Grade 5, Unit 3: Troubling Traits
Lesson Plans

Unit Driving Question:

1. How can human-caused changes to habitats impact populations?

Unit Standard(s):

- 5.L4U3.11 Obtain, evaluate, and communicate evidence about how natural and human-caused changes to habitat or climate can impact populations.
- 5.L4U3.12 Construct an argument based on evidence that inherited characteristics can be affected by behavior and/or environmental conditions.

Engage: Lesson Plan (20 min)

Materials: Teacher Slide Deck, Unit 3 Troubling Traits Student Handout #1, Wonder Wall Area, post-it notes, post Driving ?

Things to consider: Students should still be observing plants they manually pollinated, Post the new Driving ? by other Driving ?s

After students manually pollinate plants, they observe plants but will most likely not have time for further exploration of what comes next. If a teacher has the time and wants to continue on with lessons, go to https://www.fastplants.org/pdf/activities/WFP_growth-development-06web.pdf. Scroll down to Days 18-35 Flowering and Development. This module does not provide lessons for exploring cross pollination further due to time constraints. Included in the Slide Deck at the very end is a slide that wraps up their work with flowers and exploring the outcome of selecting for traits.

Lesson: First, have students look at 2 side by side images of a desert landscape before and after the invasion of Buffelgrass (slide 2.) Have them post their wonderings on the Wonder Wall. Then have the students study a table (slide 3) and work in groups groups to decide what is being sold, who is buying it, and why they would buy it. Have students record their thinking on Student Handout #1, then lead a class discussion to hear student thinking. Lead students to recall that humans select plant traits for future plant generations. The traits selected for are such things as taste, flavor, size of flower, etc. — traits that would make a plant attractive, tasty and ready to be sold at market for money. Ask students to think about what ranchers raise and what they need. Ranchers raise cattle and need to

feed their cattle. Click on the Australian Pastures Brunswick Factsheet link on slide 7 to reveal that the table the students had been looking at is from a seed catalog company for pasture grasses.

Explore: Lesson Plan (25 min)

Materials: Teacher Slidedeck, Unit 3 Troubling Traits Student Handout #1

Things to consider: Students should still be observing plants they manually pollinated in Unit 2.

Lesson: Introduce students to the vocabulary word “invasive” species (slide 8.) Have them study data from a scientific study conducted in Saguaro National Park in which scientists compared the soil, vegetation and soil seed bank of patches invaded and not invaded by buffelgrass. Some of the results are listed in a Table that students have on their Student Handout #1. Explain the key:

Relative Cover % = the number of native plants covering an area of land *with* buffelgrass COMPARED to the number of native plants covering an area of land *without* buffelgrass
BG = Buffelgrass patch
NBG= Non-buffelgrass patch

Have students analyze the data and draw conclusions on the impact of buffelgrass on different native plant species. Students should determine that the native plant species are quite negatively impacted by buffelgrass. Students may also conclude that some species can cope better with buffelgrass compared to some others. Bring attention to the very negative impact on saguaros. Mature saguaros may survive for a time with buffelgrass, but it is very difficult for young saguaros to get established in areas of buffelgrass cover. Go back and discuss the differences of the impact on different plant species. Ask students what they think the data would look like over a ten-year time span. Tell students that the longer the buffelgrass grows and takes over, the more native plant species will be eliminated from that area. Then ask students to think about how native animal species might be impacted. You may have to lead students to think about how their diet would be impacted if they rely on native plants. They should also consider how buffelgrass turns the desert into grassland and therefore changes the animals’ habitat. This discussion on how they think buffelgrass could impact native animals will be revisited in the Elaborate section of the lesson after they play the Buffelgrass Game.

Explain: (25 min)

Materials: Teacher Slide Deck (slides 14 - 28)

Things to consider: Students should still be observing plants they manually pollinated, but no recording of observations is required.

Lesson: Discuss definitions of invasive and native species. Clarify that not all non-native organisms become invasive to an area, but some do. Students learn about buffelgrass - what it looks like, where it came from, why we brought it here, why it's a problem and how to solve the problem.

Emphasize that we brought buffelgrass to the region because it had traits that allowed it to spread quickly and grow thickly to hold onto soil and provide food for cattle. Its introduction was spurred by the Dust Bowl in the 1930s. The Dust Bowl was the name given to the drought-stricken Southern Plains region of the United States, which suffered severe dust storms during a dry period in the 1930s. From Texas to Nebraska, people and livestock were killed and crops failed across the entire region. There were many causes of the Dust Bowl, including but not limited to the Homestead Act, changing climate, the belief that “rain follows the plow”, overall ignorance of proper land management and overgrazing. Winds, drought, and overused soil were other causes as well. In the arid Southwest, overgrazing had damaged soils and flooding caused erosion on rangelands, so people introduced grasses like buffelgrass to hold soil in place and increase cattle forage.

Revisit the Australian Pastures Brunswick Factsheet link on slide 7 link from the 2nd part of the Engage portion of the lesson where students are introduced to an on-line seed catalog. Take students to the B in the alphabet ribbon at the top of the Website page and go over buffelgrass information (in Australia it is spelled as two words, in Arizona we use one.) In some places, people still plant buffelgrass. But in Arizona it is now listed as a “noxious weed.” Why?

After discussing why people liked the traits of buffelgrass, discuss the negative traits. The traits we didn't consider were how it outcompetes native plants, impacting the animals that depend on them, and how it greatly increases fire danger. Most of our native plants are not adapted to fire. In contrast, buffelgrass thrives on fire. This is one of the major dangers of buffelgrass. If a fire occurs in an uninvaded desert setting, it burns out quickly, but if fire starts in a buffelgrass-invaded desert, it will spread rapidly as far as this fire-loving grass will carry it and grow back robustly from its roots. This combination of traits makes buffelgrass the greatest threat to our saguaros. Share the video on slide 24 from Saguaro National Park’s Test Burn so students can see how fast the fire spreads and how quickly it spreads. Ask your students if State and National Parks should be the only ones that care about the spread of buffelgrass. If they owned a home, should they care about buffelgrass and why? (Yes, because of fire danger). Show pictures on slides 25 - 26 of the desert before and after a buffelgrass invasion to show that buffelgrass is turning the Sonoran Desert habitat into a Grassland habitat.

Share the map showing other continents and countries impacted by buffelgrass. Point out the borders. Arizona has labeled Buffelgrass as a Noxious Weed, but surrounding states continue to sell

it http://buffelgrassseed.com/product-details/ (Teacher may choose to take students to this site to see where this company is located). Mexico listed Buffelgrass as a Federal Invasive Species in 2016. The South Australian Government declared buffelgrass a weed under the *Natural Resources Management Act 2004*. Buffelgrass seeds spread on the wind. They are also carried along roadways by car tires then blow into areas far from roads on the wind. (They will simulate this later when they play the Bufflegrass Game in the Elaborate section of the unit.) Scientists were some of the first people to sound the alarm about buffelgrass because of their concern for its effects on desert ecosystems. But animals and plants aren't the only ones it impacts, and scientists aren't the only ones who care. Who are the stakeholders that should care about buffelgrass? Define stakeholder and review them and how buffelgrass impacts them:

Property owners and renters: Buffelgrass fires can threaten all kinds of housing, from trailers, to apartments, to condominiums or houses. Some housing communities have a Homeowners Association, HOA, that makes and enforces rules and guidelines for a group of dwellings. HOAs may take an active role in removing buffelgrass to reduce fire risk.
Utility companies: Buffelgrass fires can damage structures that generate, deliver, and treat power and water.
Fire departments: Buffelgrass fires are dangerous for firefighters because they burn so hot, and with more buffelgrass, they can become more frequent.
Road and highway departments: Arizona Department of Transportation (ADOT) is the agency responsible for planning, building,operating and maintaining highways and roads and is involved with maintaining public transportation and municipal airports. ADOT does not want buffelgrass growing on roadsides, medians, or along airport runways due to fire danger.
Parks and natural areas: Tucson and southern Arizona have many beautiful parks and natural areas managed by different agencies including the city, the county, and the federal government. These land managers do not want buffelgrass to damage the resources they were set aside to protect.
Ranchers and farmers: In invaded areas, buffelgrass fires threaten animals, crops, and buildings.
Native American Tribes: Tucson and its surrounding areas are home to the Tohono O'odham and Pascua Yaqui tribes. The communities, rangelands, businesses, utilities, parks and highways on their nation and reservation face the same impacts from buffelgrass and have to be managed by their local agencies.
Military personnel: Southern Arizona has several military bases and installations impacted by buffelgrass.

Scientists and community members can help understand where the buffelgrass is and help other stakeholders inform decisions about how to manage and to prevent the spread of buffelgrass.

Ask the students to think about how people can solve the problem. We have ways to combat buffelgrass. Pulling it out by the roots works great for smaller or easy-to-reach areas. We can also treat it with herbicides (ask students what they know about this term and introduce definition - slide 31.) This can target large patches or patches in hard to reach areas where people can carry it in backpacks and apply it to the plants, or use vehicles or even airplanes to spray it. Laws have helped mobilize resources to fight buffelgrass (for teacher background, see link about recent federal funding to help:

https://www.kgun9.com/news/local-news/federal-funds-for-desert-museum-will-help-get-rid-of-invasive-buffelgrass). Share the video on Saguaro National Park's efforts to battle buffelgrass on slide 32. Bufflegrass will continue to be a problem - remind students of the lesson earlier on how pollen and seeds are moved from one place to another - so we all have to actively participate in the solution. Share the story of the power of volunteers. Many folks, like the Tucson Mountain Weedwackers, have kept buffelgrass at bay in special areas like Tucson Mountain Park. Even kids can help! The Desert Museum's Coati Kids Club removed buffelgrass on a patch of land near the museum for three years in a row. The first year, they removed 24 huge bags, the next, 10, and the third, only 2 (see slide 36.) Every year since, the Weedwackers go through and check, and there are barely ever any plants. The families removed the plants that produced the seeds, and removed the plants that grew from the remaining seeds, till it was manageable. Lead a class discussion on the meaning of the data of the number of bag loads of buffelgrass the Coati Club manually pulled. Students should conclude that the Coati Club's efforts were successful and greatly reduced the growth and spread of buffelgrass in that particular area. Continue through through the Slide Deck to reveal examples of positive human impact.

Elaborate (25 min)

Materials: Teacher Slide Deck, Unit 3 Troubling Traits Student Handout #1, Desert Museum Buffelgrass Game Boards printed and assembled, Desert Museum Buffelgrass Game Components and Rules printed and component plants and animals cut out, Dice for student teams, Bufflegrass Game Student Role Cards printed and cut out (optional)

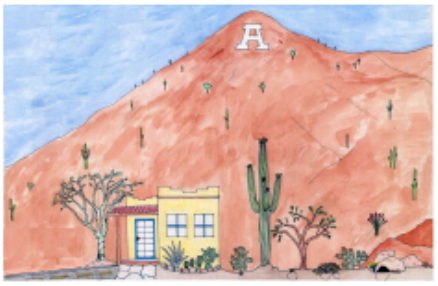
Things to consider: Students should still be observing plants they manually pollinated.

Lesson: Print and assemble the Desert Museum's Buffelgrass Game boards, print rules/plant and animal cards/student role cards (optional), and assign students to groups of 4-6 players. Assign student roles as desired. Following the game rules on the Slide Deck or the printed instructions, have them play the game in their groups for 20-25 minutes. Discuss their big takeaways, realizations, learning, and conclusions among their groups. Ask questions such as: Do buffelgrass seeds travel far from roads on the wind? Did the buffelgrass spread quickly? How hard was it to get rid of the buffelgrass? How did it impact plants and animals? etc. Have students record their learnings on page 3 of the Unit 3 Troubling Traits Student Handout #1. Then have the class revisit their predictions on the impact of buffelgrass on native animal species.

Scientists study how buffelgrass impacts animal species. Any animal that eats or relies on a native plant for its food is negatively impacted as well. In one study in Saguaro National Park, scientists measured the impact of increasing buffelgrass cover on the diversity of native plants as well as the body condition of tortoises found there. They calculated body condition by dividing each tortoise's weight by the size of its shell. Tortoises with similar shell sizes are usually about the same age, but their weights may be different, similar to how people of the same height may have different weights. Tortoises with lower body condition ratios tend to be unhealthier than those with higher body condition ratios. Share the data on desert tortoises and ask the students to consider what would cause the weight loss of the tortoises. Have the students put heads together and discuss, listening to their

thinking. The desert tortoise eats native vegetation that becomes hard to find as buffelgrass replaces native plants. Buffelgrass is not nutritious or a part of a desert tortoise's natural diet.

Teacher Instructions



This game board represents A Mountain, a famous landmark in Tucson, Arizona. It is rich in desert plants like saguaro cacti and palo verde trees, as well as many animals.

There is another plant here that isn't from the Sonoran Desert. It is called buffelgrass. People brought it here to feed cattle and prevent soil erosion, but it has become invasive. It is a threat to the desert because it outcompetes native plants for water and soil nutrients and takes over habitat that normally supports a great diversity of desert life. In addition, buffelgrass creates fuel that can carry hot, deadly fires. Most of our native plants are not adapted to fire. In contrast, buffelgrass thrives on fire. If a fire occurs in an uninvaded desert setting, it burns out quickly, but if fire starts in a buffelgrass-invaded desert, it will spread rapidly as far as this fire-loving grass will carry it.

This game shows how buffelgrass spreads, why it is a problem, and what we can do about it.

We recommend making enough sets of the game for all students in your class to play in groups of 4-6 players

Prep—

1) Print the game summary, rules, game cards and dice from the Buffelgrass Game Components and Rules template (separate document on 8.5 x 11 inch paper). We recommend printing them in color and onto card stock to make the game components last longer.

2) Cut the Animal, Plant, Buffelgrass Seeds, and Buffelgrass Plant cards out along the dotted lines.

3) Prepare dice if not using store-bought dice (one die per game set.)

4) Print the game board from this document (four panels can be printed onto11 x 17 inch sheets of paper, then laminated, or glued onto poster board.) Start overlaying the Game Board Panels at the Lower Left Panel and proceed in a counter clockwise fashion. Follow the instructions on each panel to cut out or keep edges for overlapping and adhering together. Save the Upper Left Panel for last and align the cacti and mountain edges to make the game board complete.

5) Trim outer edges to make the game board perfectly rectangular (optional.)

Play–

Have students lay out the games and follow the rules of play as listed on the Buffelgrass Game Rules sheet.

ARIZONA SONORA DESERT MUSEUM

Buffelgrass Game Rules

Buffelgrass Game Set—Up

A. Gather a team of 4-6 players.

B. Place the game board in the middle of a table for players to sit around.

C. Put the desert animal and plant cards on the table surrounding the game board.

D. Stack the buffelgrass plant and buffelgrass seed cards in the two labeled squares on the lower left side of the board.

Play Game

A. With your fellow players, place the animals and plants on the desert scene where you think they might live.

B. Take two buffelgrass plants and set them somewhere amidst the desert animals and plants. These are the only two buffelgrass plants beyond the road to start.

C. Roll the dice and place or remove buffelgrass seed and plant cards across the desert according to the number rolled as follows:

1) **Light wind blows buffelgrass seeds a short distance into the desert. (Move *two* seed cards next to each buffelgrass plant already on the board.)**
2) **Summer rain falls and buffelgrass seeds sprout into young plants. Adult plants grow tall and make lots of seeds. (Turn all seed cards on board into plant cards.)**
3) **Strong wind carries seeds across the desert. (Put *five* seed cards anywhere throughout the desert.)**
4) **Winter rain falls and buffelgrass seeds sprout; plants grow tall. (Turn all seed cards on board into plant cards.)**
5) **Fire starts and burns across the buffelgrass, charring everything in its path. Grass grows back from roots. (Keep buffelgrass where it covers the landscape. Remove any desert plants that were within an inch of the buffelgrass cards on the board, and any animals that might not escape fire nor survive without these plants.)**
6) **People clear out buffelgrass. (Remove 1/2 of the buffelgrass plant cards that are on the board and return them to the start pile. Put buffelgrass seeds cards in their place.)**

Discuss

After you play, talk about what you noticed about the challenge of buffelgrass. It's a problem we can solve! Find out how you can help at buffelgrass.org!

ARIZONA SONORA DESERT MUSEUM

Evaluate: (20 min)

Materials: Teacher Slidedeck, Unit 3 Troubling Traits Student Handout #1

Things to consider: Students should still be observing plants they manually pollinated - you will decide when observations end. Finish the unit with class discussion on the results of the students' manual pollination.

Lesson: Have students revisit the Wonder Wall and buffelgrass images from Engage part of the unit. Students reflect and share if their wonderings were answered and if they have any new wonderings they would like to post. Then lead students to revisit the Driving Question. Show the graphic on slide 56 and lead a class discussion on what the graphic is showing. After listening to students' thinking, you should explain that the larger fire sign indicates hotter, bigger fires moving down the mountain and spreading into the desert. Ask students to think and talk about why the arrow moving down is important. (This graphic illustrates what scientists predict could happen in a hotter, drier future and if buffelgrass continues to grow unabated in the desert at the foot of the mountains here. Remember how the desert ecosystem without buffelgrass is fireproof? But we sometimes get forest fires in the mountains nearby. Many Tucson students remember the Bighorn Fire in 2020. Lightning started a fire high up in the Catalina Mountains north of Tucson. Firefighters worried that it would move down the slope to the area where buffelgrass had invaded the desert and carry the fire into the communities near the mountains. Fortunately this didn't happen, but the arrows indicate that if buffelgrass makes a continuous carpet in the desert, it could carry fires from the uphill grasslands, oak woodlands, and pine forests down into the desert and nearby city.) Show slide 58 of the Catalina Mountain foothills with their buffelgrass patches. Remind students of the power of people; if we created the problem, we can solve it. Revisit how humans remove and fight buffelgrass. Students then put heads together in their groups and decide what is the best way to prevent the predicted future in the graphic from happening. Students write response on Unit 3 Troubling Traits Student Handout #1.

Wrapping up cross-pollination plant observations and units: As a quick review of their knowledge and the driving questions in Units 1 and 2, present the epilogue slides (61 - 63.) Have students' discuss their observations of the cross-pollinated plants (or their results from playing Chilicraft) and ask them how we would ensure that the traits they selected for their next generation were actually passed on. As a thought problem, if they wanted flowers to have 6 petals, how would they go about doing that? Students would need to find 2 plants with a 6-petaled flower and cross pollinate those two flowers, then plant the resulting seeds. This was how people created the lush rose blooms we appreciate in our gardens and arrangements. Wild roses have 4-6 petals. Humans selected traits over the years for bigger blooms, and domesticated roses now have ~ 45 petals.