



EDUCATION @ MESA ARTS CENTER



MESA ARTS CENTER PRESENTS
NATIONAL GEOGRAPHIC LIVE!
KAKANI KATIJA: DESIGNED BY NATURE

Ikeda Theater | February 20 | 10:15 AM | Grades: 5 - 8

2019/2020 EDUCATOR RESOURCE GUIDE



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ABOUT KAKANI KATIJA, BIOENGINEER & RESEARCH DIVER...

A former member of the U.S. International Figure Skating Team, bioengineer Kakani Katija now studies the graceful movements of life below the surface. Join her for a fascinating look at one of the least explored ecosystems on our planet—the ocean’s midwaters—and learn how its inhabitants could lead to breakthroughs in bio-inspired design.

Designers and engineers have drawn inspiration from our natural world for decades, creating innovations as groundbreaking as manned flight, and Katija’s own early work has led to energy efficient jellyfish-inspired robotics. Now, she studies little-known sea creatures that have the potential to make a big impact on some of our world’s most critical problems. As a certified research diver, Katija conducts field studies around the world, gathering data to help her develop technologies for exploring this ocean twilight zone and imagining—and creating—possibilities for the future.



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WELCOME!

Dear Educator,

Thank you for selecting a **National Geographic Live!** field trip with the Mesa Arts Center. We have a dynamic season planned and we look forward to connecting you to our many speakers and presentations. With National Geographic Live, students are able to experience dynamic presentations and make educational connections well beyond the classroom.

We also recognize and appreciate the energy and time spent on your part in coordinating field trips. In this guide we have provided information to help make this the best experience possible.

In addition, the Mesa Arts Center has many open and inviting spaces that make good places to hold a brown bag lunch. No prior arrangements need to be made.

Please contact our offices at engagement@mesaartscenter.com or 480-644-6564 should you have any additional questions.

Enjoy the show!

TEACHER AND CHAPERONE INFORMATION

Chaperones

- ♦ Assign each chaperone a designated group of students and provide him/her with a written list of the students in that group.
- ♦ Ask chaperones to stay with their assigned group throughout the field trip. Adult chaperones are responsible for the students' conduct and behavior throughout their visit to the Center.
- ♦ Please review theater etiquette rules and responsibilities with all chaperones.
- ♦ Have the phone numbers of every chaperone in your group to quickly access each other in case of emergency.

Theater Etiquette

- ♦ No Food or Drink inside the theatre (besides bottled water).
- ♦ Students must be accompanied by chaperones at all times.
- ♦ Cameras and recording devices may not be used during the performance.
- ♦ Please silence cell phones and resist the urge to text message.
- ♦ Listening and following the House Managers and Ushers will help the seating and dismissal process.
- ♦ Feel free to laugh, clap and enjoy the show but also to be respectful of those around you.



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CURRICULUM CONNECTIONS

National Geographic Live: Kakani Katija: Designed by Nature

Arizona's College and Career Ready Standards

These standards can be achieved by using the discussion questions and the STEAM lesson included in this guide.

Speaking and Listening

Grades 5-8.SL.1 — Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.

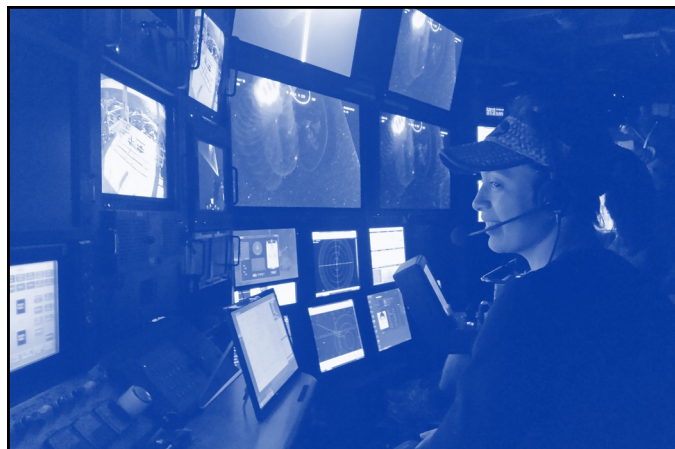
Grades 5-8.SL.2 — Ask and answer questions about key details in a text read aloud or information presented orally or through other media.

Science

SC07-S4C3-02 — Explain how organisms obtain and use resources to develop and thrive in niches and predator/prey relationships.

SC08-S4C4 -01 — Explain how an organism's behavior allows it to survive in an environment.

SC07-S4C3-03 — Analyze the interactions of living organisms with their ecosystems.



Arizona's College and Career Ready Standards

These standards can be achieved by using the STEAM lesson included in this study guide.

Math

5.MD.A.1 — Convert among different-sized standard measurement units within a given measurement system, and use these conversions in solving multi-step, real-world problems.

6.RP.A.3 — Use ratio and rate reasoning to solve mathematical problems and problems in real-world context.

7.RP.A — Analyze proportional relationships and use them to solve mathematical problems and problems in real-world context.

7.G.A.1 — Solve problems involving scale drawings of geometric figures, such as computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale.

Mathematical Practice 1 — Make sense of problems and persevere in solving them.

Mathematical Practice 2 — Reason abstractly and quantitatively

Mathematical Practice 6 — Attend to precision.



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CURRICULUM CONNECTIONS CONTINUED

National Geographic Live: Kakani Katija: Designed by Nature

Arizona's College and Career Ready Standards

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Science

Strand 1 of the Science standards lays out the Inquiry process for students in grades 5-8. Performance objective details vary by grade but the general goals of each Concept are below:

SC-S1C1 – Observe, ask questions, and make predictions.

SC-S1C2 – Participate in planning and conducting investigations, and recording data.

SC-S1C3 – Organize and analyze data; compare to predictions.

SC-S1C4 – Communicate results of investigations.

Additionally these standards support the Engineering Design Process:

Grade 5:

SC05-S3C1-02 – Propose a solution, resource, or product that addresses a specific human, animal, or habitat need.

SC05-S3C1-03 – Evaluate the possible strengths and weaknesses of a proposed solution to a specific problem relevant to human, animal, or habitat needs.

SC05-S3C2-03 – Design and construct a technological solution to a common problem or need using common materials.

Grades 6-8:

SC-S3C2-01 – Propose viable methods of responding to an identified need or problem.

SC-S3C2-02 – Compare possible solutions to best address an identified need or problem.

SC-S3C2-03 – Design and construct a solution to an identified need or problem using simple classroom materials.

Speaking and Listening

Grades 5-8.SL.4 – Present claims and findings, sequencing ideas logically and using pertinent descriptions, facts, and details to accentuate main ideas or themes; use appropriate eye contact, adequate volume, and clear pronunciation.

21st Century Learning Skills

By using the STEAM lesson included in this guide, students can become more proficient in the following Competencies:

- Critical Thinking
- Creativity
- Communication
- Collaboration





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DISCUSSION QUESTIONS

Pre-Performance Discussion Questions

Kakani Katija's presentation is titled *Designed by Nature* and specifically focuses on nature that is underwater. In particular, Kakani has done a lot of research on jellyfish. What do you already know about jellyfish? What might you want to learn about jellyfish?

Kakani Katija originally wanted to be an astronaut and even trained as an aerospace engineer, but ultimately became fascinated with the undiscovered depths of the ocean during her college experience. What are you interested in as a career? Are you open to your life taking an unexpected career path?

Kakani Katija trained as a competitive figure skater for about 15 years and was part of the US International Figure Skating team as an ice dancer with her brother. Although an injury and grad school caused her to discontinue with the sport, she credits her work ethic, stubbornness, and ability to focus on the end goal to all those years of training. Are you involved in a competitive sport? What can involvement in a sport training program teach you?

Post Performance Discussion Questions

What was something surprising or interesting you learned from Kakani Katija's presentation on underwater technologies and research diving?

In what ways did Kakani Katija demonstrate curiosity, responsibility, empowerment, and persistence in her work? Why do you think these attitudes are important for explorers?

Did Kakani Katija make any call to action to support her work? Are there any changes we can make in our day to day lives to support people or animals in crisis? What can we work on together as a group?



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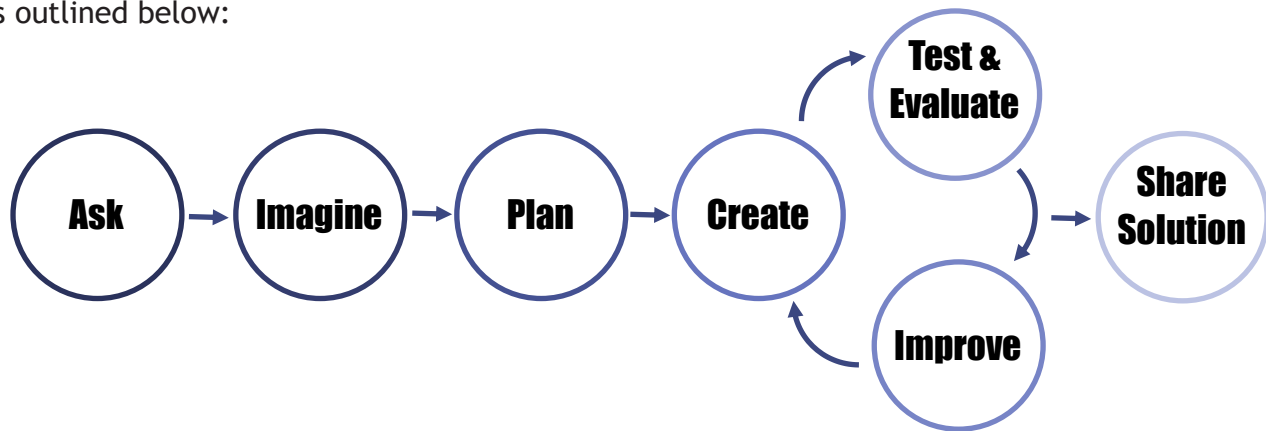
WHAT IS STEM?

STEM is a common buzzword in education these days, so it is important to know what exactly STEM is, and also what it is not. A true STEM lesson not only incorporates different subject areas, but also works to develop students' abilities to think creatively, reason, investigate, and work as a team. Here is a breakdown of what STEM means:

| S Science | T Technology | E Engineering | M Math |
|---------------------------------|---|--|---|
| The study of the natural world. | While traditional digital technology meets this part of STEM, technology is any product made by humans to meet a want or need. Any product created by students to solve a problem can be considered technology. | The design process students use to solve problems. | The study of numbers, equations, functions, and geometric shapes and their relationships. |

A science experiment is not necessarily a STEM lesson. The requirements below need to be met as well for a lesson to be STEM based learning:

- The lesson focuses on a real world problem/issue.
- Students are working in productive teams.
- Students are engaging in hands-on inquiry and open-ended exploration. Students should be able to redesign as needed (within time constraints) so there should not be an exact end product/result predetermined by the teacher in mind.
- Students understand that there are multiple right answers to the posed problem and that failure can be used to reevaluate and make changes towards discovering a solution.
- The lesson uses the *engineering design process (EDP)*. EDP is similar to the scientific method and is outlined below:



- Adding any type of art component to the lesson changes STEM to STEAM.



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BIOMIMICRY STEAM LESSON

Kakani Katija contributes to scientific research by studying little known sea creatures that can lead to bio-inspired design. Some of her early work led to jellyfish inspired robotics. This is not a practice that can be replicated in the classroom naturally, but students can explore the related study of biomimicry. “Bio” means life and “mimicry” means to copy or mimic, so biomimicry is the study of animals and how their natural adaptations can be mimicked in the human world to create efficiency and sustainability.

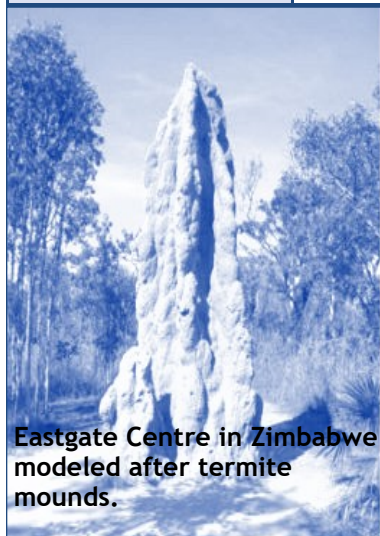



| | |
|-------------------------------------|---|
| ASK (REAL WORLD PROBLEM) | <p>As the world becomes more crowded and ecological concerns intensify, building efficient homes with sustainable materials is increasingly important. Animals build homes uniquely suited to their environment and survival needs. Through the study of biomimicry, we can look at how animals build their homes and see if any of the features that make them most successful can be adapted to human homes or buildings. To help students understand biomimicry you can share some of the examples on page 10. Ask students, “Can you create a scaled model of a building or home that mimics at least one desirable quality of a vertebrate’s home?”</p> |
| MATERIAL POSSIBILITIES | <p>Students will need a variety of materials to choose from to create their building model. Cardboard, paperboard from food boxes such as cereal boxes, plastic cups, construction paper, index cards, paper bags, aluminum foil, paperclips, string, pipe cleaners, tape, glue, scissors, etc. To take this from a STEM to a STEAM lesson, give students access to crayons, colored pencils, markers, paint, or other art materials to add their artistic touch to their building model.</p> |
| IMAGINE & PLAN | <p>After students have been grouped and presented with the problem, they will need to decide on which class of vertebrate they are going to research to create their building model. Encourage groups to pick different animal classes so that there are a variety of building models. Things to consider when designing your building model: What are the advantageous features of your animal’s home? What type of person or group can benefit from a house modeled after this animal class? What biomimicry design elements can you incorporate that can make the building more efficient? Are you choosing materials that your teacher is able to acquire? Students should sketch out their building design <i>to scale</i> before moving on to the create stage.</p> |



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BIOMIMICRY STEAM LESSON

| | |
|--|---|
| <p>CREATE</p> | <p>After presenting their design sketch and explaining the design choices to their teacher, students can create their building model as long as the materials are available to them. If after presenting the design plan, the students are informed that a material is not available to them they will need to reevaluate their plan and revise it to work with available materials. Remind students that they should be measuring materials to match their scaled design so that they are not using more than necessary or being wasteful with materials. If you are incorporating art into this lesson, offer students materials to add their personal aesthetic flair to their building model.</p> |
| <p>TEST, EVALUATE, & IMPROVE</p> | <p>Since students will not actually be able to test these as true buildings, instead they can present their building to at least one other group. Students should explain design choices and detail how the building's design incorporates biomimicry for their chosen animal class. The other group can provide constructive feedback and then, in turn, present their design for feedback as well. Then provide time for groups to improve their design if needed based on the feedback they received.</p> |
| <p>SHARE SOLUTIONS</p> | <p>Once the building models have been explained, evaluated, and improved if needed, students can present their final products to the class. Each student in the group should have a role or part in the presentation. The class can discuss any factors that may contribute to the success or failure of each building model.</p> |
| <div>  <p>Eastgate Centre in Zimbabwe modeled after termite mounds.</p> </div> <div>  </div> | <p>LITERACY CONNECTIONS</p> <ul style="list-style-type: none"> • Students could also write a research paper about an animal home. They should include information about where the home is located, what materials it is made of, and any special features of the home. • Students can write a narrative about an animal who has a problem with his home and seeks help from other animals. |



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BIOMIMICRY EXAMPLES

Give your students an introduction to Biomimicry by watching Janine Benyus (the co-founder of the Biomimicry Institute) give a short explanation in this video, “What is Biomimicry?”:

<https://www.youtube.com/watch?v=FBUpnG1G4yQ>

Here are some examples of biomimicry in nature:

- Radar and sonar navigation technology and medical imaging inspired by the echo-location abilities of bats
- Swimsuit, triathlon and bobsled clothing fabric made with woven ribbing and texture to reduce drag while maintaining movement, mimics shark’s skin
- Adhesives for microelectronics and space applications inspired by the powerful adhesion abilities of geckos and lizards
- Water filters designed like animal cell membranes to let certain things pass through while others are kept out
- Running shoes with technology learned from studying the mechanics of animal feet
- Super strong and waterproof silk fibers made without toxic chemicals by spiders
- Underwater glue for slippery surfaces, as made by mussels
- Anti-reflective, anti-glare film used for flat panel displays, touch screens, lamps, and phone and PDA lenses replicates the nano-structures found in the eyes of night flying moths
- A better ice pick for mountain climbers designed after the woodpecker.
- Glow sticks made with light-up chemicals, just like fireflies
- Very efficient pumps and exhaust fans applying the spiraling geometric pattern found in nautilus sea shells, galaxies and whirlpools
- Hook and loop material (Velcro©) inspired by cocklebur plants
- A wind-driven planetary rover design that maximize drag, learned from the tumbleweed
- Self-cleaning exterior paint, tiles, window glass and umbrella fabric inspired by the slick leaves of the lotus flower plant and its natural ability to wash away dirt particles in the rain
- Reduced-drag propeller designs inspired by the spiral shape of kelp, which moves with the current rather than fight it, so much less energy is required to move water or a ship





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BIOMIMICRY LESSON GROUP PLANNING SHEET

Group members: _____

Chosen vertebrate class: _____

GATHER INFORMATION

Before brainstorming ideas, research at least 3 animals from your animal class and record information about their homes. Try to find at least 4 important features about each animal home so that you have plenty of information when it is time to brainstorm.

| Animal | Type of Home or Shelter | Important Features |
|--------|-------------------------|--------------------|
| | | |
| | | |
| | | |



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BIOMIMICRY LESSON GROUP PLANNING SHEET

BRAINSTORM IDEAS

After your group has enough information, brainstorm together following these rules:

- Only positive comments
- Encourage wild ideas
- Write down all ideas
- Build on the ideas of others
- Stay focused on the topic

Record your ideas here:

CHOOSE A DESIGN

After discussing all the ideas, choose the design that is the most promising and can be made with the materials at hand. If the group wants to choose an idea that needs a material that is not available, you can ask your teacher to see if the material might be made available. Write a description of your design here:

SKETCH DESIGN

On a separate piece of paper, draw a sketch of your idea. Include the dimensions of the actual size the building would be as well as the scaled sizes that you will need to build your model.

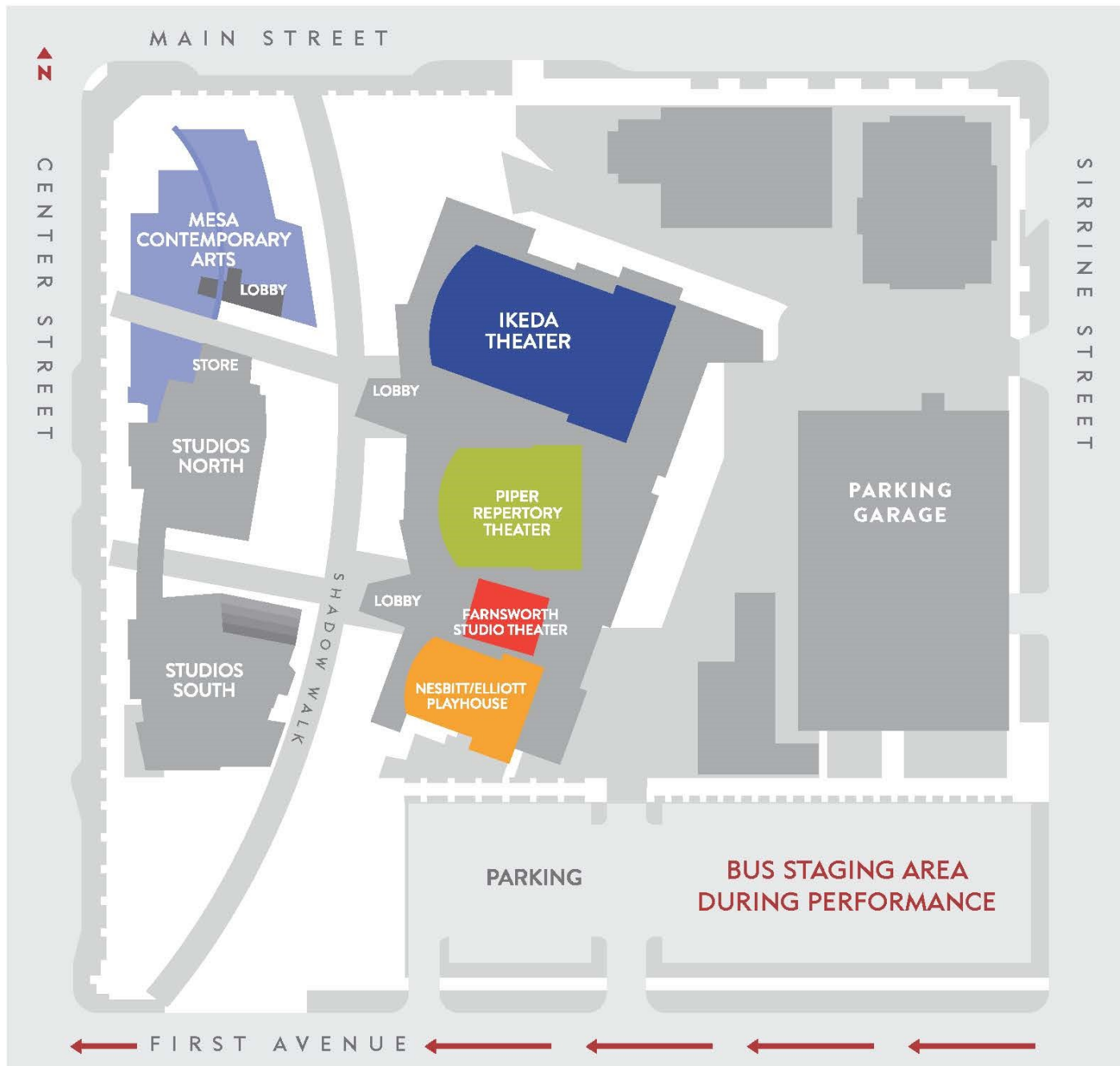
MATERIALS NEEDED

List all the materials you will need to complete your building model.

BUS PARKING MAP



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STEPS TO UNLOAD

- 1 Enter the drop off area by coming in westbound on 1st Avenue.
- 2 Pull up to the curb marked with cones and wait until notified to unload passengers.
- 3 Await parking direction from MAC security

STEPS TO PICK UP

- 1 Passengers will exit the theater and meet buses in the bus parking lot area.
- 2 Wait for clearance to depart.



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SHARE YOUR EXPERIENCE!

We'd love to hear your students' response to our shows.
We especially appreciate pictures and letters!

THANK YOU!

Questions? Please contact Engagement at:

P 480-644-6540 | F 480-644-6503

engagement@mesaartscenter.com