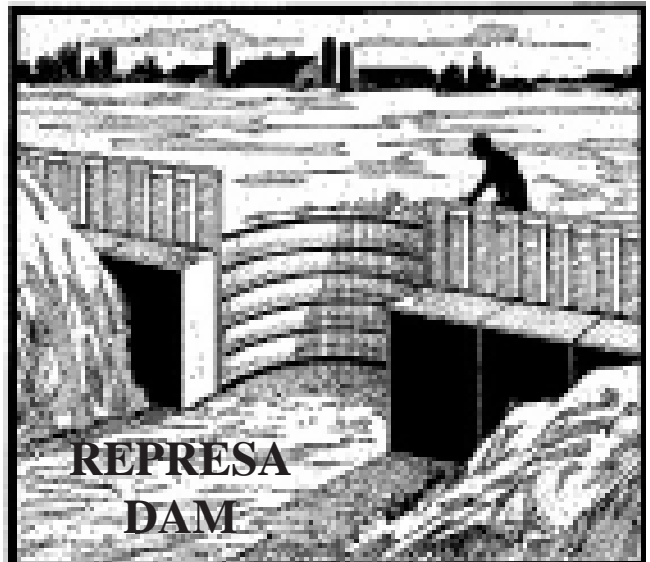


RIO

RIVER



**LLUVIA
RAIN**



**REPRESA
DAM**

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