Activity 1:

Design a Park

Overview

Participants are invited to imagine the park of their dreams! In small groups, they place moveable pieces on a grid, iterating on their plan together to create a plan for a community park. A variety of park features are offered as choices to include on the map, including a playground, skate park, water features, picnic areas, trails, and more. Like real-world projects, the plan is limited by the realities of space and funds. For younger children, groups are limited to choosing less than 10 features. Children ages 9 and up are limited not by the *number* of features, but by their *cost* in terms of points: They are challenged to keep track of the points on the park features cards and use less than 250 total points. Some park features, including a natural wetland and ice cream shop, promise to provide revenue back to the community and are worth points. Others, like a skate park or swimming pool, "cost" points.

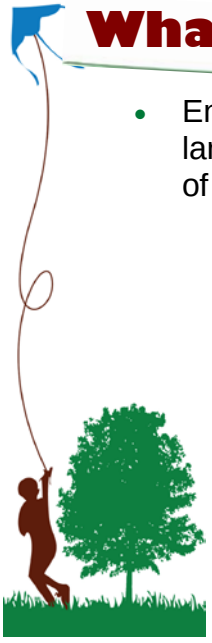
Activity Time:

30 minutes to one hour

Intended Audience:

Families or other mixed-age groups, including children ages 5–7 *with assistance from an older child, teen, or adult*
School-aged children ages 8–9
Tweens up to age 11

What's the Point?

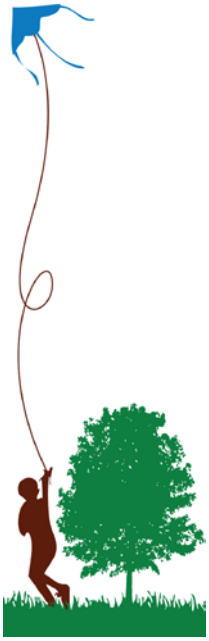


- Engineers work to provide the infrastructure that supports the way we live. On a large scale, engineers create urban infrastructure. They perform the same kinds of work on a smaller scale to build community parks. They:
  - Plan how we will move between areas and build the needed trails or paths;
  - Supply electricity for lights along the trails or bike paths, in the restrooms, and at other buildings like ice cream shops, as well as for powering filters for water features (and heated pools).
  - Provide clean water for water features;

  - Remove used water from restrooms and drinking fountains, redirect storm water, and dispose of trash; and
  - Design structures and controls to maintain healthy wetlands, streams, and ponds.
- There are limitations to what engineers can achieve in designing a park, including available space and funds.
- Participating children, tweens, and adults, like engineers, can plan a community park through the creative process of brainstorming about a problem and factors they have to consider to solve it.

Facilitator's Note: Young participants in this activity are potentially the next generation of engineers, and those engineers will face an array of pressing challenges identified by the National Academy of Engineering as Grand Challenges for Engineering. "Restore and improve urban infrastructure" is one of those challenges. Engineers of the 21st century must work to improve the systems that support our communities (such as transportation and energy, water, and waste systems). These systems must also use energy wisely and be better for the environment.

Similar challenges are reflected in this activity, which considers several basic aspects of infrastructure — set in the kid-friendly context of imagining and designing the community park of their dreams!



Materials

For the Facilitator

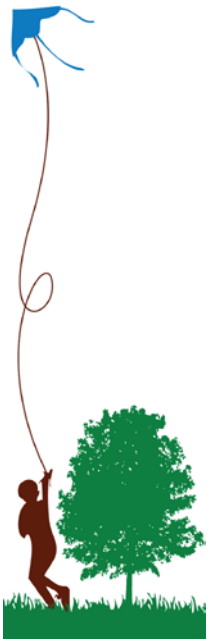
- ☐ *Implementation Guide* (available at www.starnetlibraries.org), which includes:
  - ☐ *Playful Building's* key features
  - ☐ Annotated facilitation outline
  - ☐ Facilitator background information
  - ☐ Shopping list
  - ☐ Extended supporting media suggestions
  - ☐ Correlations to National Science Education Standards
  - ☐ Contact information
  - ☐ STAR_Net project overview
  - ☐ Credits and acknowledgments
- ☐ *Brief Facilitation Outline* page
- ☐ *Playful Building* PowerPoint presentation (or the instruction slides printed for the groups to use) (available at www.starnetlibraries.org)

Facility Needs

- ☐ Optional: computer, speakers, projector, projection screen, and access to the Internet
- ☐ 6 or more small tables, each with 4 or more chairs

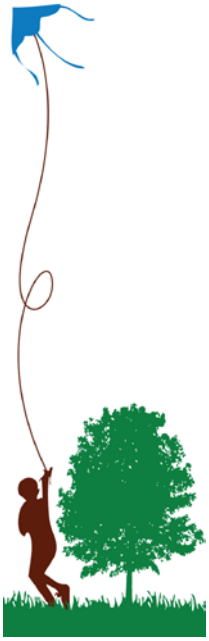
For Each Family/Small Group of 3–4 Participants

- ☐ 1 park map set, which includes:
  - ☐ 1 (27" × 17" or so) blank sheet of graph paper (with 1-inch square rule) (which is half of a 27" × 34" sheet, available from a retailer such as Staples.com)
  - ☐ 1 (8½" × 11") set of *Park Features*, preferably printed on cardstock at actual size, and cut into individual pieces
  - ☐ 1 (44") length of brown, tan, or gray yarn
  - ☐ 1 pair of safety scissors
  - ☐ 10 yellow pony beads in a small container (such as a cup or baggie)
  - ☐ 1 calculator



For Each Group of 15–20 to Share

- ☐ 1 (8½" × 11") *Be Creative…Be an Engineer!* poster (for tweens, teens, and adults), preferably printed in color
- ☐ Optional: 1 (8½" × 11") *Grand Challenges of Engineering* poster (for teens and adults)
- ☐ Optional: coloring supplies



Supporting Media

Consider setting up a digital media player (such as a computer), speakers, and access to the Internet to display videos, images, podcasts or websites before, during, or after the activity.

A more extensive list is included in the *Implementation Guide*.

Online Resources

Tillery Park
www.tillerypark.org
Tillery Park was renovated in 2007 thanks to community-based efforts. Read about the design stage and the costs and placement of playground equipment in the "playground" tab. Find similar projects through the designer's website: www.leathersassociates.com.

Engineer Your Life: Civil Engineer Erin Fletcher
www.engineeryourlife.org
This guide to engineering offers videos, photos, career stories, and personal "tidbits" for each of 12 engineering professionals. For example, Erin Fletcher enjoys managing the diverse talents on her team as they work to develop bridges and barriers that reduce traffic noise — taking both the technical aspects, as well as the aesthetic, environmental, political, and community needs, into account. Appropriate for ages 8 and up.

NMSU Engineers Without Borders Builds Bridge in Nicaragua youtu.be/PNHe0AsmgFQ
The Engineers Without Borders chapter at New Mexico State University constructed a pedestrian suspension bridge in a small Nicaraguan community, which will allow children to cross the river to attend school — even during the rainy season. Appropriate for ages 8 and up.

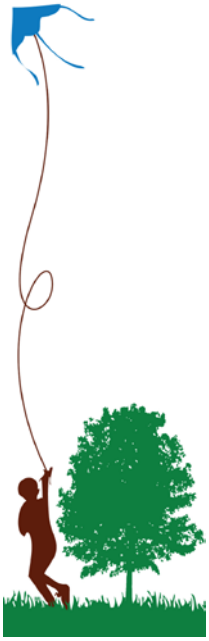
Student Work: Engineers Without Borders, Sierra Leone
www.princeton.edu/main/news/archive/S35/77/44O86/index.xml?section=featured
The Engineers Without Borders chapter at Princeton gathered information in Sierra Leone during the initial stages of an infrastructure redevelopment project in one of the villages, addressing access to clean water and sanitation as well as providing safe bridges.

Grand Challenges for Engineering
www.nae.edu/Activities/Projects/grand-challenges-project/Videos_grandchallenges.aspx
National Academy of Engineering videos provide insights into the Grand Challenges for Engineering, and include interviews with engineering professionals. Appropriate for ages 10 and up.

"Security"

Report Card for America's Infrastructure
www.infrastructurereportcard.org/
The American Society of Civil Engineers offers a series of videos that feature interviews with engineers and descriptions of how certain cities are updating their aging water systems, levees, and transportation. Appropriate for teens and adults.

Facilitator's Note: Adults participating in this activity may be interested in submitting further conversations about your community's infrastructure. Encourage them to visit the "Restore and improve urban infrastructure" section of engineeringchallenges.org and participate in the fully moderated discussion around the question, "What infrastructure challenges face your community?"



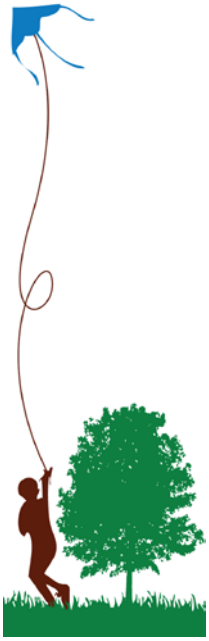
Preparation

Before the day of the activity

- ☐ Use the *Implementation Guide* to determine the setup of your engineering program(s), organize and prepare your presentation, and help you collect the materials.
- ☐ Prepare publicity materials for these or any other future engineering and technology programs.
- ☐ Optional: Incorporate the *Playful Building* PowerPoint presentation into your facilitation plan. Modify the presentation to suit your needs.
- ☐ Collect and prepare the materials.
  - ☐ Provide a 27" × 17" or so blank sheet of graph paper with 1-inch square rule for each group to represent about an acre of land. (The length of a 1-inch square is equal to 30 feet or about 9 meters.) Cut large 27" × 34" sheets of graph paper in half.
  - ☐ Print the *Park Features* cards at actual size (ensure that "fit" and "shrink oversized pages" are *not* selected when printing). Cut the cards into individual pieces.

The day of the activity

- ☐ Set up the facility.
- ☐ Set out the materials.
- ☐ Print the *Brief Facilitation Outline* page, which integrates the steps of the activity with the annotated facilitation outline presented in the *Implementation Guide*, to use as presentation notes.
- ☐ Provide access to any supporting media and the *Playful Building* PowerPoint presentation (or printed copies of the instructions slides for this activity).
- ☐ Set out the *Grand Challenges* page and the *Be Creative* poster (or hang them on a nearby wall).



Activity

1. Ask questions to facilitate a conversation about what real-world limitations engineers face — including space and money — in building community parks and other projects.

Facilitator's Note: If teens and/or adults are present, offer the *Grand Challenges of Engineering: Restore and improve urban infrastructure* card as a source of further information.

2. Optional: Use the supporting media to explore how engineers are designing, building, testing, and modifying urban infrastructure and, on a smaller scale, community parks.
3. Challenge the participants, working in groups, to brainstorm, discuss, and ultimately map their ideas for the community park of their dreams! Show a copy of the grid and explain how the features are to be arranged on it:
    - The features are depicted to scale. Make sure they fit on the grid!
    - Visitors have basic needs! The park must include restrooms.
    - Visitors must be able to get from one area to another: Connect the different areas by cutting the yarn and using the pieces to represent trails or bike paths.
    - Design a safe place to play — add yellow beads along the paths to represent the locations of lights.
    - Provide age-appropriate limitations on the number of features that can be included in the park.

    Allow time for questions.

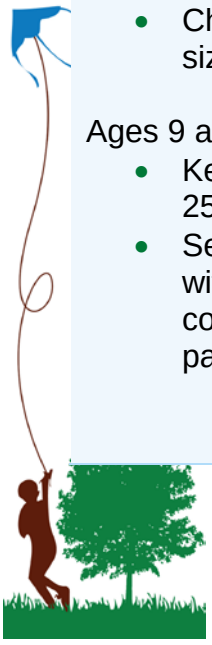
Facilitator's Note: Like all engineering projects, each groups' community park has a "budget."

Ages 5 to 8

- Choose 10 or fewer park features to include on the map (in a way that fits the size of the grid!).

Ages 9 and up

- Keep track of the points on the park features cards and keep the total under 250 points.
- Select either "inexpensive" park features, or include a balance of park features with positive and negative point values. Park features cost money for the community to build and maintain, but some features offer benefits that fully or partially recoup costs:
    - The ice cream shop and boat rental shop earn revenue for the community.
    - Wetlands not only attract a multitude of wildlife to the park, they also serve



two important functions:

- Wetlands act like a sponge, taking on water from the surrounding area. Wetlands can even store floodwaters.
- Wetlands help clean surface waters. Water tends to slow down when it enters a wetland. Like in a snow globe, particles settle out of the water when it becomes more still. The particles can include sediment, chemicals, and excess nutrients (which could otherwise lead to algae blooms in lakes or oceans downstream). Wetland plants and microbes take up or begin to degrade chemicals.

- Preserving undeveloped land as open space was assigned slight earnings.
- While trees cost money to plant and maintain, they offer multiple benefits, including shade, cleaner air, and protection from erosion, so they are worth "0" and do not affect the total number of points.

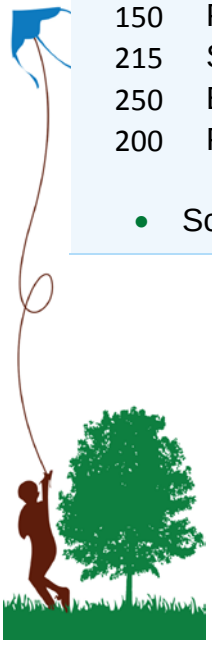
These features "cost" points for the community to build and maintain:

10	Pond
15	Ball Courts (such as for basketball or tennis)
15	Dog Park
20	Water Playground
30	Swimming Pool
30	Stream and Footbridge
30	Trail/Bike Paths
50	Community Garden
75	Picnic Area
90	Restrooms and Drinking Fountains
150	Playground
215	Skate Park
250	Baseball Diamond
200	Parking Lot

These features offer additional benefits to the community — they help reduce the group's total number of points:

–1	Wind Turbine Generating Electricity
–30	Boat Rental Shop, Boat Slip, and Pond
–30	Wetland
–85	Open Space
–300	Ice Cream Shop

- Scale: the length of one (1-inch) square is equal to 30 feet (or about 9 meters).



4. Break into groups (with three to four people each) and begin. Encourage each family to work together as a group — parents too!
5. Guide the children through the initial engineering design process, using conversation and brainstorming to think of a plan.

Facilitator's Note: The individuals may have different ideas about what features their group should include in the design. Encourage them to explain their ideas to each other and decide together which features should be included. Prompt the groups to converse with the following questions:

- What features would you like to have? Should there be a playground? What type of water features should there be: perhaps a pond or a swimming pool? There are many options, but there is limited space and money available.
- What features are necessary? What things do people need to have there to be healthy and safe? Your park must include restrooms.
- How will people move from one area to another? Where will you need to place the trails or bike paths?

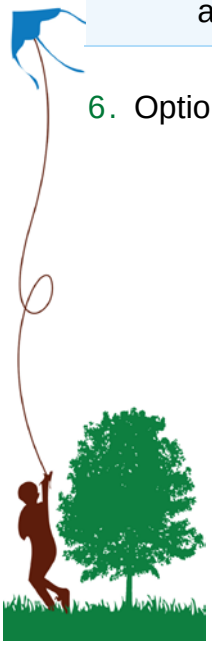
Connect back to the participants' experiences by inviting them to think of the parks that they have visited.

- What kinds of things could you do for fun there? What did you enjoy the most?
- What did you use to get from one area to another — perhaps a trail or bike path?
- What kinds of things did the park need to have there in order for you to be comfortable?
- Were there restrooms? Were there picnic tables where you could eat?

Toward the end of the activity, begin to challenge the groups to make improvements to their plans:

- What are some ways to make your park design more energy-efficient? For example, a fountain or swimming pool requires the use of energy to run the water pumps. Is there a feature that is still fun, but requires less energy?
- Are you able to include some features that help improve the environment, such as wetlands, which hold and clean water?

6. Optional: Have each group present their final plan to the entire audience.



Extensions

Build a *Real* Playground, Community Garden, or Entire Park

Design a Park opens the discussion for organizing a community effort to plan, design, fund, and build a community park. Consider taking the *Playful Building* module to the next level: Encourage teens and adults to build all or part of the components of the community park!

Research Ways to Improve the Park Plan

Invite tweens, teens, and adults to modify their plans based on further information. Have them research choices and incorporate aspects that will use more renewable energy, be easier for park visitors to navigate, include environmentally-friendly features, or cost less to install and/or maintain. Prompt their research with questions such as:

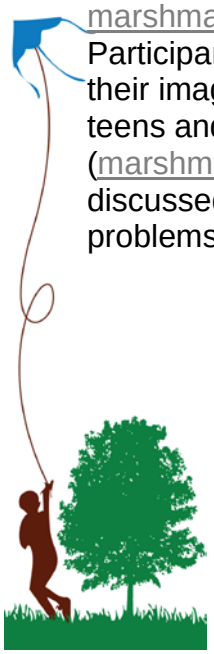
- What material will be used for the playground base? Concrete? Recycled tires? Grass? Dirt? What are the benefits, drawbacks, costs, and environmental impact of each?
- What plants will be planted? What native plants can be incorporated? How will the plants be kept up? What are the benefits, drawbacks, costs, and environmental impact of each?

Have the participants align their choices and research with infrastructure decisions that engineers need to be make with such a project. Have teens and adults refer to the *Grand Challenges of Engineering: Restore and improve urban infrastructure* poster.

Additional Activities

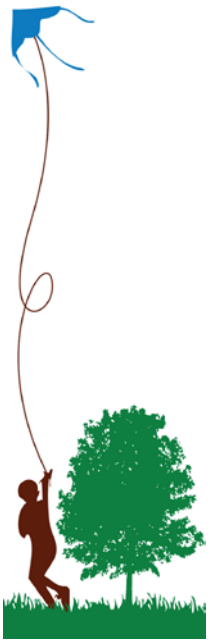
Allow additional time, per the instructions provided on these external websites, if incorporating these activities.

Marshmallow Challenge
marshmallowchallenge.com/Instructions.html
Participants work in groups to build a structure — perhaps a feature they'd like to include in their imagined community park — out of spaghetti and balance a marshmallow on its top. With teens and adults, consider showing the TED 2010 talk, "Marshmallow Challenge" (marshmallowchallenge.com/TED_Talk.html) and using the design process concepts discussed there to launch a discussion about engineering and ways to tackle the world's problems. Appropriate for children ages 6 and up.



Peppy's Day in the Park
www.cmhouston.org/attachments/contentmanagers/45/peppy.pdf
Children ages 8 and up make perimeter and area calculations in the context of seeing how far Peppy, an imagined dog, will walk around the perimeter and run within the whole space of the park.

Math by Design
mathbydesign.thinkport.org
Produced by a national public television collaborative, the online game "Flossville Town Park" incorporates geometry and measurement in the fun context of designing a town park. Appropriate for middle-school students taking Algebra I and II.



Brief Facilitation Outline

Introduction

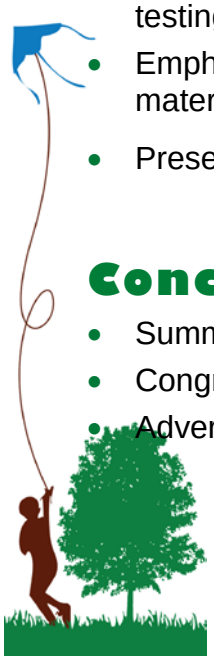
- Introduce yourself and the library.
- Frame the activity with the main message: Engineers work to solve the basic challenges of life — including having fun!
- Conversation:
  - Ask open-ended questions about things we need for *enjoyment* in life.
  - Discuss examples of the systems (infrastructure) that engineers design and support for our cities and parks, e.g., how people move, access clean water and electricity, and remove waste.
  - Ask questions about some real-world limitations to engineering and park design: space and money.

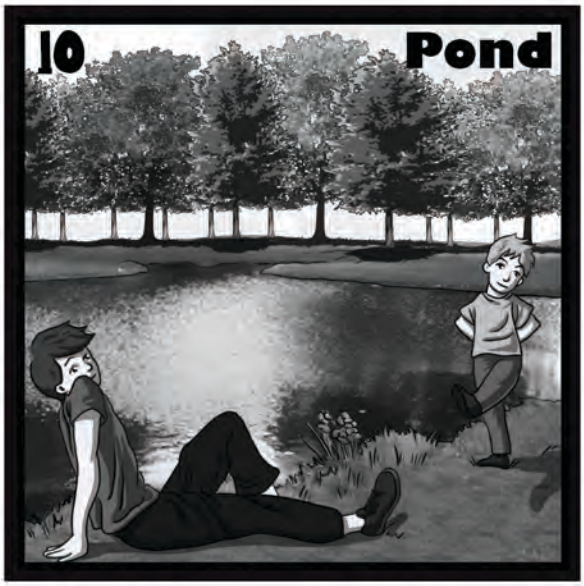
Activity

- Use supporting media to explore how engineers are designing, building, testing, and modifying urban infrastructure/community parks (optional).
- Challenge (in groups of 3–4; parents too!): brainstorm, discuss, and ultimately map a community park that:
  - Fits on the grid,
  - Includes restrooms,
  - Has different areas connected by yarn pieces (i.e., trails or bike paths) with yellow beads (lights) along them,
  - Has EITHER 10 or fewer park features (with ages 5 to 8) OR the total points add up to 250 or less (with ages 9 and up).
- Encourage persistence: successful engineering involves a process of thinking, building, testing . . . and doing it again!
- Emphasize the engineering design process; encourage groups to methodically test one material at a time.
- Present the final community park plans (optional).

Conclusion

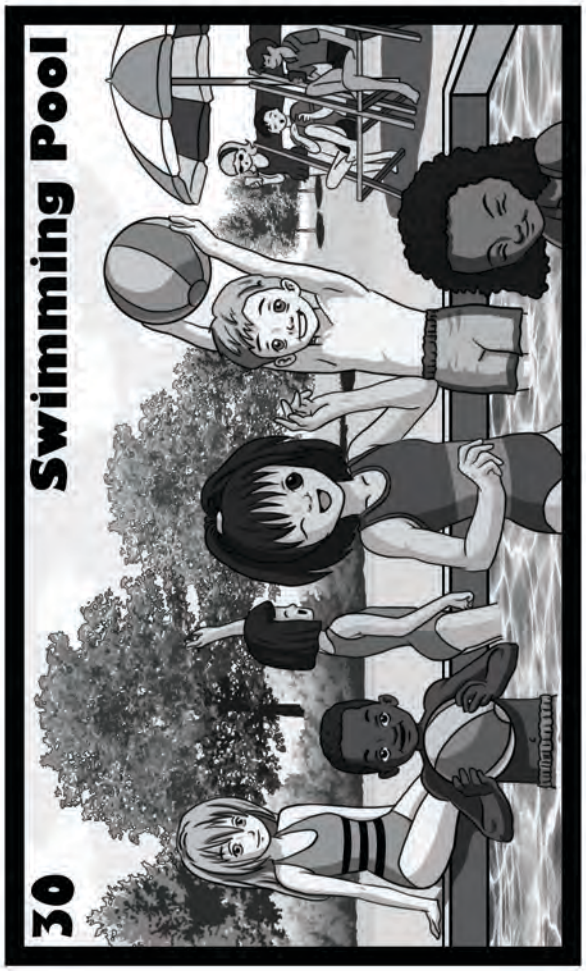
- Summarize the groups' explorations of how engineers solve life's challenges.
- Congratulate the groups on their accomplishments.
- Advertise any future engineering and technology events.

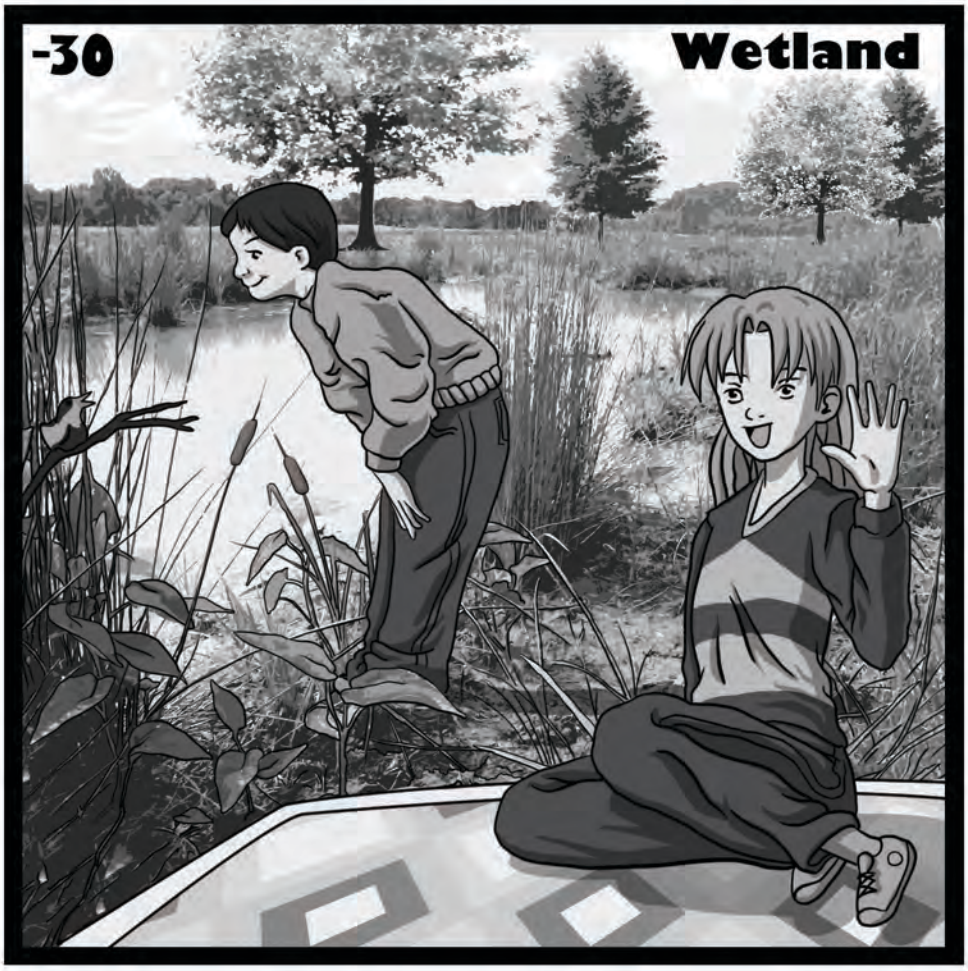



10
Pond

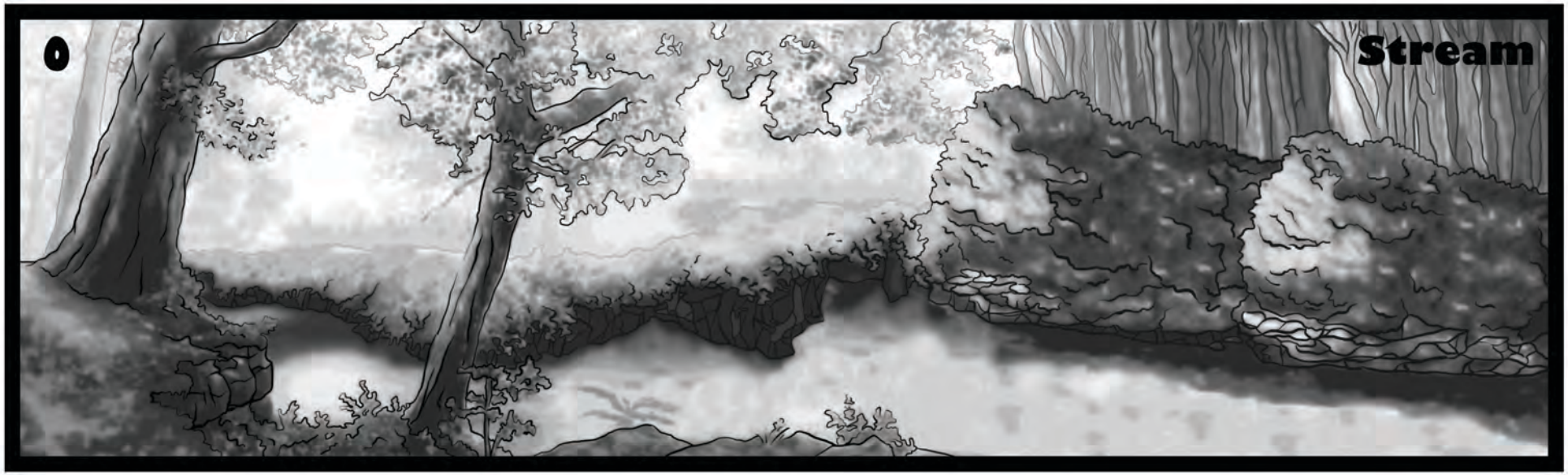

20
Water Playground


-30
Foot
Bridge


Swimming Pool
30

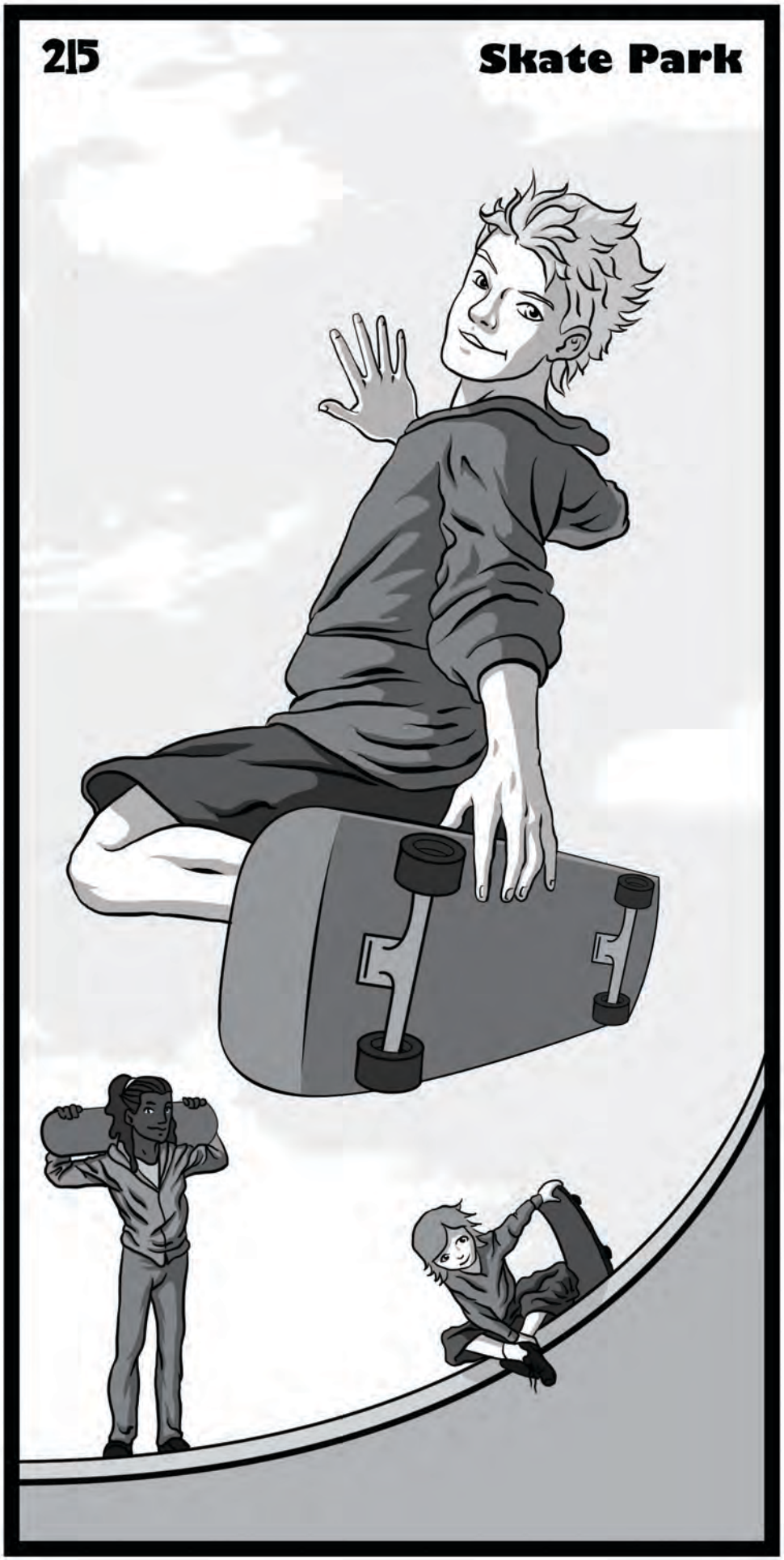

-30
Wetland

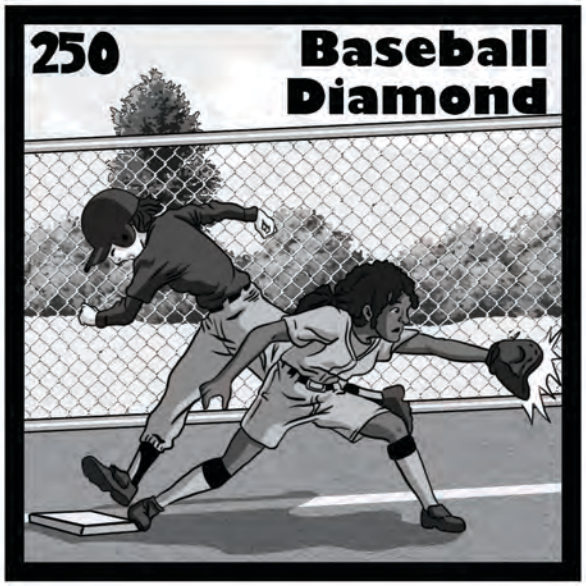

-30
Boat Rental Shop,
Boat Slip, And Pond

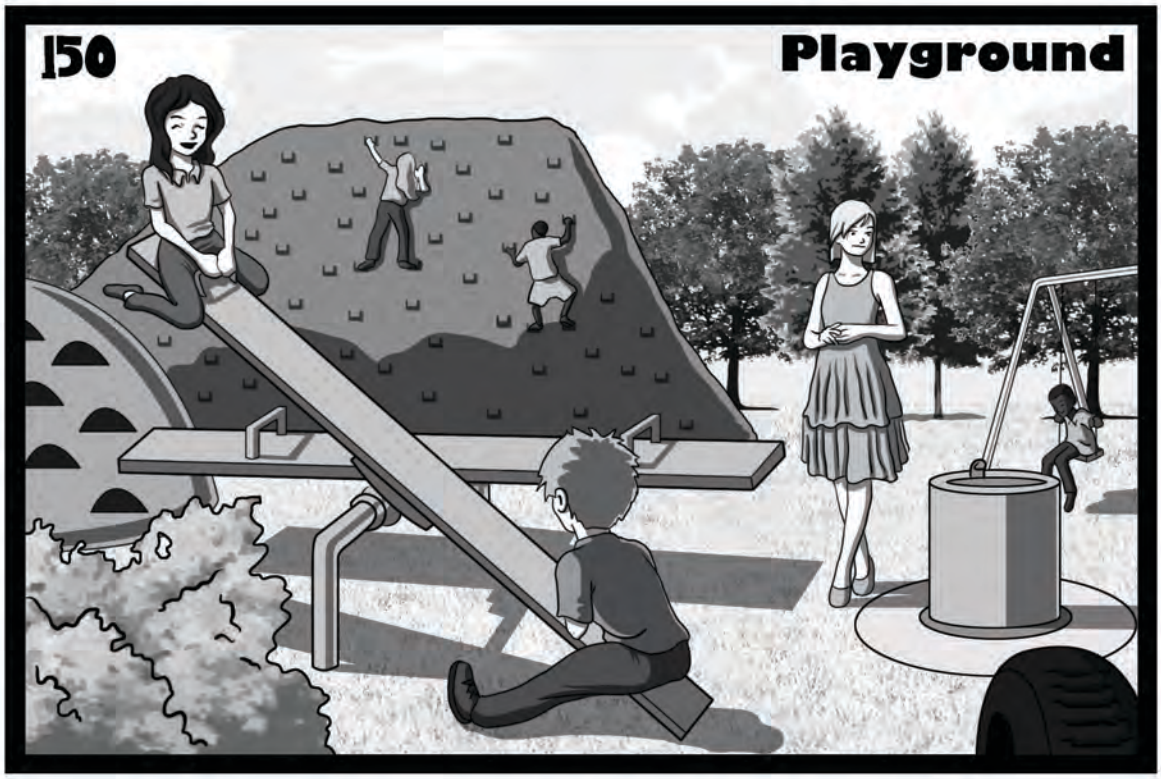

0
Stream

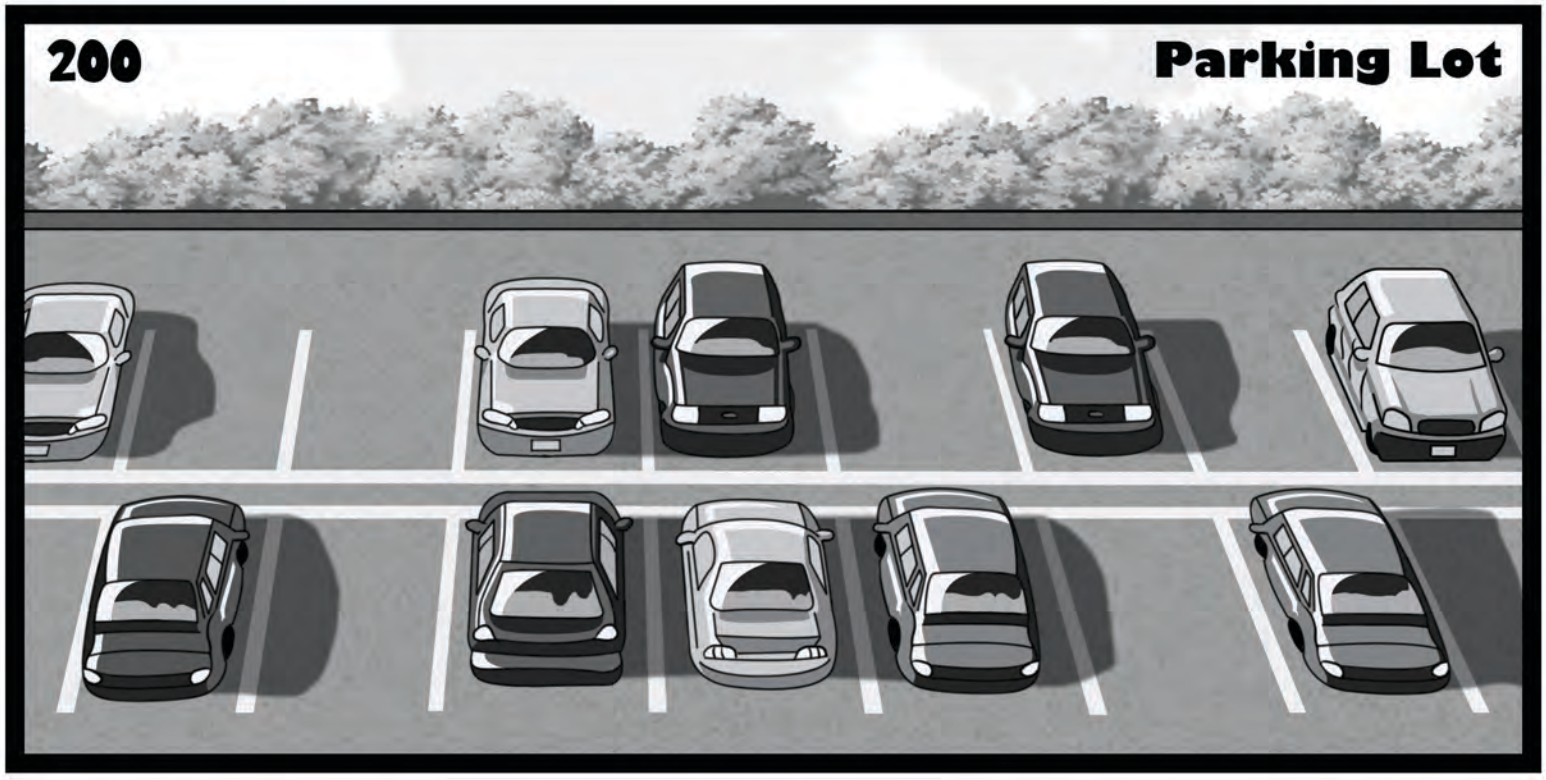

0
Stream


15
Basketball Courts

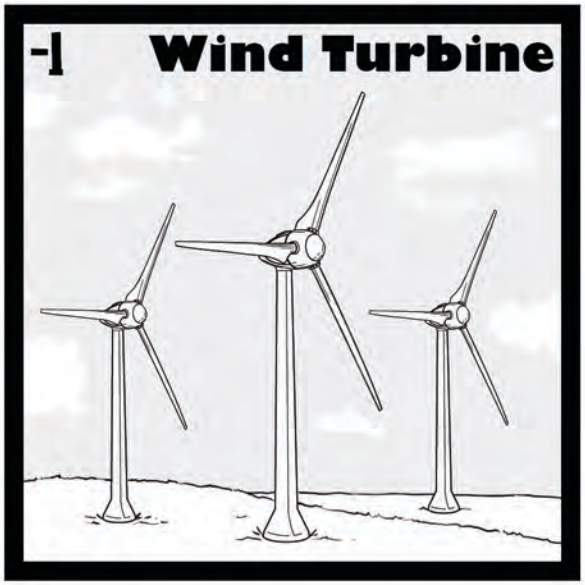

215
Skate Park


250
Baseball
Diamond


150
Playground


200
Parking Lot


-90 Restrooms
Restrooms


-1
Wind Turbine

0 **Shade Tree**

0 **Shade Tree**

0 **Shade Tree**

-85 **Open Space**

15 **Dog Park**

0 **Shade Tree**

-50 **Community Garden**

0 **Tree**

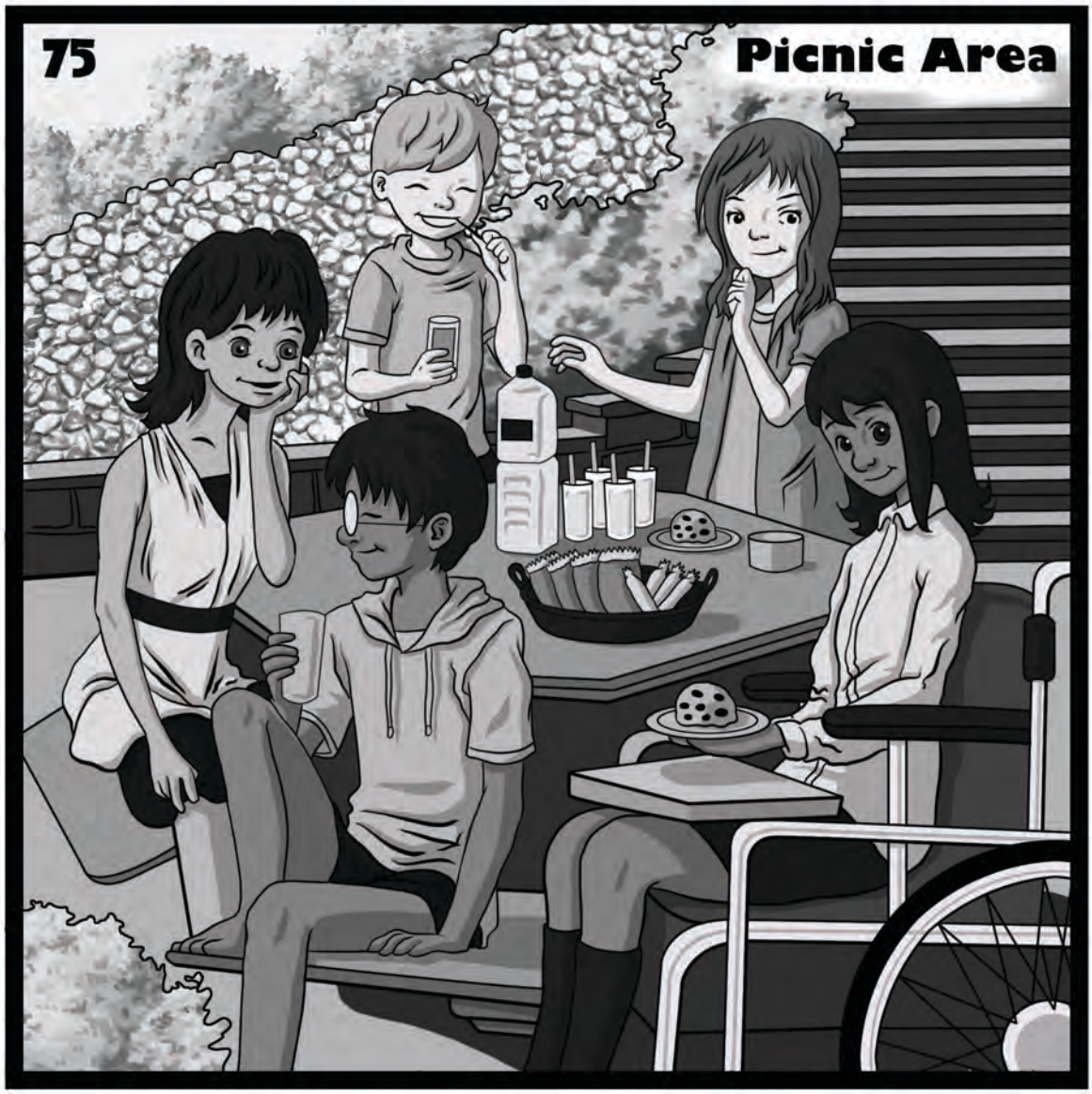
0 **Tree**

0 **Tree**

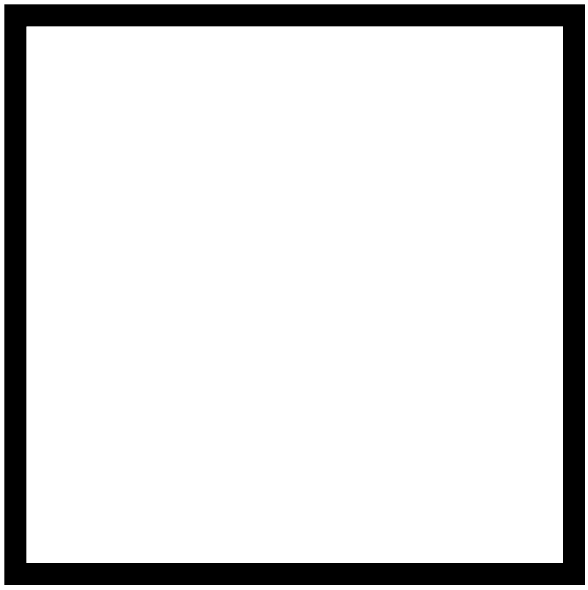
0 **Tree**

0 **Tree**


-300 Ice Cream Shop


75
Picnic Area

Create your own park features!

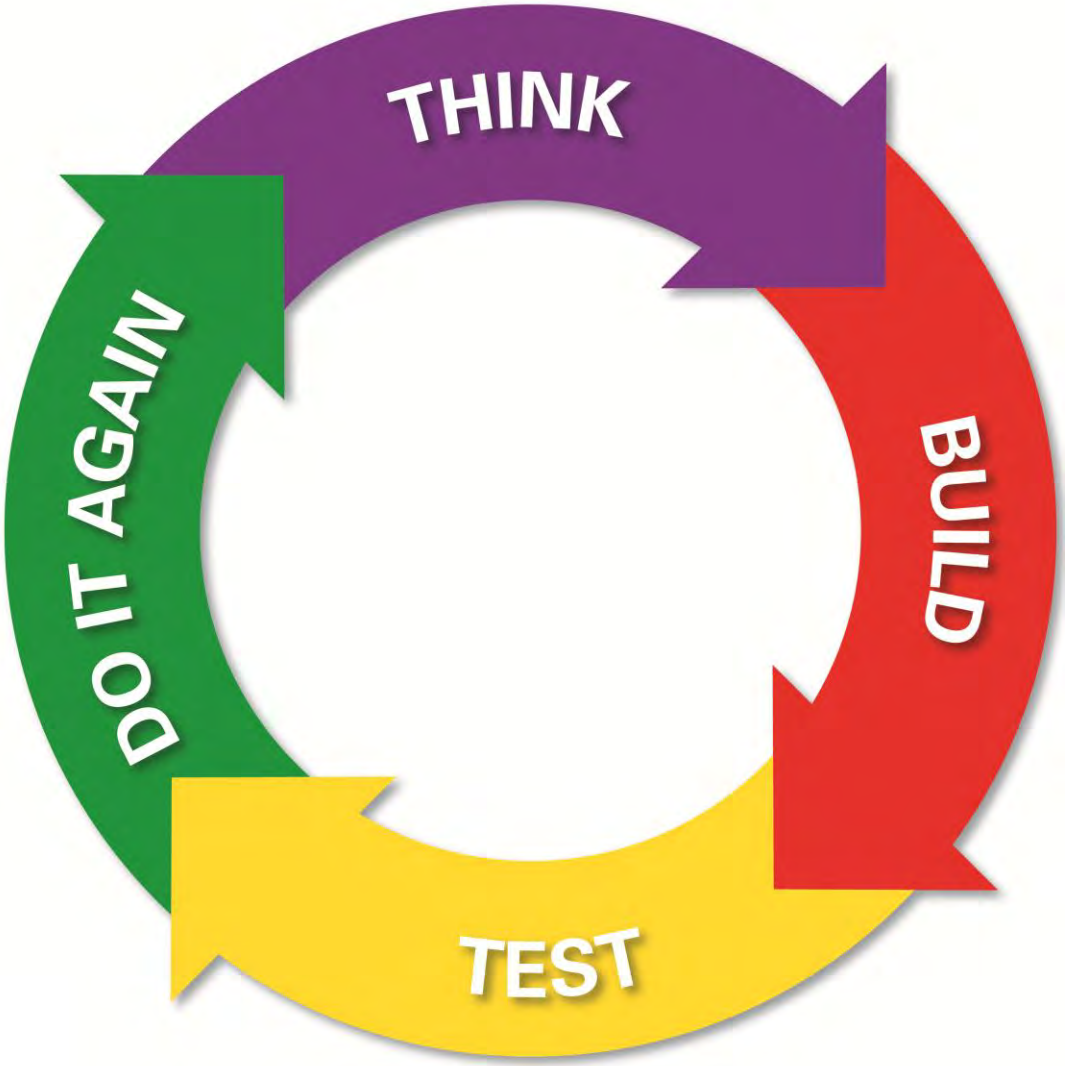


Be Creative...Be an Engineer!

Think, build, test, do it again: That's the process engineers use when they tackle a problem. Engineers don't have official rules telling them to follow this set of steps. But, over time they've learned that they get the best results this way:

They think and brainstorm about a problem and factors they have to consider to solve it. They come up with an idea and build a prototype. They test the prototype. And, then they repeat the process to improve their results.

Engineers often move back and forth within the loop, repeating two steps over and over again before moving forward. It's a key to engineering success.



Provide Access to Clean Water

This GRAND CHALLENGE encourages engineers to **find ways to provide all people on Earth with access to clean water.**

One in six people in the world don't have sufficient access to clean water for drinking, sanitation, and agriculture. To meet this challenge, engineers **need to find ways to transport water** from areas where it is abundant to remote communities where it is not. They must also develop **effective systems for cleaning contaminated water**.

Restore and Improve Urban Infrastructure

This GRAND CHALLENGE encourages engineers to **improve aging roads, railways, water facilities, sewage treatment, and other city systems.**

Urban infrastructures have been crumbling for decades. The problem is especially acute in Asia, home to the world's largest cities. Engineers must find **environmentally safe ways to modernize outdated and inadequate city support systems**. Billions of people's health, safety, and quality of life depend on it.