NTX Future City Junior, 2020

DELIVERABLE #2
PHYSICAL MODEL

Students build a physical model of a section of their city using recycled materials. The focus of the model will be to illustrate the team's solution to this year's challenge. The model must have at least one moving part, be built to scale, and may not exceed the $50 expense budget.

Suggestions and Resources for Completing the Model Assignment
Building the model is one of the most exciting aspects of the competition. It is where to get to see your ideas come to life.

Engineers, architects, scientists, and city planners all use models to help them communicate their ideas, share their research, and predict the success of their design. Emphasize to the students that the ideas represented in their Model should be in alignment with their Essay and reflect the overall vision that they have for their city.

You want to be sure to start early collecting recyclables and potential building materials for the model. Before you've even decided what the model will look like. You will need to have a variety to choose from when you do finally decide on the scale and start to build.

Physical Model Resources: Begin by reviewing the Physical Model Requirements, below. In addition, you will find these resources useful (see attached forms or download from website http://futurecity.org/resources):

- Begin with the Build Your City Model handout (attached). It's full of valuable information about ways to create different parts of the model, questions to keep in mind, and tips for the moving part component.
- Check out the models that teams have created over the years at Junior Team Center (http://www.dfwfuturecity.org/team_junior.html).
- Review the Physical Model Rubric (attached) to make sure you understand what the judges will be looking for in your model.

You might also want to check out these activities related to model design and construction (download from http://futurecity.org/resources):

- Understanding Scale:
    - Introduction to Scale
    - Plan and Elevation View
    - Proportions, Ratios, and Scale Drawings
    - Scale Map
- Practice designing and building:
    - What Is a Model?
    - Plan-Relief and Architectural Models
    - Building Strong
- Two videos will give you ideas about your model: City Model video and Moving Parts Video
- For general background into city planning and design, you may want to look at City Design: Questions to Consider.

Physical Model Assignment
Students will build a scale model of a section of their city that illustrates the solution to this year's challenge: Clean Water: Tap into Tomorrow. The model should be built primarily of recycled materials and be no larger than 25" (w) x 36" (l) x 20" (h) and contain at least one moving part.

Physical Model Requirements

- Must be built to scale as determined by the team.
- Must be no bigger than 20" high, 36" long, and 25" wide, including all support braces, material hanging below or beyond the tabletop, and any fully extended parts, such as access doors or hinged pullouts.
- Vertical-oriented models are not allowed.
- Must contain one or more moving part(s). Any electrical power must be self-contained (e.g., a household battery and a simple circuit).
- Models cannot use or contain:
    - Power from electrical outlets
    - Live animals, perishable items, or hazardous items (e.g., dry ice)
    - Audio or sound
- Although a small number of individual pieces from previous competition models may be reused, models must be a new representation of a future city and built from the bare baseboard up.
- The total value of the materials used in the model may not exceed $50 and must be reported on the Competition Expense Form.
- A Model Identification Card must be included on your model. This 4" x 6" index card is used by the judges and photographer to identify your team and model. The card should include:
    - City name (has to be the same as the team's name)
    - Scale used for the model
    - School/Organization name
    - Names of the three presenting students, educator, and mentor.

Collect Recycled Materials

Remind students that they only have a $50 budget and need to think creatively about their building materials. In addition to the recycled materials (valued at $0), consider these sources:

- Flea markets and garage sales are excellent sources for old toys, bottles, tins, and buttons.
- Old toys, such as Lego pieces, gears, Tinker Toys, and blocks, are excellent materials.
- Builders and plumbers may have discarded pieces of pipe, wire, and wood.
- Home improvement companies and remodelers may be willing to part with obsolete materials from houses they are remodeling. Old parts from stoves, cabinets, and plumbing fixtures may be sources for moving parts or may provide unusual shapes for your buildings.
- Obsolete or outdated electronic equipment may be reused and can provide visual interest in your city.

Note: All of these items have value and need to be listed on the Competition Expense Form.

Review the Competition Expense Form

Students must list the costs of all items used for their model. Common recycled materials, such as plastic tubs and glass jars may be assigned a zero cost value. Other used, donated, or borrowed items must be assigned a fair market or salvaged value, which may be determined by pricing found at a yard sale, auction, classified ad, or surplus store, for example. For more details, see the Competition Expense Form at the Junior Team Center (http://www.dfwfuturecity.org/team_junior.html).

Competition Scoring

Teams can earn up to 60 points for their Model. Make sure students have thoroughly covered these categories in the rubric to maximize points:

- City Design 15 points
- Build It: Quality & Scale 15 points
- Build It: Materials & Moving Part(s) 15 points
- Judge Assessment of Model 15 points

Total 60 points

Scoring Deductions

1–5 points – Remember your Model Identification Index Card and proofread it to make sure it includes all of the required information.

15 points – Models that exceed the dimensions will lose points.

5 points – Not including your receipts with your Competition Expense Form will result in losing points.

15 points – A missing, incomplete, or inaccurate Competition Expense Form will lose points.

15 points – There is a budget of only $50 for the model

Build Your City Model

Questions to Consider

- What scale works best for your model?
- What recycled materials could you use? How could you use them in creative ways?
- If there was funding for only 20 buildings, which buildings would city planners be sure to construct first?
- Buildings are one of the most visible parts of a city. Where are the hospitals? Are there retail centers? Where are the residences? Are there colleges? What about government buildings?
- Identify the infrastructure. How are roads and highways connected? Where are the energy production facilities? Do the water delivery systems and waste management systems have water treatment plants?
- How will you incorporate this year's resilient water supply system challenge into your city model?
- What makes your city innovative and futuristic? How can you show your futuristic ideas are based on science and engineering?
- What will the moving part(s) do? How is it related to an aspect of your city's design or function?
- How will the moving part be powered? Can you easily repeat the movement?
- How can the engineering design process help you build your model?

Tips for Creating the City Model

- Check out the Gallery at futurecity.org/gallery to see models from past competitions.
- Pick an area of the city that best showcases the competition criteria and your concept for the city. The model should highlight the thought process behind the city.
- Remember to choose a scale that works best for your city design. The team members decide the scale based on their design. They will need to create a scale key, such as 1 inch = 5 feet.
- Be sure your model includes a physical representation of your team's solution to the resilient water supply system challenge.
- Remember to add at least one moving part. Designing your own moving part, or creatively modifying an existing item, will earn more points than using a prefabricated or purchased item. The moving part is an excellent opportunity to explore the physics of simple sources of power, such as rubber bands, weights, heat, springs, pulleys, simple circuitry, light and/or solar power.
- Think about how you will transport your model to the regional competition. Ask yourselves:
  - How will we protect the model while we are moving it?
  - What materials will we use to protect the model?
  - How much thickness and bulk will the packaging materials add to the model?
  - Does it weigh more than 75 pounds? If our team advances to the Finals, models cannot exceed 75 pounds.
- Create a solid base for your model by using plywood or particle board. You want to save on weight, but your base has to be stiff enough to carry the model without flexing.

SCALE MEASUREMENTS

Consider a scale that works for both large items, such as buildings, as well as smaller items, such as windows within buildings and traffic signs. These measurements below can be used as a general guide for scaling basic city features. Research dimensions for other features that you plan to include in the model.

12 feet	Width of traffic lane
8 feet	Height of stop sign
10 feet	Height of a building story
4 feet	Minimum width of residential sidewalk

Model Enhancement Ideas

- Trees: These can be made from twigs and sticks with cotton balls (can be painted green), lichen from a hobby store, dried flowers or weeds, or sponges with food coloring.
- People: These can be made from sticks, toothpicks, mat board, pins, dowels, pipe cleaners, and so on.
- Cars: These can be made from layers of mat board or cardboard glued together, toy cars that are the right scale, Styrofoam, and so on.
- Glass: You can use clear plastic dividers, sleeves, or sheets. Remember to put this on last so that it doesn't get scratched.
- Bricks/Pavers: You can use colored paper or other colored material that matches what you want it to look like and then draw on the pattern or you can take white paper or material and color it with markers, crayons, or similar, remembering to show the pattern.
- Asphalt: You can take black paper or color white paper black and then draw on the lane markers with a white and/or yellow colored pencil or crayon and then cut to size.
- Cement: You can use gray paper or color white paper and then cut to size.
- Grade changes: You can use Styrofoam that is cut/shaped to what you want and use layers of cardboard or mat board to form contours or slope the model.
- Water: You can use blue colored paper or color white paper blue. For added affect, you can put clear plastic or plastic wrap (the kind you use for foods) over it.
- Building material look: To make something look realistic, you can draw on joint lines.
- Sand/beach: You can use sand paper (very fine grit).
- Grass: Use green colored paper or color white paper green, green felt or fabric, or you can use a grass material from a hobby store.

MOVING PART MECHANISMS

Your moving part must be able to have the motion repeated and must be related to a function of the city or your resilient water supply solution. Ideas for moving part mechanisms include:

- Rubber bands
- Heat
- Light/Solar
- Weights
- Springs
- Pulleys
- Batteries
- Simple circuitry

Creatively engineered or innovatively modified moving parts garner more points. For example: a store bought, electric, hand-held fan that is glued to a model is technically a moving part, but it will not receive as many points as a moving part whose team put time, effort, and engineering thought into its construction or development.

Scale Model Rubric (FC Jr.)

	0 **No Points** Requirements missing	1 **POOR** Poor-Fair quality. Fulfills at least 20% of requirements.	2 **FAIR** Fair-Average quality. Fulfills at least 50% of requirements	3 **GOOD** Average quality. Fulfills at least 90% of requirements.	4 **VERY GOOD** Above average quality. Fulfills 100% of requirements.	5 **EXCELLENT** Excellent quality. Fulfills 100% of requirements. Additional distinctive features.
I. CITY DESIGN (15 POINTS)	**0**	**1**	**2**	**3**	**4**	**5**
1. Model demonstrates theme: Clean Water: Tap into Tomorrow • Incorporating essay topic/theme into model • Solutions for making the water supply more resilient	No illustration of theme.	Little illustration of problem or solution.	Some illustration of problem and attempt at solution.	Fairly good illustration of solution making water supply system more resilient.	Good overall illustration of the water supply resiliency solution. Could be more comprehensive.	Excellent illustration and overall solution for making water supply system more resilient.
2. City Representation • Includes clearly recognizable city elements and identifiable structures	No recognizable structures.	Elements and structures unclear. Little variety.	Elements and structures somewhat clear. Little variety.	Elements and structures clear. Some variety.	Elements and structures clear and some variety. But, could be more comprehensive.	Elements and structures form clear representation of city. Very good variety.
3. City Infrastructure and Services • Includes infrastructure and services essential to support the theme (water supply resiliency)	No infrastructure or services.	Shows very little infrastructure and services.	Few infrastructure or service components.	Some infrastructure and services.	Several infrastructure and services. Not all essential theme.	Several infrastructure and services essential to theme.
II. BUILD IT: QUALITY AND SCALE (15 points)						
4. Quality Workmanship and Age Appropriateness • Age appropriate for 4-5th grade • Quality construction • Reasonably durable	Poor quality. Not age appropriate.	Mediocre quality.	Fair to good quality.	Good quality. Age appropriate.	Very good quality. Age appropriate.	Excellent quality. Age appropriate.
5. Appearance • Use of color, graphics, shapes, etc. • Realistic elements (flora, fauna, landscapes) • Good use of available space	No aesthetics.	Poor aesthetics.	Fair aesthetics.	Good aesthetics enhance the model.	Very good aesthetics enhance the model.	Excellent aesthetics enhance the model.
6. Model Scale: _____ • Appropriate scale chosen to create a good city model • Consistent scale throughout model • Applied horizontally and vertically	Scale not used.	Inconsistent scale for majority of model.	Fair scale choice. Some scale inconsistencies.	Good scale choice, city elements easy to identify. Scale consistently applied over majority of model.	Very good scale choice; city elements easy to identify. Consistent application.	Exceptional scale choice, city elements very easy to identify. Consistent application of chosen scale across entire model.
III. BUILD IT: MATERIALS AND MOVING PARTS (15 points)						
7. Innovative Construction Materials, Techniques • Variety of materials, imaginative or unusual materials • Creative modification and application of recycled materials • Building materials primarily recyclables to comply with $50 budget.	No creativity or innovation.	Few recycled materials. Not within budget. Very few creative materials or modifications.	Recycled materials. Little creativity, variety. Little attempt to modify.	Recycled materials. Some variety of innovative materials. Some creatively modified.	Recycled materials. Good variety of innovative materials. Many creative modifications and applications.	Recycled materials. Exceptionally varied and innovative materials. Most creatively modified and applied.

Scale Model Rubric (FC Jr.) – cont'd

	0 **No Points** Requirements missing	1 **POOR** Poor-Fair quality. Fulfills at least 20% of requirements.	2 **FAIR** Fair-Average quality. Fulfills at least 50% of requirements	3 **GOOD** Average quality. Fulfills at least 90% of requirements.	4 **VERY GOOD** Above average quality. Fulfills 100% of requirements.	5 **EXCELLENT** Excellent quality. Fulfills 100% of requirements. Additional distinctive features.
8. Moving Part Innovation and Quality • At least one moving part • Quality workmanship, durability • Repeatability of movement • Innovative execution	No moving part.	One moving part. Fair quality. One time movement.	One moving part. Good quality. Little innovation.	At least one moving part. Good quality. Repeatable movement. Somewhat innovative.	At least one moving part. Very good quality. Repeatable movement. Innovative.	More than one moving part. Excellent quality. Repeatable movement. Highly innovative.
9. Moving Part Relationship to the Design or Function of the City • At least one moving part • Closely related to function of the city	No moving part.	Moving part cosmetic; not relevant to city function.	Moving part not relevant to city function.	At least one moving part closely related to city function.	At least one moving part intrinsic to city function.	More than one moving part essential to city function.
IV. JUDGE ASSESSMENT OF DESIGN (15 POINTS)						
10. Innovative, Futuristic Solution • Innovative solution to water supply resiliency theme • Futuristic, yet plausible and technologically sound	No solutions	Poor solution, not innovative or futuristic.	Fair solution. Somewhat innovative and futuristic, but not real plausible.	Good solution. Somewhat innovative, futuristic and plausible.	Very good solution that is innovative and futuristic.	Excellent, innovative, futuristic and plausible solution.
11. Questions and answers • Answers questions with confidence • Accurate and complete answers	No answers.	Answers a few questions accurately. No supporting facts.	Students answer at least 50% of the questions accurately, few supporting facts	Students answer 90% of questions with accuracy and some supporting facts.	Answers 100% of the questions accurately with some supporting detail.	Students fully, accurately, and confidently answer all questions with many supporting details.
12. Teamwork • Team members supported each other • Team members shared time equally • Team members displayed an equal amount of knowledge • Full complement of team members (three students)	No teamwork.	A small amount of collaboration among team members but more support of one another is needed; one or two tend to dominate.	Some collaboration, some support and sharing among some team members. Amount of knowledge appears unequal. One or two tend to dominate.	Good collaboration; support and sharing among most members. Full complement of three team members. Some team members have more knowledge and dominate	Very good collaboration, support and sharing among the team. Equivalent knowledge level for most of team. Full complement of three team members.	Excellent collaboration, support and sharing among all team members. Equivalent knowledge level for all. Full complement of three team members. No one dominates.

Within maximum model size: 25" (w) x 36" (l) x 20" (h) ☐ Yes ☐ No

Within maximum expense: $50 ☐ Yes ☐ No