



# Protecting and Conserving the World's Environment

Christy Tapert | 2nd - 4th grades

## Unit Description

In this unit, students will study the biodiversity of the Amazon rainforest. Combined with NGSS second, third and fourth grade students will learn about the forest layers- the emergent layer, the canopy, the understory, the forest floor and the rivers and the unique animals that live there. Students will investigate their favorite animal, whether it be in their residing state of Delaware or the Amazon rainforest, create it in clay and construct a diorama (National Core Arts Standards) of that animal in its habitat. Students will think about the distinguishing characteristics of their chosen animal and why it is adaptable to its environment. Students will also learn that rainforests are very important to every single person on Earth, and ways that rainforests help us.

## Content Standards

1. Make observations of plants and animals to compare the diversity of life in different habitats. (NGSS. 2-LS4-1)
2. Anchor Standard 11: Relate artistic ideas and works with societal, cultural, and historical context to deepen understanding. (National Core Art Standards)

## Objectives and Outcomes

1. Students will learn what happens to ecosystems when the environment changes.
2. Students will learn what is biodiversity, how do humans affect it, and how does it affect humans.
3. Students will classify animals in a chart.
4. Students will demonstrate an understanding that the Amazon is important to conserve.

## Supporting Material

1. [DTI 2022 Unit](#)
2. [Video](#)



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# Protecting and Conserving the World's Environment

*Christy Tapert*

## **Introduction**

I teach art at South Dover Elementary School in Dover, Delaware, one of the six elementary schools in the Capital School District. For the 2021/2022 school year, South Dover Elementary has a student enrollment of 591 students in kindergarten through fourth grade. The male to female ratio is 1:1. The majority of students, 54% are African American while 19% are Caucasian, 16% Hispanic, 8% Two or More Races, 2% Asian and 1% Native American. South Dover Elementary currently has 61% students from low income families. South Dover hosts Spanish Inclusion class<sup>7</sup> kindergarten through fourth grade allowing some students to spend half of their day instructed in Spanish. There are 70 students that are serviced as English Language Learners. Students in kindergarten through fourth grade participate in Art class for a weekly 45-minute period. Class sizes range from 25 to 32 students.

This unit is based on Jon Cox's seminar, "Bringing the Amazon Home." Students will study the Amazon rainforest, the animal kingdom that occupies the environment, and their individual habitats. Scientists estimate that more than half of the world's animals live in rainforests making it rich in biodiversity. "Rainforests only cover three percent of Earth's surface, but are home to one-half of the world's plants."<sup>1</sup> Also, students will make observations about various threats to the rainforest including weather (fire, floods), deforestation, dam building and gold mining. If the rainforest disappeared, the wildlife would suffer as well as other life around it. How that would affect us as humans is important to understand. Rainforests affect everyone whether it is global warming, the tropical fruits we eat, the oxygen we breathe, the world's water supply, the medicines we use, or the utilization of economic goods like rubber. By implementing this unit, I hope to bring conservation awareness to students and what they can do to help. The best way to help save the rainforests is to be aware. What's more, responsible shopping for products that weren't made by hurting the rainforest helps. As quoted by David Sobel (2019), "If we want children to flourish, to become truly empowered, let us allow them to love the earth before we ask them to save it."<sup>2</sup>

## **Rationale**

Currently, there is no set curriculum or lesson plan guide book for the visual art teachers in our district. This issue requires me to create art lessons that suit the interests, and needs of my art students and align with the National and Delaware Visual Art Content Standards. Students in art class learn about a variety of artists, art styles, and works from various cultures around the world. They create art using many mediums such as crayons, markers, watercolor pencils, watercolor and tempera paint, printmaking, collage, and ceramics. Collaboration with other disciplines such as Math, English Language Arts, Social Studies, and Science provides further development and understanding.

Combined with NGSS second, third and fourth grade students will learn about the forest layers the emergent layer, the canopy, the understory, the forest floor and the rivers and the unique animals that live there. These students should already have a basic knowledge of animal and plant dependence. After gathering new information about several animals from books read in class and a virtual trip to the rainforest, students will investigate their favorite animal, and plan to construct a diorama of that animal in their natural habitat. First, creating their animal in clay will provide students with knowledge about the animal's characteristics and why it is adaptable to its environment. For example, the red-eyed tree frog has sticky toe pads so that it can adhere itself to the underside of leaves. Next, making a diorama influences students to collect information about their animals' habitat, as well as engage students in a creative activity. Included in the diorama should be evidence of the particular animal's diet whether it be a carnivore, herbivore or omnivore, thus providing additional learning of plants and other animals eaten as prey.

As outlined in the K-5 Science Curriculum, it is important for students to understand "when the environment changes in ways that affect its physical characteristics, temperature, or availability of resources, some animals survive and reproduce, others move to new locations, yet others move into the transformed environment, and some die." The Amazon rainforest is a perfect example of environmental changes due to uncontrolled deforestation. The Maijuna, one indigenous community of the Amazon, has had to battle with uncontrolled logging and the resulting collapse of the ecosystem. Loggers and gold miners have used "large amounts of mercury, a potent and dangerous pollutant to effectively extract gold from sediment. Mercury use in turn has lifelong health consequences for residents and wildlife". The local fish died from the poisoned water sources, and larger animals that are hunted as food, moved from the environment leaving the Maijuna starving. The story of the Maijuna's can be viewed in the documentary film, Guardians of the Forest, 2020, and will be shown to students.

### **Content Objectives**

There are several course objectives that align with NGSS that I will address in this unit. Students will learn (1) there are many different kinds of living things in many areas, and they exist in different places on land and in water, (2) to form comparisons by making observations (firsthand or from media) to collect information, (3) populations live in a variety of habitats and change in those habitats affects the organisms living there.

Essential questions are (1) LS2.C: what happens to ecosystems when the environment changes? (2) LS4.D: what is biodiversity, how do humans affect it, and how does it affect humans? To answer the first question, students will learn about animal and plant life in the Amazon rainforest. This information is to be learned from listening to three rainforest books and videos. Observations will be recorded on a chart so as to make comparisons of the forest layers, which require planning and investigation. Students will be looking for patterns and order by classifying animals through these observations and conclude that there are many different kinds of animals in Delaware and the Amazon Rainforest and they exist in many different places on land and in water. With the information learned from this unit, students will create a clay animal and habitat

diorama. The second question will be explored when students learn about the threats to the rainforest as mentioned above, but particularly deforestation since that is a human affect to the environment. Deforestation occurs for several reasons, logging, cattle ranching, gold mining, and construction of roads all of which can have devastating effects on the wildlife and peoples of the Amazon rainforest.

## The Amazon Rainforest

The territory of the Amazon rainforest is a total of 3.2 million square miles (9 million km<sup>2</sup>), which is roughly the size of the contiguous 48 US states. Brazil contains most of Amazonia: approximately 60%. Just over 11% of Amazonia is found within the borders of Peru, followed by Colombia (8%), Venezuela (7%), Bolivia (6%), Guyana (3%), Suriname (2%), Ecuador (2%), and French Guiana (1%).<sup>3</sup> More than rainforests, the Amazon also includes aquatic ecosystems such as rivers, lakes, swamps and seasonally flooded wetlands. The Amazon region's biodiversity is the "largest living assemblage of plants and animals on the planet".<sup>4</sup> "Manu National Park in southeastern Peru harbors 25% more species of birds than are found in the entire United States and four times more butterflies than inhabit Europe. Amazonia has more types of fish than the Nile, the Congo, and the Mississippi combined."<sup>5</sup> Species previously unknown to science are constantly being discovered in the Amazon. One recent estimate calculated that a new species is collected every three days. In the past two decades, scientists have collected more than a thousand new plant species, 400 fish species, 300 amphibians, 65 mammal species and insects and other invertebrates too numerous to count.

The daily weather forecast in the Amazon is hot and humid with temperatures between 75 and 80 degrees Fahrenheit. Tropical rainforests are also wet, receiving on average from 60 to 120 inches of rain per year. This in large part is due to the Intertropical Convergence Zone (ICZ) near the equator where the northeast trade winds and southeast trade winds converge in a low pressure zone. Solar heating in the region, forces air to rise through convection resulting in an abundance of rainfall.<sup>6</sup> What's more, according to Rhett Butler of Mongabay: "Each canopy tree transpires 200 gallons of water annually, translating roughly into 20,000 gallons transpired into the atmosphere for every acre of canopy trees. Large rainforests (and their humidity) contribute to the formation of rain clouds, and generate as much as 75% of their own rain and are therefore responsible for creating as much as 50% of their own precipitation."<sup>7</sup>

## Forest Layers

There are several "layers" of the rainforest recognized by ecologists. Each layer has its own characteristics and is home to certain plant and animal species. The top layer or emergent layer consists of "individual and isolated giant trees that tower over the rest of the forest".<sup>8</sup> Some emergent trees can be 200 feet high and because they are so exposed must be able to "withstand strong winds, high heat, humidity and torrential rain."<sup>9</sup> Here, agile monkeys swing through the trees. The next layer down, also known as the "roof" layer, is the canopy, formed by the uppermost portions of the tallest trees in the rainforest and can be more than 100 feet from the

ground. Most of the sunlight covers this area making it the “primary site for photosynthesis, pollination, seed dispersal, herbivory, and even biodiversity.”<sup>10</sup> More wildlife lives in the canopy layer than anywhere else. Below the canopy is the understory where little direct sunlight passes through to the forest floor and plant life is thin. “Only about 5% (or less) of the sunlight striking the emergent and canopy layers penetrates deep into the forest.”<sup>11</sup> Temperatures in the understory remain relatively constant with high humidity due to little wind or air circulation with the canopy overhead. This layer is home to tiny frogs. The bottom layer, known as the forest floor, is dark and humid. Even less light makes it to the forest floor so there are few flowering plants. This place is where decomposition takes place and “most of the soils are poor, acidic, and heavily eroded due to the constant precipitation.”<sup>12</sup> The forest floor is home to many fungi, insects and animals like anteaters.

### The Amazon and Climate Change

Thirty years ago, “Save the Rainforest!” was the outcry for the global environmental movement. This issue brought about the Rio Environmental Conference in 1992 with its focus on environmental protection and sustainable development for the Amazon. “Save the Rainforest” seemed to be an international goal. Since that time, “the global perception of the Amazon’s importance for human well-being has clearly declined.”<sup>13</sup> We now know that the Amazon “plays a key role in stabilizing both the world’s climatological and hydrological cycles while providing food and water security to tens of millions of people in the region.”<sup>14</sup> The fate of the Amazon affects everyone with today’s news of accelerating climate change. “The number two cause of carbon being released into the atmosphere is deforestation”.<sup>15</sup> Within the borders of Brazil, satellites have recorded more than 20,000 fires in a single day. Home to almost 400 billion trees, the Amazon rainforest plays a vital role in stabilizing global climate by absorbing titanic amounts of carbon dioxide or releasing it into the atmosphere if burned. “Living forests therefore mitigate climate change, while deforestation exacerbates the process.”<sup>16</sup> Rainforests also exhale enormous amounts of water during photosynthesis so it is believed by scientists that the moisture in the Amazon remains in a relatively closed cycle whereby the rain returns the water to the forest and the rivers. Deforestation, on the other hand, breaks the cycle and rainfall declines causing droughts to occur. Changing rainfall patterns in the United States, Europe, and China have been directly linked to tropical deforestation and interruptions of climatic patterns. A 2014 study in the journal *Nature Climate Change* found that “complete Amazon deforestation would reduce rainfall in the U.S. Midwest, Northwest and parts of the south during the agricultural season.” This physical climate change indirectly affects other states like Delaware as a drought in the Midwest could threaten food production and destabilize ecosystems. Delaware, an agricultural state, would therefore, need to yield more food, which could lead to deforestation to produce more crop lands. Clearing land in turn, causes wildlife disturbances.

What makes the Amazon so important are the roles that the Amazon River and the rainforest play. The northern half of South America’s continent contains a great deal of the world’s terrestrial and freshwater diversity. “This biodiversity is extraordinarily interdependent with reference to food web maintenance, pollination, nutrient cycling, and a host of other ecosystem

processes, meaning that the destruction of any one of the millions of species living there could have disastrous impact on many, many others.”<sup>17</sup> Roughly 400 tribes inhabit the Amazon today, many of which still depend on the forest and the rivers for their livelihood: for food, shelter, fuel and many other purposes. These forests also play key roles in local, regional and global water cycles. Destroying the forests can reduce local rainfall and lead directly to droughts.

Rainforests possess another value as ecotourism venues. Tourism is expected to grow and expand as one of the world’s leading industries making the value of “authentic wilderness experiences” valuable.

According to Mark J. Plotkin, the most important reason for protecting the Amazon species is an ethical and moral one: “we must decide whether we want to live in a world-or have our children and grandchildren grow up in a world-that lacks pink dolphins and blue Morpho butterflies because they were driven to extinction through human shortsightedness, stupidity, and greed.”<sup>18</sup>

The final reason the Amazon is so important is biomimicry, the design and production of materials and structures based on models in nature. The best known example is velcro, which is based on burrs that loosely attach to natural surfaces. Also, compounds in vampire bat saliva are being studied as models for anticoagulants, peptides in frog slime are being investigated as models for antibiotics, scorpion and snake poisons are teaching us how to better attack brain cancers and other tumors.

## The Amazon River

The Amazon is the longest river on the planet and drains almost 40% of the South American continent including more than 1,000 rivers emptying into it from the Andes to the Atlantic. In the rainy season, the mouth of the Amazon reaches 300 miles wide and produces the greatest annual discharge of any river.<sup>19</sup> The Amazon River has two major sources, the Marañon, and the Ucayali, which originate in the Peruvian Andes and flow north where they join just south of the port of Iquitos to form the main river. The Amazon contains a wide variety of aquatic habitats including oxbow lakes, named for their horseshoe shape. “Oxbows are formed when a bend in a meandering river is isolated as a result of a river changing course.”<sup>20</sup> Wildlife thrives in these calm lagoons such as the endangered species of black caiman, giant otters, giant Victoria water lilies and hoatzin birds. The Amazon also features enormous river islands- Marajo, Ilha do Bananal, and the Tupinambarana being the three largest, which harbor resident human populations.

## Amazon Biota

Palms are among the most useful groups of plants to the Indigenous peoples of the Amazon. First, palms provide foodstuffs in exceptional quantities. A single bunch harvested from one palm can yield more than 1,000 fruits. Palms also provide dietary components like minerals, oils, proteins, and vitamins. Amazonian peoples also consume palm hearts and high-quality oils from

the fruit, they can make bread from the starch of the stem, and prepare three types of wine- one from the fruit, one from the trunk sap and another from the unopened flower clusters. Palm fruits are also dietary staples for Amazonian birds, fish, and mammals.<sup>21</sup>

The second most important use of palms in the Amazon is for shelter. The widespread use of palm leaves for thatching is based on their “internal strength, durability and flexibility.” Palm thatch roofs are widely used because the leaves are freely available in the forest; they are cooler under the sun than metal roofs; they are far quieter during rains; they allow cooking smoke to escape; and they are lighter in weight, allowing a lighter frame for support.<sup>22</sup> Palm fruits are used as livestock feed, while the leaves and fibers are made into hats, mats, shoes, baskets, cordage, brooms, fire fans, roofs, walls, spears, bows, arrows, looms, graters, kitchen utensils, fencing, souvenirs for tourists, and backpacks.<sup>23</sup> In terms of international commerce, the acai is the most important Amazonian palm whose annual export value from Brazil exceeds \$100 million. <sup>24</sup> Acai is a major food source for the peasant populations in lower Amazonia.

### Amazonian Fauna

Currently, scientists estimate that there exist between 1,300 and 1,500 species of birds in the Amazon; more than 1,000 species of frogs; more than 3,000 species of fish in the rivers and creeks; 450 species of reptiles; and about 430 species of mammals, primarily bats and rodents. Invertebrates dominate the Amazon rainforest and range from 1 million to more than 20 million species. These include insects such as ants, bees, beetles, butterflies, termites, and wasps, as well as arachnids like spiders and scorpions. In comparison, flowering plants in the Amazon are estimated to number 40,000 species, of which 16,000 are trees.<sup>25</sup>

The most fearsome Amazon predator, also one of the most critically endangered reptiles, is the Orinoco crocodile, which can reach a length of more than 22 feet and weigh over a ton. This predator eats birds, fish, snakes, turtles, caimans and mammals. The Orinoco crocodile population has been reduced to fewer than 1,500 individuals due to massive overhunting for meat and leather as well as habitat disruption. Almost as large as the Orinoco crocodile is the black caiman. This predator devours anacondas, armadillos, birds, capybaras, deer, fish, frogs, giant otters, lizards, monkeys, peccaries, sloths, snakes, tapirs, turtles and other caimans. They also consume animals outside of the rainforest such as cattle, dogs, horses, and pigs.<sup>26</sup> Another reptile of concern to humans is the anaconda. Known as the longest snake in the Amazon, Anacondas lurk below the water’s surface near river banks with only their eyes and nostrils exposed as they wait for unsuspecting prey to approach and drink. Anacondas will then seize and constrict their prey.<sup>27</sup> Another predatory creature, “the King of Beasts of the Amazon rainforest,” is the jaguar. It is “the world’s third largest feline, exceeded in size only by the lion and the tiger.” “Jaguars are renowned for their exceptionally powerful bite: they can easily penetrate turtle carapaces (shells) and often kill mammalian prey with a single bite to the back of the neck.”<sup>28</sup> Ranked “among the world’s most extraordinary mammals in both appearance and capacity” is the pink river dolphin or boto. Excessive fish-eaters, botos are known to “consume more than 50 different species”.<sup>29</sup> As a means of searching for prey along the river bottoms, boto have a habit of swimming upside down. Unfortunately, some botos have succumbed to human

behavior. “Some fishermen in the Amazonia kill botos to keep them from consuming fish, while others cut them up for fish bait, despite legal prohibitions against this in every country where they are found.”<sup>30</sup> Some botos become entangled in fishing nets and drown since they are air-breathing mammals. Gold mining along rivers threatens the well being of botos due to poisonous mercury in the flesh of bottom-dwelling catfish, a large part of the botos diet. Dam building is also another big threat to the botos.

## Amazon Threats

With the first mass production of automobiles in 1901, the demand for high grade rubber tires rose rapidly. The Amazon rainforests became inundated with people in search of what was termed “white gold.” At this time, the Amazon remained the sole source of rubber.<sup>31</sup> In addition to car and airplane tires, natural latex is used in the manufacture of “airbags, wetsuits, adhesives and protective coatings, surgical gloves, condoms, and automobile parts such as serpentine belts and brake padding.”<sup>32</sup> As rubber was extracted out of the rainforest, money flowed into the Amazon and obscene crimes were committed in pursuit of culminating fortunes. “Local Indians were enslaved, tortured, raped, mutilated, and often murdered in the quest to obtain even more rubber, a hideous episode that became known as the Putumayo Atrocities.” “It is estimated that as much as 80% of the local population was exterminated in the drive to meet the industrialized world’s growing demand for rubber.”<sup>33</sup> Today, almost all natural rubber comes from Amazonian trees planted in Southeast Asia.

Brazil is one of the world’s biggest beef exporters, shipping meat to 150 countries and supplying about a quarter of global demand. About 40% of the Brazilian cattle are in the Amazon and the growth of this industry has led to 70% of deforestation. “Greenpeace has calculated that the cattle sector in Brazil is the single largest driver of deforestation in the world. And the government has announced plans to sharply increase cattle production.”<sup>34</sup> Most of the beef produced in Brazil is consumed domestically and also has become one of the top producers of tanned leather, the majority of which is shipped overseas. This leather is used to make shoes, furniture, leather upholstery and high quality goods for the fashion market. In 2009, Greenpeace launched its famous campaign “Slaughtering the Amazon,” detailing how much forest destruction was a result of the cattle sector. Greenpeace’s claim was that major global brands like “Nike, Adidas, Carrefour, Walmart, Kraft, Timberland, Louis Vuitton, and Prada were buying and selling products that were being produced on deforested lands.”<sup>35</sup> With the Brazilian government actively promoting the spread of cattle further into the rainforest, more than 74,000 fires were documented in the Brazilian Amazon in 2019.

South American governments have for the most part deemed hydroelectric dams a limitless source of clean, renewable electric energy without fossil fuels. However, the negative impacts of these dams have become more apparent. “For a variety of reasons—mostly poor planning, corruption, overestimates of output, and underestimates of costs—these dams often operate below capacity and seldom generate the predicted return.”<sup>36</sup> Fish, a major protein source in the Amazon, is most directly threatened by the construction of hydroelectric dams. Dams have disrupted the

migration of some commercially important species, particularly the giant catfish in the Madeira River. Dams are also known to negatively affect the annual water cycle in floodplain forests where important species spawn. Moreover, the changes in water temperature brought about by dam power generation may diminish fish populations. As well, the dams also obstruct the movement of manatees and dolphins affecting the ecosystem in ways we still don't understand. Large dam projects also are responsible for the displacement of Indigenous peoples exiled from their traditional lands. Not only does diversion and alteration of rivers hurt indigenous and other rural populations; water quality declines while the roads built to haul construction materials encourage outside settlers and drive deforestation. Outside laborers employed in construction often introduce disease and pollution. Dam construction also necessitates the formation of quarries and borrow pits that act as breeding pools for malaria carrying mosquitoes.<sup>37</sup> Compounding the damage, the artificial lakes formed behind the dams flood and destroy areas of rainforest. "Once considered sources of green energy, these dams are increasingly recognized as greenhouse gas generators. Not only is carbon released from the soil and dying vegetation once a forest is flooded, decaying vegetation in a low oxygen environment at the bottom of the reservoir produces titanic quantities of methane- so much so experts term these dams 'methane factories'."<sup>38</sup> Smaller and better-placed dams (dams built on more of a slope can generate more energy in a smaller area) could have less negative impact, especially if planners consider the complex ecological interconnections that characterize the Amazon.

Today, massive amounts of gold are being extracted from the Amazon: Peru is the world's sixth largest gold-producing country.<sup>39</sup> Unfortunately, gold mining has destructive impacts on the forest, on rivers, on animals and the indigenous peoples. Not only do miners use high-powered hoses to disintegrate riverbanks and heavy machinery to excavate gold-yielding gravels, they use two highly toxic chemicals in the process of gold extraction. Large scale operations often employ cyanide with serious and long term impacts on water quality, fish stocks, and both Amerindian and urban populations who "suffered serious nerve damage and accelerating rates of cancer"<sup>40</sup> Another highly toxic chemical, mercury, is widely used in smaller-scale mining. "It is estimated that for every gram of gold collected through small-scale mining, more than a gram of mercury is released into the environment. Some is burned off, and it then enters the atmosphere and can return in precipitation. The rest of the mercury is released into waterways, where it settles into river sediments and ends up in the food chain."<sup>41</sup> Mercury poisoning causes irreversible nerve damage, brain damage, retardation, and birth defects when absorbed by pregnant women. Indigenous peoples in the Amazon tend to be heavily affected by mercury pollution, since fish serve as their major protein source. The fact that low mercury and mercury-free gold-mining techniques are known and available, but not common in the Amazon, "due to ignorance, greed, and the low cost of mercury," is devastating.

Another trend that seems likely to accelerate the deforestation in the Amazon is agricultural production. Large scale agricultural farms, usually producing a single crop such as soy, oil palm, or sugarcane have been directly responsible for the deforestation of large areas in the Amazon. Even more than this, water pollution has ensued with the application of massive quantities of agrochemicals. A milestone in the evolution of the Brazilian soy industry was Greenpeace's 2006

report, “Eating Up the Amazon,” that linked Cargill and McDonald’s to deforestation for their role in expanding soy plantations in South America. The result was the Amazon Soy Moratorium (ASM) which banned direct conversion of Brazilian Amazon forests to soy fields and in which major soy traders pledged not to buy local crops produced on recently deforested lands. It represented the very first zero deforestation agreement in the tropical world.<sup>42</sup>

Compared to large scale agriculture, cattle ranching, and mining, logging is a lesser cause of deforestation. The standard approach to timber harvesting in the Amazon has been selective logging: identifying and felling the few individuals of the most economically valuable species. Ecologist Greg Asner concluded that such operations lead to multiplied gaps in the forest, increased forest fragmentation, more light reaching the forest floor, increased likelihood and severity of fire, and perturbations in the nutrient cycling and other fundamental ecological processes.<sup>43</sup> As the global population continues to increase, global demand for timber is expected to rise. According to a 2016 report by Interpol and the UN Environment Programme (UNEP), illegal logging around the world already is the world’s highest-value environmental crime. Estimates are as high as \$152 billion per year with many major crime syndicates involved in this trade.

Human activities pump greenhouse gases like carbon dioxide into the atmosphere, driving climate change. After fossil fuel consumption, deforestation, primarily in the tropics, is the second largest source of these emissions. Per recent estimates, close to 10% of all global greenhouse emissions stem from forest destruction and land use change. “Alterations predicted by modeling of the Amazonian climate include rising temperatures, diminished rainfall, more frequent droughts, and variations in seasonality, such as the early arrival of, delay in, or elimination of the rainy season.”<sup>44</sup> Over the past two decades, many species have moved toward the poles and/or higher elevation in search of cooler weather. Many rainforest species like amphibians, insects, and reptiles are poikilotherms (cold-blooded animals), unable to control their body temperatures and therefore especially vulnerable to a changing climate. “Biological attrition,” the lethal process of when a local climate warms beyond a species’ ability to survive and no cooler climate exists in reach.<sup>45</sup> Harmful effects will impact The Amazonian flora as well. Furthermore, “climate change will increase mortality due to longer and stronger heat waves, declining air quality, additional drought, and reduced water quality and food security.”<sup>46</sup>

The zoological counterpart of deforestation is defaunation, the process whereby animal populations are reduced or eliminated. With respect to market demand, it is defaunation that is causing the most concern. The bushmeat trade, in which mostly large mammals and birds are slaughtered for sale in urban areas like Belem or Manaus, in mining camps or even in tourism lodges. What's more, the skin trade (cat pelts and caiman leather), the pet trade, and folk medicine beliefs have had a noticeable effect on defaunation. Recent reports from Bolivia and Suriname are that Chinese buyers are financing the slaughter of jaguars for their teeth. These unrestrained practices have exacted a huge biological toll. The depletion of large animals can disrupt a variety of interrelated ecological processes, leading to a series of cascading changes in animal and plant species' composition.<sup>47</sup>

## How Can The Amazon Be Saved

Protected areas form the best support for rainforest conservation. “These enormous reserves offer the best hope for the protection of relatively intact rainforest ecosystems that harbor healthy populations of apex predators like jaguars and pumas and preferred game species such as spider monkeys, woolly monkeys, and tapirs as well as large birds like harpy eagles and guans.”<sup>48</sup> Often overlooked, another conservation opportunity is represented by Indigenous reserves and territories. These homelands close to a quarter of the Amazon and the rainforests and rivers in these Indigenous areas are often better managed and protected than elsewhere in tropical South America. “[Indigenous] peoples living a relatively traditional lifestyle maintain both a physical and a spiritual tie to the forests and the waters. Everything from the quality of drinking water to the availability of foodstuffs to the accessibility of medicinal plants is dependent on careful stewardship of local resources.” Many [Indigenous] peoples are well aware that, if the forests disappear, they will lose not only their subsistence and economic base, but their cultural identity as well.”<sup>49</sup> These peoples “have an unparalleled knowledge of the resources on their land and how best to manage them”.<sup>50</sup> Hence, ensuring the collective rights of Indigenous communities are respected by local, regional, national, and international authorities is an important step toward conservation. Another solution is to train and employ forest inhabitants to protect their ecosystems. The Amazon Conservation team has trained and equipped an Indigenous park guard force in the northeast Amazon, which has been patrolling the boundaries of their ancestral lands and protecting the forest for more than a decade. Analogous efforts could be undertaken for all of the Amazon. A major component of deforestation in the Amazon is the failure to provide sufficient economic benefits to the rural poor. By assisting poor farmers in gaining title to their lands, the destructive cycle of endless migration and deforestation could be eliminated. Beyond that, farmers need training in improving agricultural techniques. One example of this is permaculture techniques that rely more heavily on planting tree crops that are less destructive to both the soil and to plants and animals. Another method of helping farmers is by introducing ancient practices such as the production of “terra preta” soils that are both more resilient and more productive than typical Amazon soils.<sup>51</sup> More research is needed to experiment with underutilized, but economically promising species of plants that thrive in poor soils like Cacay (oil for cosmetics), Tabakabon (high-grade firewood), and the tagua palm (vegetable ivory). Relieving the pressure on pristine forests, would be the recovery and rehabilitation of degraded lands that offer great potential to produce cattle, crops, and timber.<sup>52</sup>

Large-scale agricultural and industrial operations, primarily forestry, fishing, and mining, have played a huge role in the deforestation of the Amazon. An obvious first step is the reduction or elimination of the release of toxic chemicals into the environment. As mentioned before, this issue would be the cyanide and mercury used in gold mining as well as the harmful pesticides and fertilizers used in industrial agriculture. Another approach, extensively applied in Costa Rica, is “payment for ecosystem services (PES) in which direct payments are made to landowners who protect forests whose benefits accrue to others”.<sup>53</sup> Promoting sustainable development can also be done through better and more accurate economic analysis of mega-infrastructure projects, particularly road and dam building. The amount of data available to decision makers has never

been greater, especially with today's technology whether it be through satellite imagery, biological surveys or learning through past mistakes. Development planners can make much better decisions such as Professor William Laurance and his colleagues who have “designed ‘smart’ road-building plans that minimize destruction of biodiversity and stream connectivity.” Maximized appreciation for and protection of freshwater ecosystems is an urgent priority. Threatened by the continued construction of huge dams, the connectivity of Amazonian rivers and fresh water systems must be maintained giving priority to headwaters and headwater forests where the rivers originate.

Encouraging is an increasing desire for particularly big businesses to be seen as environmentally friendly. Major global corporations like Unilever have announced “Zero Deforestation” pledges that represent steps in the right direction, but more must be done, especially for agricultural products and timber.<sup>54</sup>

Energy development must be considered as well. Since the Amazon receives as much sunlight as any other region on the planet, maximizing solar power should be a top priority in addition to experimenting with wind power and other renewable energy sources.

Finally, protection of the Amazon will require a different mindset other than “merely maximizing short-term economic return to global elites”.<sup>55</sup> We must “modify our goals and our approach to encourage sustainable harvest and production and long term planning while incorporating societal well-being.”<sup>56</sup> This idea means embracing clean air and water, the deceleration of climate change, the promotion of a fair opportunity for all, and human rights.

## **Teaching Strategies**

A variety of teaching strategies will be used to conduct this lesson. Students will gather and record information about plant and animal life in the Amazon rainforest on a classification organizer after listening to the teacher read several books about it and taking a virtual trip to the rainforest. The idea is to give students knowledge about the rainforest, its species and their habitats in order to create their specific dioramas and learn about biodiversity. A similar comparison will be done with the animals of Delaware. What's more, students will learn the dependence that their chosen animal has on its specific environment along with various threats to that environment. Finally, I want students to learn various ways they can protect the rainforest such as using less paper to protect the trees, and responsible ways to buy products like bananas, wood, and nuts.

### **Direct Instruction**

Much of this lesson will rely on the direct instruction method of teaching as I introduce the unit of the Amazon rainforest. I will present the new material and have students take notes on organizers as guided practice. Students' independent practice results in the creation of their specific animal (Amazonian or Delaware) from clay and their diorama of that animal's habitat.

Once we have a classroom of completed dioramas, we can evaluate and review all the various Amazon rainforest species along with Delaware species.

### Classroom Discussion

Essential to this unit is facilitating whole-class discussion so that students will have an opportunity for increased perspective taking, understanding, empathy and higher order thinking. I want students to clarify, justify, and support their answers, consider different perspectives, predict, hypothesize, decide, compare and generalize the information that they have learned.

### Collaborative Teaching

The “Think, Pair, Share” strategy can be used several times throughout the unit. I plan to use this method when students have completed their organizer, and they pair with another student to discuss their findings. Most importantly, I want to use this strategy when students have completed their clay animals and dioramas to pair with a partner to talk about and decide whether their animals could survive if they switched habitats whether it be in the Amazon rainforest or Delaware.

### Time to Investigate and Produce

Students will have to research their chosen animal, and its specific characteristics that help it adapt to its environment, in order to create it from clay. Next, they will build a diorama displaying the natural habitat of their specific animal which requires thoughtful investigation.

### Questioning & Cues

This will take place when the teacher asks students about their prior knowledge of the Amazon rainforest and introduces the students to several species that they might find unusual compared to the species found in the United States. Once students discover that there are thousands of species in the Amazon, although we will review only specific ones, I will prompt students to devise a way that they can organize and record their new information. Thus, the use of a graphic organizer.

### Advanced Organizers

In order to help students plan for learning information, I have created three organizers. A note taking chart will be provided for the various animal and plant species we learn about. A cause and effect worksheet will be used to record the cause or why it happened (forest fire, deforestation, mining) and the effect or what happened (destroyed habitats, destroyed habitats, water poisoning).

### Organizing Conceptual Knowledge

In order for students to have a strong understanding of individual concepts, see patterns and make connections I have designed learning activities using categorizing, classifying and comparing activities on the animal and plant habitats of the Amazon rainforest. For instance, we will analyze how habitats are similar and different thus comparing examples and non examples of the concept habitat.

### **Classroom Activities**

Start with the "I can" statement, "I can create a clay animal (Amazon Rainforest or Delaware) and show how it adapts to its environment." Recall the word "habitat" and have students tell what it means. Ask students to identify various habitats for animals such as forest/woodland, coastal/river, grasslands, meadow, and desert. Introduce the rainforest habitat by intriguing students with some questions about its more unusual animals, perhaps, "Do you know that some dolphins are pink and can swim upside down?" "Do you know that some frogs contain poison?" "Do you know that jaguars have powerful jaws that can bite through turtle shells?" Read a children's book about the Amazon (see Resources) to students while they gather and record information using a classification organizer about plant and animal life in the rainforest. The organizer depicts six animal groups: 1) amphibians 2) birds 3) mammals 4) reptiles 5) fish 6) insects and one plant group. Students will also view a YouTube video titled Virtual Field Trip – Amazon Rainforest and take additional notes on the back of their organizer. Another film to be viewed is the story of the Maijuna, one Indigenous community of the Amazon, in the documentary film, Guardians of the Forest, 2020.

Another teaching activity following the introduction of the Amazon Rainforest is to take students outdoors for a class in search of different animal habitats in Delaware. Fortunately, our school backs up to the St. Jones River and a small wooded area in which bald eagles, raccoon, fox, deer, opossum, snakes, and snapping turtles have been observed. Even if this were not the case, students can go outside to a small grassy area and use a magnifying glass to look for various insects. I think students would be surprised to see how many insects occupy a small space.

Students will record their observations.

After completing their classification organizer, students will choose their favorite animal from Delaware or the Amazon rainforest to create their diorama. First students will make a "Biodiversity Plan," a diagram of their animal in its habitat. Students will think about the distinguishing characteristics of their animal by considering these questions: "Think of the animal in its habitat, what makes it possible for it to live there? "What do they eat that their body helps them to find, or catch? What about their body helps it to move around in its habitat?" When the "Biodiversity Plans" have been completed, students will "Think, Pair, Share" to discuss their findings and then create their chosen animal in clay and create their dioramas. Boxes for dioramas would be collected well in advance of this lesson and students can choose materials that the teacher supplies or use their own. Once dioramas have been completed, students will write an "information card" on their animal to include the most interesting fact

about their animal and again participate in the “Think, Pair, Share” strategy to discuss whether their animal could survive in a different habitat.

Next, conduct a classroom discussion as to ways in which students can help bring awareness to save the rainforest. Discuss how rainforests affect everyone and help us to breathe, clean our air, produce rain, feed us, give us rubber and help keep us well (medicines that originate from rainforest plants). Then, examine how the future of the rainforest is imperiled through deforestation, gold mining, and global warming, and how that affects the local people, animals, plants, and everyone. Reference specific animals that have reached extinction in the Amazon Rainforest. Suggestions for students to help save the rainforests would be to find organizations that support conservation and spread the word, recycle paper so that fewer trees need to be cut, and make sure that foods they buy are from sustainable sources.

Finally, have students create an art gallery with their dioramas and “information cards.” Display the art gallery in school or other public places to raise awareness.

### **Resources**

#### Student Resources

Arlon, Penelope and Gordon-Harris, Tory. 2013. Scholastic Discover More Rainforest. Singapore: Scholastic Inc.

References the rainforests of the world including its plants and animals.

Greenwood, Elinor. 2001. Rainforest. New York: DK Publishing, Inc.

This book explains the forest layers and the animals and plants that live in each layer.

West, Tracy. 2009. Planet Earth Amazing Animals of the Rainforest. USA: Scholastic Inc.

This book references the layers of the rainforest and specific animals that live there.

#### Teacher Resources

Biodiversity, V. F. (2018, October 10). The Poisoning of the Amazon. Retrieved from <https://blog.nationalgeographic.org/2018/10/02/the-poisoning-of-the-amazon/>

Website about gold mining in the Amazon.

Blog Archives. (n.d.). Retrieved from <https://www.natureconnect.ca/blog/archives/04-2019>

Website titled: Let Nature Be Your Teacher: Curriculum Emerging from the Land provides a look at students taking part in an “outdoor classroom” focusing on nature.

Ortiz, Erik. "How the Amazon Fires, Deforestation Affect the U.S. Midwest." August 23, 2019. <https://www.nbcnews.com/news/world/how-amazon-s-fires-deforestation-affect-u-s-midwest-n1045886>.

Website that explains the effect of Amazon fires and deforestation on the U.S. Midwest states.

Plotkin, M. J. (2020). *The amazon : what everyone needs to know* (Ser. What everyone needs to know). Oxford University Press. <https://delcat.on.worldcat.org/oclc/1129392019>

This book is the source of much of the references used in this paper and gives extensive information about the Amazon.

Red-eyed Tree Frog | Amazing Animals. (2016, April 07). Retrieved from <https://www.youtube.com/watch?v=42GAn4v5MgE>. National Geographic Kids. April 7, 2016. Video on the characteristics of the Red-eyed Tree Frog

Badger, A. M., & Dirmeyer, P. A. (2015). Remote tropical and sub-tropical responses to Amazon deforestation. *Climate Dynamics*, 46(9-10), 3057-3066. doi:10.1007/s00382-015-2752-5

References Amazon deforestation.

Barcellos, C., Feitosa, P., Damacena, G. N., & Andreazzi, M. A. (2010). Highways and outposts: Economic development and health threats in the central Brazilian Amazon region. *International Journal of Health Geographics*, 9(1), 30. doi:10.1186/1476-072x-9-30

References diseases of the Amazon region specifically Aids and malaria.

"Amazing Animals: Rainforest Animals (Part 1 of 2)." YouTube, 5 Jan. 2014, <https://youtu.be/PGU3X0Qj4Kw>.

Video on rainforest animals.

Guardians of the forest [Video file]. (n.d.). Retrieved from one planet. <https://vimeo.com/415664376>

Video on the indigenous peoples of the Amazon and their plight with illegal loggers and gold miners.

"Virtual Field Trip - Amazon Rainforest." YouTube, 1 Nov. 2014, <https://youtu.be/JEsV5rqbVNQ>.

A virtual field trip video to be used in the unit for student viewing.

## **Appendix: Implementing District Standards**

### New Generation Science Standard

2-LS4-1. Make observations of plants and animals to compare the diversity of life in different habitats

### National Core Art Standards

Anchor Standard 1: Generate and conceptualize artistic ideas and work.

Anchor Standard 2: Organize and develop artistic ideas and work.

Anchor Standard 3: Refine and complete artistic work.

Anchor Standard 4: Select, analyze, and interpret artistic work for presentation.

Anchor Standard 5: Develop and refine artistic techniques and work for presentation.

Anchor Standard 6: Convey meaning through the presentation of artistic work.

Anchor Standard 11: Relate artistic ideas and works with societal, cultural, and historical context to deepen understanding.

This unit meets both national science and art standards. Students are learning about different animals of the Amazon rainforest and their specific habitats, recording the newly learned information on an organizer, which follows the science standard of comparing the diversity of life in different habits. Students are responsible for choosing their favorite animal and creating it first in a diagram and then in clay thereby fulfilling the skills of organizing, developing, and refining artistic works. They will construct a diorama of their chosen animal's habitat and present it for display meeting the requirements for developing and refining work for presentation. Information cards are to be written and displayed with their diorama thereby bringing attention to the Amazon rainforest and its uncertain fate linking artistic ideas and works with societal, cultural and historical context.

### Notes

1 (West 2009)

2 (Sobel 2019)

3 (Plotkin 2020, 9)

4 (Plotkin 2020, 9)

- 5 (Plotkin 2020, 9)
- 6 (Waliser 2015)
- 7 (Plotkin 2020, 2)
- 8 (Plotkin 2020, 6)
- 9 (Plotkin 2020, 6)
- 10 (Plotkin 2020, 5)
- 11 (Plotkin 2020, 6)
- 12 (Plotkin 2020, 7)
- 13 (Plotkin 2020, 10)
- 14 (Plotkin 2020, 11)
- 15 (Plotkin 2020, 11)
- 16 (Plotkin 2020, 11)
- 17 (Plotkin 2020, 12)
- 18 (Plotkin 2020, 12)
- 19 (Plotkin 2020, 34)
- 20 (Plotkin 2020, 41)
- 21 (Plotkin 2020, 64)
- 22 (Plotkin 2020, 64)
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- 24 (Plotkin 2020, 66)
- 25 (Plotkin 2020, 72)
- 26 (Plotkin 2020, 77)

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33 (Plotkin 2020, 141)  
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47 (Plotkin 2020, 181)  
48 (Plotkin 2020, 189)

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51 (Plotkin 2020, 192)

52 (Plotkin 2020)

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56 (Plotkin 2020)