



## **Montessori's Cosmic Curriculum and Biodiversity in Africa**

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### **Introduction**

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Imagine a standard analog clock. The time it takes for the hour hand to make an entire revolution around the clock is 12 hours. Think of those twelve hours as the amount of time the Earth has been in existence. Of those 12 hours, human beings have only been on the Earth for 14 ½ seconds.<sup>1</sup> This is the Neozoic Era, the Anthropocene, the age of humans. The history of humans on Earth is very short, merely a blink of an eye in the history of all life on Earth. The human species originated in Africa. We are all descendants of these oldest humans found on the planet.

Africa is the second largest continent on Earth. It is a vast plateau. Africa has many large megacities as well as areas that are less populated with indigenous people. As the youth population of Africa grows, urban areas will continue to grow.<sup>2</sup> The Atlantic Ocean lies on its west coast and the Indian Ocean lies on the east coast. The Mediterranean Sea is to the north. The equator goes right through the middle of the continent, meaning that most of Africa lies in the tropic zone. The continent of Africa has many different biomes. The biomes that are most prevalent on the continent are the tropical forest, the grassland, and the desert, although there are also wetlands and mountains. Being in the tropical zone means that it is very hot, with little to no change in temperature. Because of this, the changes in climate center around rainfall. The wettest part of Africa is the Congo rainforest, which is just north of the equator. From there, the continent gets drier and drier as you travel away from the rainforest. As you move out of the tropical zones into the more temperate zones, there is very little forest because of the lack of rainfall.<sup>3</sup>

Africa is home to a widely diverse collection of animal and plant life. It is said to be home to more than 50,000 known plant species, 1,000 mammal species, and 1,500 bird species.<sup>4</sup> Indigenous people of Africa and traditional African societies rely on these species for survival. There are many things about their culture that show how they live in harmony with nature, and there are many things that they can teach us. Some of the indigenous tribes include the Maasai of the grassland, the !Kung of the desert, and the Efe of the tropical forest.

## Rationale and School Profile

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The Montessori Method takes a different approach to teaching science and social studies that integrates the philosophy of Cosmic Education. Cosmic Education is introduced to the students to help them have an admiration of and respect for the world and their place in it. This unit invites the student to undertake the study of the continent of Africa according to the biota that live there. It also incorporates the study of indigenous cultures that meet their needs within their biome.<sup>5</sup> This approach encourages an integration of various disciplines. The zoological and botanical species that inhabit the African continent are interconnected with the geography of that specific continent. Human culture is also influenced by the biome and its characteristics. In order to meet their fundamental needs, humans can either adapt and live in harmony as indigenous cultures have historically done or, as modern cultures, exploit resources and modify the biome in which they live. This approach encourages the students to see how they themselves relate to the world. By studying the various biomes of Africa, the students will develop an understanding of how plant, animal, and human life adapt to different conditions found within the biome.

The focus of the unit will incorporate teaching Lower Elementary students their connection to other living things and how they can be caretakers of the planet. The students will be introduced to many aspects of nature in Africa including plants, animals, and humans. Montessori believed that students should be taught to respect nature. This will allow them to obtain an understanding of the natural world, and therefore themselves.

Pittsburgh Montessori is a public Montessori Magnet School in the Pittsburgh Public School District that serves children 36 months in age through early adolescence. It is the only fully public Montessori school in the state of Pennsylvania and one of the few in the country. The vision at Pittsburgh Montessori PreK-5th grade is to embrace the entire school community to acquire measurable growth in the development of the whole child utilizing the Montessori philosophy. Pittsburgh Montessori utilizes Montessori materials and philosophies to enhance the Pittsburgh Public School District's standards aligned curriculum. Part of the work is to foster independence and empower students to be lifelong learners. Through our multi age classrooms we are able to foster an academic culture of personalized learning in the development of the whole child.<sup>6</sup> This unit was created for a Lower Elementary Classroom comprised of first, second, and third grade students. In each Lower Elementary class, we have 7-10 students in each grade level.

In Montessori classrooms, we have the benefit of a mixed age grouping where we have the same children for a three-year cycle. This means that we do not have to study the entire globe in one year. We have the luxury of studying one continent and its biomes during a semester before moving on to a different continent the next semester. As the students grow each year, they will use acquired skills to dig deeper and will be able to share their knowledge base with the first-year students.

## Learning Objectives

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Throughout the unit, the students will explore how the indigenous people of the different biomes believe that no element of the natural world exists in isolation. All things are interconnected in the web of life. Students will obtain a reverence for natural order and a sense of thoughtful understanding for their place as overseers of the environment. The goal is to challenge the prevailing culture that humanity is above the laws of nature and entitled to unlimited use of its resources for development. Students will be encouraged to evolve in a more enlightened direction.

Students will be given structure and background before launching into independent research: finding life forms in their assigned biome and paying attention to their adaptations, and investigating indigenous people according to the way they satisfy their basic needs within their biome. Students will also be encouraged to develop a relationship with the natural world and experience it beyond the abstract. First year students will study the tropical forest, second year students will study the grassland, and third year students will study the desert.

This unit will be taught after teaching Montessori's second and third Great Lessons: The Timeline of Life and The Coming of Humans. The unit will be a part of Montessori's "cosmic curriculum," which tells how all living things are connected. The students also will have previously studied their own continent and home biome because it is most familiar to them. The study of North America will be a foundation and a point of comparison for the exploration of Africa, our continent study.

## Content Objectives

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Biodiversity is defined as the variety of life on Earth. It is all around us and we see it every day. Biodiversity is, however, more than what we can simply see. It includes how everything is connected. Every species, including humans is interconnected. We all rely on each other to survive. Local adaptations of plants, animals, and other creatures to specific biomes located on a continent can make them uniquely different from other species on that continent and creatures found elsewhere in the world. An expanding human population and the increase in human consumption of natural resources is a very large threat to biodiversity.

By studying different biomes in the continent of Africa, the students will research how plant and animal life has come to adapt to their environment in a specific biome. The students will learn about the indigenous people of Africa and the biota that are of importance to each particular group. In each biome, students will learn the names, importance of, and possible adaptations of biome specific plants and animals. Africa and its biomes are home to many unique species that are not found elsewhere. The plant and animal life that is taught throughout the unit is only a small sampling of the rich biota present on the continent of Africa. The information gained about these life forms will create a dynamic learning experience for the students. By studying Africa in this manner, students will learn to have an appreciation of another culture. They will also develop an understanding of the differences and similarities of their own culture from the indigenous people of Africa. In accordance with the standards, students will develop critical thinking skills and a motivation to read, write, and communicate information. The students will read, comprehend, and respond to informational texts.

They will then have to collect evidence from informational texts according to grade level reading standards to support analysis, reflection, and research. The unit is separated into the three different grade levels that make up a Lower Elementary classroom. First year students will study the tropical forest biome, second year students will study the grasslands, and third year students will study the desert.

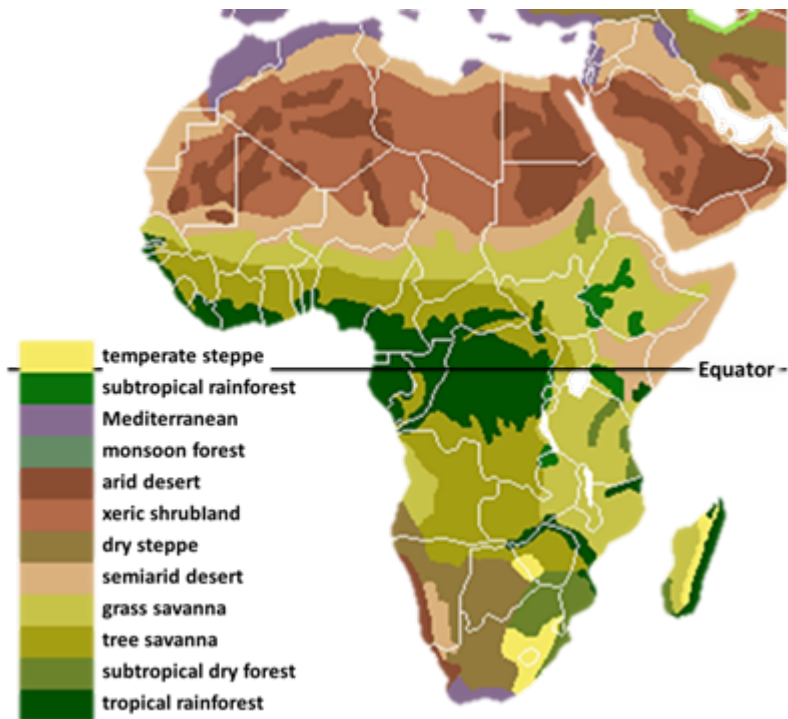


Figure 1. Biomes of Africa<sup>7</sup>

## Background Content

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### Tropical Forest - First Year Topic of Study

A large part of Africa around the Congo River is rainforest. Many tropical forests in Africa have wet and dry seasons. Plant life is very dense. Vines weave through the forest. Very little light gets through to the forest floor. It is home to many different types of plants and animals. By learning about the tropical forest biome, students will be empowered to be guardians or caretakers of the forest. They will be taught conservation, and principles of respect and collaboration. The students will be taught through both a scientific model and through traditional community knowledge.

#### *Plants of the African Tropical Forest*

Numerous varieties and species of plants flourish in the tropical forest. There have been 11,000 forest plants identified. 1,100 of these are unique to the forest and found nowhere else in the world. It is estimated that 69 of these plant species are threatened.<sup>8</sup> The trees in the tropical forest can reach heights of 130 to 160 feet.<sup>9</sup> The Congo Rainforest is known for its small number of tree species that comprise the rainforest. The African oak, red cedar, and mahogany, which are all broadleaf trees, form the dense upper canopy. The upper canopy

is usually located over 40 meters above the ground.<sup>10</sup> The lower canopy is comprised of trees of different types and sizes. In these lower layers, trees compete for light. This means tall vegetation growth is vital for survival because sunlight usually does not penetrate through to the forest floor.

Because of the limited sunlight, the survival rate of plants at the very bottom layer of the rainforest is low. Two different climbing plants thrive at the bottom layers. They are lianas and ficus (strangler figs). In order to survive, these two plants send shoots through the trees to acquire more sunlight.<sup>11</sup> This bottom layer of the rainforest is also comprised of small ferns and dead leaves that are rapidly decomposing. Moss also grows on downed trees. The mineral nutrients that the dead decomposing materials provide are vital to the plants in the rainforest. The dead trees provide sites for breeding as well as shelter for bats, birds, and other small animals.

Plants that have medicinal properties are habitually harvested from the rainforest. They are used by both the indigenous people and the modern world. Biochemicals are often extricated from the plants of the rainforest. They are then used in the production of certain drugs. The International Cancer Institute has identified 1,400 tropical forest plants with anti-cancer potential. <sup>12</sup>

### ***Animals of the African Tropical Forest***

The animals in this biome also have adaptations characteristic of living in their homes. One example is the leaf tailed gecko, which has a tail that looks like a decaying leaf to camouflage it against the forest background. The blotchy tail appears to have sections missing and looks like a leaf that has been broken over time. Also, this lizard is able to shed its tail to further confuse and avoid possible predators.<sup>13</sup>

Another example is the potto. This is a nocturnal mammal that has thumbs that can grasp branches as well as eyes to help it see at night. These animals have thin, slender bodies. Their long limbs, which are about the size of their entire body, are the key factor in them being able to cling to branches and trees. The potto has a large bridge between its eyes that is used to head butt predators in battle.<sup>14</sup>

Another animal that lives in the tropical forest is the tree pangolin. The tree pangolin can curl into an armored ball when it feels threatened. Its armor is made up of overlapping scales that are made of keratin, like our fingernails. Tree pangolins have a tail that helps them hang on to tree branches.<sup>15</sup> The prehensile long tail lets the animal reach ant and termites. Its long, sticky tongue can also lick up the insects it eats.<sup>16</sup>

The goliath frog that lives in the tropical forest is as big as a house cat. One of the reasons that this frog is endangered is because the Efe indigenous people hunt it by trapping it in a basket. Once prepared, the animal can feed several families. Researchers have studied this frog in the wild and have noticed that they shift very large stones in nearby streams to build nests for their young. These rocks can weigh up to 5 ½ pounds. This is one possible explanation as to why the frog is so large.<sup>17</sup>

### ***Indigenous People of the African Tropical Forest -The Efe***

There is a small village outside of Isiro on the edge of the jungle. This is the only place where the Efe people live. It was once common that the Efe were referred to as pygmies because of their short stature, but the term was seen by some as offensive and therefore they are generally referred to as Efe in the current day. The Efe people have long been studied by anthropologists. They used to live by hunting and gathering in the rainforest. They move their camp often to avoid taking too much from any one area. The Efe live in dome

shaped huts covered with large leaves. Each hut has an open doorway facing the center of the camp.<sup>18</sup> The children do not go to school; they work with their parents and learn how to live on the land. They often camp near a tribe of farmers. In conjunction with the farmers, they try to improve how much food they can harvest from their land. The Efe work in the fields in exchange for the rice, sweet potatoes, plantains, and peanuts they help grow. They also trade honey, meat, mushrooms, and medicines that they hunt and gather from the rainforest.<sup>19</sup> The Efe move their camp to find food. Living day to day, and sometimes going hungry, is not an easy life.

The Efe people feel that their environment is bountiful and giving. They live in bands of 15 to 60 people.<sup>20</sup> They hunt for their meat, gather plant foods, and collect honey. They are a nomadic tribe. This means that all of their possessions have to be brought when they move to a new hunting camp. This is one of the main reasons why the Efe have very few belongings. The Efe people know the rainforest very well. They pay attention to the cycles of plants including when they are flowering and bearing fruit. They can also locate a bees' nest from the flight of a bee, and the location and direction of animal tracks. They can recognize distinct properties of thousands of plants and utilize them for many reasons. This includes knowing which plants are safe to eat, and which ones can be used as medicines to help with pain relief, heal wounds, and cure fever.<sup>21</sup>

Recently, however, the Efe people had to adapt their traditional way of life. Commercial forestry is now making its way deeper into the rain forest. The Efe people have been hired to assist with logging.<sup>22</sup> This means that the food supply has been significantly reduced. Along with this, the Efe people's homes and their natural habitat are being destroyed. New roads have also been built. Animals that the Efe would have previously been able to hunt have now disappeared or have been scared away by the noise. <sup>23</sup>

Anthropologists have noted that rituals which support their relationship with the forest and with the spirits of the forest are important to the Efe people. Music and songs are a crucial part of these rituals. This music may last throughout the night.<sup>24</sup> The Efe feel that in order for the hunt to be successful, it is necessary to establish a peaceful state of mind and unity among the camp. This is the primary aim of the rituals. Another aim is to re-establish a good relationship with the forest.<sup>25</sup>



Figure 2. Tropical Forest in Gabon, Africa<sup>26</sup>

### **Grasslands - Second Year Topic of Study**

A large portion of Africa is tropical grassland called the savanna. The African savanna is the most extensive ecosystem in the world. It is also the richest grassland biome in the world.<sup>27</sup> The savanna is home to many indigenous plants and animals. It is also home to the world's most prevalent concentration of large mammals including buffaloes, elephants, leopards, giraffes, rhinoceroses, lions, zebras, cheetahs, and hippopotami.<sup>28</sup> Vegetation including tall grasses and thorny bushes grow here. Trees may stand alone. Herds of animals graze here. It does not rain very often. Animals migrate seasonally in search of water. This grassy biome is a species-rich ecosystem. They are being destroyed at a very fast pace. Second year students will be encouraged to acknowledge the fact that these areas have rich biodiversity.

#### ***Plants of the African Grasslands***

There are many notable trees that live in the grasslands. One is the rare Acacia tree. It thrives in the savanna and is one of its most iconic sights. This tree is one of the giraffe's favorite foods. A herd of giraffe will often gather around one tree and eat the leaves. Because of this in order to curb feeding, the tree has evolved to grow sharp thorns as long as four inches.<sup>29</sup> To counter the thorns, giraffes have developed a flexible tongue that allows them to navigate around the thorns. Some of these trees have developed the ability to release tannins in response to injury. The chemicals have a bitter taste to giraffes and are mildly toxic. These tannins even send out chemical signals to nearby trees. These signals warn trees in close proximity to do the same.<sup>30</sup>

Another tree found on the grasslands is the baobab tree. These trees can live to be thousands of years old and grow to be exceptionally large. One hollowed-out baobab is so large that up to 40 people can take shelter inside at once.<sup>31</sup> This tree is very hardy. Their trunks are able to store water for months. The baobab trees are also extremely fire resistant. If the tree is burnt, it will grow all-new bark and continue to grow and flourish like

nothing happened.<sup>32</sup> This tree is also known as the tree of life. This is because it can provide all of the basic needs such as shelter, clothing, food, and water for both animals and humans.

### ***Animals of the African Grasslands***

The animals that live in the savanna represent extreme biodiversity. Goats, zebras, hyenas, giraffes, lions, and elephants are some of the large mammals that live in the grasslands. Because the African savanna is an open area containing very few trees, many of the animals that live in the savanna have to adapt to their unique biome. Large cats and hoofed mammals have evolved to run quickly across the plains. Scavengers also flourish because of the nature of the area. They are able to see their prey or carcasses that are on the grasslands. Animals have adapted to the unique features that the grasslands possess. These adaptations include having to deal with the warm climate.<sup>33</sup>

One such animal is the pancake tortoise. The pancake tortoise has a flat shell that allows it to wedge itself in the cracks of the rocks for protection from predators.<sup>34</sup> The South African rain frog hides in the sand during the day and comes out in the cooler evening to feed. It has webbed feet to walk on sand and it can lay its eggs without water. The male weaver bird weaves a nest that hangs from a tree branch. This nest is closed except for a small hole in the bottom. The male weaver bird attracts a female to its nest. The oxpecker bird and the eland antelope also live in the grassland savanna. The oxpecker lands on the back of the eland and sucks off the ticks that latch on to its back. In this way, the oxpecker is fed and the eland is kept clean. The way they interact is called symbiosis.<sup>35</sup>

### ***Indigenous People of the African Grasslands - The Maasai***

The Maasai people have been known for centuries as fearsome hunters and warriors. The Maasai are semi-nomadic, meaning they move seasonally from place to place. They live in southern Kenya and northern Tanzania.<sup>36</sup> The tribes revolve around their cattle. Cows are seen as part of the family and have names. The bond that they have with their cattle has led them to their nomadic way of life. They follow the rainfall and search for food and water for their cattle. The Maasai depend on their cattle for many things. They drink the milk and eat the meat. The cow dung is also used for building their houses. Traditionally, the cattle were also slaughtered for ceremonies.<sup>37</sup> The Maasai people who live in the Serengeti also raise goats for meat. The Serengeti is an ecosystem in central Africa. It is a region known for its biodiversity, especially the so-called "big five." This includes lions, leopards, elephants, rhinos, and buffaloes. Anthropologists have also found some of the oldest fossils of early humans in this area.

In their villages, the Maasai sleep in their Inkajjiki (Maasai word for a house) in a circle. Their houses are oblong and made of sticks, mud, grass, cow dung and cow urine.<sup>38</sup> The people have to go to the waterhole for water. In the wet season, you do not have to go far. In the dry season, they may have to walk for miles to get water. During the dry season, the young men must take the cattle to other places for grass and water. They may set up camp if they find a good spot. They build a corral of thorn bushes to protect the cattle at night from lions and other predators. They do not go back to the village until the dry season is over. These places become harder and harder to find because so much land has been put aside for wildlife by the government.<sup>39</sup> The land that a Maasai tribe has to roam is smaller because of the parks and farms. The size of their herds has become smaller and they are not as strong and independent as they once were. In the savanna, there has been a significant increase in urbanization. In addition, there are new National Game Reserves that were once land that the Maasai used for grazing.<sup>40</sup>



Young Maasai children will join the warriors when they are older. They will live in a camp together away from the village and take the herds to a far pasture during the dry season. The men grow their hair in braids and wear beadwork made by the women. A very important part of Maasai culture is beauty.<sup>41</sup> Both men and women use beads as a form of adornment. They are worn almost all of the time, and most people have different pieces of jewelry for different occasions. Some are worn nearly every day, while others are for ceremonies and rites of passage. Some are crafted and given to visitors as a sign of gratitude and respect.<sup>42</sup>



Figure 3. African grassland savanna<sup>43</sup>

### **Desert - Third Year Topic of Study**

The Kalahari Desert is hot and dry all the time. Sometimes it rarely rains, and other times it does not rain at all. According to an article in Science Daily, the sand in the desert is home to a bacterium that helps gather and store carbon dioxide from the air. Because of this, the Kalahari Desert is an important carbon sink of the Earth. The desert sands store more carbon than they release.<sup>44</sup> By studying the desert biome, students will learn more about how to be a caretaker of the earth.

#### ***Plants of the African Desert***

In order for plants to survive in the desert, they have to adapt to an extremely dry environment. Because of the arid environment, plants need to be good at both storing and finding water. Some desert plants have seeds that can stay dormant in the sand for a long time. They will stay underground until there is enough rain for them to grow.<sup>45</sup> Mostly annual grasses inhabit the desert biome. In the rare occasion that there are abundant rains, the desert plains can be covered with a plethora of short annual grass. However, in more normal years, the plains can appear empty with the annual plants staying in the form of seeds.<sup>46</sup>

The tsamma melon is a desert watermelon that can be a source of water. The flesh is white and bitter. The !Kung people drink its juice and use its flesh as a body scrub to clean up and cool down. The tsamma melon provides the necessary hydration for hunting. The seeds of the melon are nutrient dense, and the flesh has a

very-high water content. It has been said that people can survive on only this melon for a long period of time.<sup>47</sup>

Another plant is the *Hoodia gordonii*. This is a cactus like succulent plant. This plant can be peeled. You can chew on the bitter, inside flesh. It is quite bitter, but it can help a hungry belly. If the day's hunt was unsuccessful, it can make you feel full. The !Kung have been known to suck on Hoodia as the whole fresh plant, or the dried-out plant for some time.<sup>48</sup> It has been known to fight hunger and thirst during long hunting trips. It has gained in popularity today in the United States and around the world because it has been used as a dietary supplement to aid in weight loss.

### ***Animals of the African Desert***

Just like the other biomes, there are many animals that live and adapt to the desert biome. The hot environment requires the animals to adapt to the arid conditions, winds, and intense heat. Because of the characteristics of the biome, the mammals are relatively small and able to meet their needs for water in their diet. The animals hunt and forage mainly at night when it is cool. The African desert biome is home to about 70 species of mammals, 90 species of birds, and 100 species of reptiles.<sup>49</sup> The pam-pam bird, poison dart frog, gemsbok, ostrich, webbed footed gecko, and the naked mole rat are all found in the African desert.

One insect that can be found in the desert is the termite. Some of the research suggests that the large dirt mounds that termites create can be a key factor in making the deserts more resilient to climate change.<sup>50</sup> The termite mounds allow water to better penetrate the soil, and to store water and nutrients in their internal tunnels. Termite habitats allow for a richer vegetation and decrease the amount of desertification by helping to protect from drought. <sup>51</sup>

The fennec fox is another animal that has had to adapt to the desert conditions. The first thing that one notices is the large ears. They have a highly developed sense of hearing. These large ears can filter sound through the same and can also detect the differences of the calls of other fennec foxes. Their ears also help to disperse the heat and locate prey moving in the sand.<sup>52</sup> The feet of the fennec fox are heavily furred. This protects their pads from the hot temperature while moving across the desert sand.<sup>53</sup> Another type of adaptation they have is that they do not need to drink often. The plants they eat can be a source of water when in need.

There are other animals in the desert that also need to adapt to the arid conditions. The sandgrouse has strong wings that allow it to travel as long as 100 miles each day to a water source.<sup>54</sup> It calls to others of its kind to take turns at a water hole. The dromedary has a large fatty hump that can be used for accessing water and energy when needed. It rarely sweats and can live without water for three weeks.<sup>55</sup> The fog-drinking beetle collects water from the morning desert fog on the bumps on the beetle's back. It then runs down channels to its mouth. The kangaroo rat has large legs for leaping fast.<sup>56</sup>

### ***Indigenous People of the African Desert - The !Kung***

The !Kung people have lived in the African desert for thousands of years. They are one of the few holy tribes still living on their ancestral land. !Kung are traditional tribal religionists whose religion is similar to Christianity. The symbols of their spirituality are celestial bodies, such as the stars, sun, and moon.<sup>57</sup> . The !Kung also often dance near a fire. They believe that by doing this, they will gain the power to heal. The !Kung spiritual leaders serve as the tribes' diviners and healers. Another important aspect in the life of the !Kung are

legends. Each legend is based on a tribe member's view of the supernatural and explains some aspect of the divine.<sup>58</sup>

In the tribe, everyone is equal. Even the best hunters or gatherers are do not receive special treatment. Traditionally, the !Kung were nomadic in order to follow the water. When it rained, they built shelters each night, moving constantly in search of green plants. In the dry season, they built larger huts in a circle around permanent waterholes. Now, they are semi-nomadic. They will move their camps at irregular intervals. Because of varying factors, some of the !Kung people have been forced to abandon their traditional hunting and gathering way of life. There are only a few thousand left that are still living by traditional hunting and gathering techniques.<sup>59</sup>

The bush-living people manage to survive primarily on wild game meat and vegetable foods. Most plants are dead or dormant during the dry season and nuts are all that can be gathered. Meat is practically important during the dry months when the wildlife cannot travel far from the waterholes.<sup>60</sup> The !Kung people know which plants have roots that store water. In order to live off of the land in this way, you need a lot of land to roam. Farming and parks have left the people with much less land than they once had. The reserve is only one fourth of the land that they once had. There is not enough land for them to live as hunter gatherers as they used to. Many have been forced to now farm themselves, or work on nearby farms.<sup>61</sup>



Figure 4. Kalahari Desert <sup>62</sup>

## Classroom Strategies

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The unit will include direct instruction, various artistic mediums, student readings, research projects, project-based learning, virtual field trips and videos, and self-directed and self-chosen learning materials including independent shelf work. This shelf work consists of concrete materials; Montessori nomenclature, that were

specifically designed for this topic. Student engagement will be at the forefront of every activity. This will be done through Montessori's guiding principles. The most important principle is fostering a student's natural desire to learn. Other principles include using the students' surroundings and the prepared environment to help educate and encouraging the students to be independent thinkers and learners.<sup>63</sup> This unit will also allow students to demonstrate their knowledge in a variety of ways. This gives them more ownership over their education and their chosen topic of study.

## Classroom Activities

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The first step in the unit would be to introduce and teach the different biomes of Africa to all students. The students will be able to explore the biomes across Africa and make observations. The biodiverse plant and animal life on the continent of Africa would then be introduced to all students in a broad form. Each grade level within the classroom would then have a separate biome to study. Within that biome, the students would first focus on plant life. This is because Maria Montessori believed animal life is dependent on plant life.<sup>64</sup> Student research will be guided to find the diversity in the predominant plant life or to find different kinds of plants in different layers of the biomes. Students would then focus on the animal life within the biomes. Their research could include a description of what a chosen animal eats, how it lives in the biome, as well as any special adaptations it possesses. Students will also have the opportunity to compare the different plants and animals within their biome in Africa and research how they are interconnected. Students would then focus on the people of Africa, mainly those that live in indigenous cultures. Students would research how they interconnect to the biodiversity of a particular biome.

### Activity One - African Plants

In this activity, students will learn, in depth, about a plant of their own choosing from their assigned biome. This plant should be prevalent in the lives of the indigenous people that inhabit the biome. After classroom instruction, interaction with Montessori nomenclature, videos, and puzzles the student will research their plant using books from the classroom, Epic, or a child friendly search engine. The research will include many things. For first year students and some second grade students their research should include: the name of this plant, the region it grows in, how it reproduces, the relationship to the indigenous people of the biome, is it harmful or useful, and where the plant grows. For the remaining second and third year students, they would also need to include: where the plant fits on the Plant Kingdom Chart, whether it is flowering or non-flowering, what kinds of animals, if any, eat the plant, do any animals use this plant as a home, do humans eat this plant and if so, how is it prepared, and if it is used for anything else, like fuel, clothing, medicine, or decoration.

After completing the writing process and publishing their research paper, the student will then either draw a picture of their plant or make a model of their plant using a self-selected medium. This could include any artistic medium they chose including clay, colored pencils, or any other three-dimensional models. All students would have to label the parts of the plant including its root, stem, branches, leaf, seed, and fruit. Once complete, students would have an opportunity to share their research with their classmates with an "author's chair."

## **Activity Two - African Animals**

In this activity, students will learn, in depth, about an animal of their own choosing from their assigned biome. This animal should be prevalent in the lives of the indigenous people that inhabit the biome. After classroom instruction and interaction with Montessori nomenclature, the student will research their animal using books from the classroom, Epic, or a child friendly search engine. The research will include many things. For first year students and some second grade students would need to include: the name of the animal they chose to research, if the animal is a vertebrate or invertebrate, if the animal lives on land, water, or both, what the animal eats; if the animal lays eggs or gives birth to live babies and if the animal is harmful or useful to humans. For higher second year students and third year students, they would also need to include additional findings in their research such as: the specific classification for this animal, how the animal adapts to its biome, if it could it live elsewhere in the world, what kind of shelter, if any, the animal needs, how long it takes to mature into an adult, what special community or group the animals live in, and how this group helps the animal to survive.

After completing the writing process and publishing their research paper, the student will then either draw a picture of their animal or make a model of their animal out of a self-selected medium. This could include any artistic medium they chose including clay, colored pencils, three dimensional models, or dioramas of the animal in their biome. Second- and third-year students would have to label the parts of the animal and point out any unique and interesting features. Once complete, students would have an opportunity to share their research with their classmates with an "author's chair."

## **Activity Three - Indigenous People of Africa**

It is important for students to study the culture of other people. It will lead them to an understanding and awareness of other cultures and ultimately an appreciation for the diversity of the world. In Activity 3, students will study the indigenous people of their specific biome.

After researching the indigenous people of their specific biome, the students will write about a day in the life of a person living in this biome. This can include how they survive, what language they speak, what they wear, what they eat, what kind of work they do, and what tools they use to do that work. Other things that should be included is their relationship with nature, their culture views on biodiversity, and if they view nature as existing to serve humans. The project should include how the biome meets the fundamental needs of the people.

There are also additional questions that the students may seek to answer when conducting their research. These questions include: how the conditions of their assigned biome affect how the indigenous people's basic needs are met, if temperature, rainfall, weather, or season affect the food that can be grown or gathered in a biome and if that influences the way people eat, does temperature, rainfall, weather, or season affect the animals that people use for food in a biome, if the people in the biome eat meat, do they eat wild or domesticated animals and how are domesticated animals adapted to that biome, and how does a biome influence the way people dress.

## **Activity Four - Culminating Activity**

The last activity of the unit is a culmination of the first three activities. The students will create a portfolio, either on paper or virtual of their research regarding their particular biome. If in the classroom, the unit will end with an in person continent celebration. The students will plan a celebration (in person or virtual) for the

school's stakeholders that showcases what they learned. This would include their research and art show to highlight the completed student work.

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Montessori Curriculum Resources

## **Appendix on Implementing District Standards**

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This unit is designed for first, second, and third grade students but can be adapted for higher grades as well. It is based on the third grade Pennsylvania Common Core Standards, the Next Generation Science Standards, and Montessori guidelines and philosophy.

In English Language Arts, students will have to read on-level text with accuracy. In their research, students must draw evidence from literary or informational texts to support analysis, reflection, and research, applying grade-level reading standards for literature and informational texts. Students will conduct short research projects that build knowledge about a topic and write routinely over extended time frames, including time for research, reflection, and revision. These writings will be an informative/explanatory text to examine their chosen topic and convey ideas and information clearly.<sup>65</sup>

In the Pennsylvania Common Core Science Standards, students will identify organisms that are dependent on one another in a given ecosystem and define habitat and explain how a change in habitat affects an organism. In addition, students will describe changes in natural or human-made systems and the possible effects of those changes on the environment. This includes describing how human interactions with the environment impact an ecosystem. Students will identify plants and animals that live in certain areas including wetlands. They will also identify resources humans take from the environment for their survival. Students will recognize the structures in plants that are responsible for food production, support, water transport, reproduction, growth, and protection, and acknowledge that plants survive through adaptations, such as stem growth

towards light and root growth downward in response to gravity.<sup>66</sup>

The Next Generation Science Standards are also included in the unit. Students will need to construct an argument that some animals form groups that help members survive and use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing. These examples of cause and effect relationships could be plants that have larger thorns than other plants may be less likely to be eaten by predators; and, animals that have better camouflage coloration than other animals may be more likely to survive and therefore more likely to leave offspring. Students will also have to construct an argument with evidence that in a particular habitat, some organisms can survive well, some survive less well, and some cannot survive at all. Examples of evidence could include needs and characteristics of the organisms and habitats involved. The organisms and their habitat make up a system in which the parts depend on each other. The last standard addressed states the student would need to make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change. Examples of environmental changes could include changes in land characteristics, water distribution, temperature, food, and other organisms.<sup>67</sup>

## Endnotes

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