

## NTX Future City Junior, 2022

### PART 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>):

- Future City Design: Questions to Consider (included with the Junior Essay requirements document). Students in the Junior Competition are not required to design a complete city – just focus on the solution to the waste problem in one selected area. These questions cover a wide range of city issues, but will help guide students to consider all the related aspects of their city solution.
- 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](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 (<http://futurecity.org/resources>).

## Physical Model Assignment

Students will build a scale model of a section of their city that illustrates the solution to this year's challenge: A Waste-Free Future. The model should be built primarily of recycled materials and contain at least one moving part.

**Format for 2021-2022:** To accommodate both in-person and virtual learning environments, there are two model building options for this year's competition. Both options will be demonstrated in the Model Presentation Video.

- Option 1: Your team can choose to build one single model (recommended for teams working together in class)
- Option 2: Your team can choose to build multiple model segments. These model segments are separate pieces that represent various sections of the city. Model segments do not need to fit together physically (recommended for those teams working remotely in a distance-learning environment).

## Physical Model Requirements

- **Model/Model Segments:** Teams may create as many model segments as they want. Review the model slideshow template and rubric for the specific requirements before you plan your model or model segments. If building model in segments, the pieces do not need to physically fit together to form a single model. However, they should thematically work together to demonstrate an overall vision of your future city.
- **Scale:** Each model segment must be built to scale as determined by the team. But different segments may use different scales as long as the scale is consistent within the segment itself.
- **Moving Part(s):** Each model (entire model – not each model segment) must contain one or more moving part(s). Any electrical power must be self-contained (e.g., a household battery and a simple circuit).
- **Model Size:** There are no size restrictions on the model or model segments this year.
- **Model Materials:** 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. Models cannot use or contain:
  - Power from electrical outlets
  - Live animals, perishable items, or hazardous items (e.g., dry ice)
  - Drones or other flying objects
  - Audio or sound
- **Budget:** The total value of the materials used in the model may not exceed \$50 and must be reported on the Competition Expense Form.

## 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](http://www.dfwfuturecity.org/team_junior.html)).

**Model Deliverable:** This year, since there will be no on-site event, the model will be judged using a video recording that the team creates and uploads. See the Presentation Video Requirements document for more detail on the recording.

### Competition Scoring

Teams can earn up to 75 points for their Model Presentation Video. Refer to the Presentation Requirements Document for information on the deliverable and rubric.

#### Scoring Deductions

5 points – Late submissions are accepted with a small point deduction (see online schedule)

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 MODEL - QUESTIONS TO CONSIDER**

- Will your team create a single model or multiple segments?
- Will your team work together in person or remotely? How will you divide up responsibilities?
- What recycled materials could you use? How could you use them in creative ways?
- What scale works best for your model? (Remember: scale has to be consistent throughout each single segment, but different segments can use different scales.)
  - Remember to choose a scale (or multiple scales) that works best for your city design and the materials your team has available. If one model segment builder has large materials to work with, he might choose a scale that shows off a larger physical area of the city. If another builder has smaller materials, she might choose a different scale for her segment to show more detail.
- How are your different city zones visually distinctive?
- Think about your city's infrastructure. Where are the energy production facilities? What does your city's transportation system look like? How do the realities of living on the Moon influence your infrastructure choices?
- What are some of the services in your city? How will you represent them in the model?
- How will you incorporate the Waste-Free Future challenge?
- How does your city incorporate the three principles of a circular economy into its design and daily functions? How will you represent this in your model?
- How can you make your model look as realistic as possible?
- What will the moving part do? How is it related to an aspect of your city's design or function? How will the moving part be powered?
  - Remember that each team needs to include a moving part (which can be on any model segment). 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.
- What makes your city innovative and futuristic? How can you show your futuristic ideas are based on real science and engineering?

### **SCALE MEASUREMENTS**

Consider a scale that works for both large items, such as buildings, as well as smaller items, such as windows 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 (like hills or craters): 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/lunar soil: You can use sandpaper (very fine grit).

### 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 this year's challenge. 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, handheld 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 Presentation Rubric (FC Jr.)

|   | <b>0<br/>No<br/>Points</b><br>Requirements<br>missing | <b>1<br/>POOR</b><br>Poor-Fair quality. Fulfills at least 20% of requirements.           | <b>2<br/>FAIR</b><br>Fair-Average quality. Fulfills at least 50% of requirements | <b>3<br/>GOOD</b><br>Average quality. Fulfills at least 90% of requirements.   | <b>4<br/>VERY GOOD</b><br>Above average quality. Fulfills 100% of requirements.                                    | <b>5<br/>EXCELLENT</b><br>Excellent quality. Fulfills 100% of requirements. Additional distinctive features.                                  |
|---|---|--|--|--|--|---|
| <b>I. CITY DESIGN (15 POINTS)</b>   | <b>0</b>  | <b>1</b>   | <b>2</b>   | <b>3</b>   | <b>4</b>   | <b>5</b>  |
| <b>1. Model demonstrates theme: Waste-Free Future</b> <ul style="list-style-type: none"> <li>Incorporating essay topic/theme into model</li> <li>Circular economy: design out waste, keep materials in use, regenerate natural systems</li> </ul>   | No illustration of theme.                             | Little illustration of problem or solution.  | Some illustration of problem and attempt at solution.                            | Fairly good illustration of solutions eliminating waste.   | Good overall illustration of solutions to eliminating waste. Could be more comprehensive.                          | Excellent illustration and overall solutions to the challenge of eliminating waste.   |
| <b>2. City Representation</b> <ul style="list-style-type: none"> <li>Includes clearly recognizable city elements and identifiable structures</li> </ul>   | 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.   |
| <b>3. City Infrastructure and Services</b> <ul style="list-style-type: none"> <li>Includes infrastructure and services essential to support the theme (Waste-Free Future)</li> </ul>  | No infrastructure or services.                        | Shows very little infrastructure and services.   | Few infrastructure or service components.  | Some infrastructure and services. Few essential to theme.  | Includes infrastructure and services essential to the theme. Some additional infrastructure and services.          | Thoroughly represents infrastructure and services essential to theme, as well as some additional city infrastructure.                         |
| <b>II. MODEL: QUALITY AND SCALE (15 points)</b>   |   |  |  |  |  |   |
| <b>4. Quality Workmanship and Age Appropriateness</b> <ul style="list-style-type: none"> <li>Age appropriate for 4-5<sup>th</sup> grade</li> <li>Quality construction</li> </ul>  | Poor quality. Not age appropriate.                    | Mediocre quality.  | Fair to good quality.  | Good quality. Age appropriate.   | Very good quality. Age appropriate.  | Excellent quality. Age appropriate.   |
| <b>5. Appearance</b> <ul style="list-style-type: none"> <li>Use of color, graphics, shapes, etc.</li> <li>Realistic elements (flora, fauna, landscapes)</li> </ul>  | No aesthetics.  | Poor aesthetics.   | Fair aesthetics.   | Good aesthetics enhance the model.   | Very good aesthetics enhance the model.  | Excellent aesthetics enhance the model.   |
| <b>6. Model Scale</b> <ul style="list-style-type: none"> <li>Appropriate scale chosen to show structure and detail</li> <li>Consistent scale throughout model or model segment</li> <li>Applied horizontally and vertically</li> </ul>  | Scale not used or demonstrated.                       | Inconsistent scale for majority of model or model segment.                               | Fair scale choice. Some scale inconsistencies within model or model segments.    | Good scale choice, city elements easy to identify. Scale consistently applied over majority of model or model segment. | Very good scale choice; city elements easy to identify. Consistent application across model or all model segments. | Exceptional scale choice, city elements very easy to identify. Consistent application of chosen scale across entire model and model segments. |
| <b>III. MODEL: MATERIALS AND MOVING PARTS (10 points)</b>   |   |  |  |  |  |   |
| <b>7. Innovative Construction Materials, Techniques</b> <ul style="list-style-type: none"> <li>Variety of materials, imaginative or unusual materials</li> <li>Creative modification and application of recycled materials</li> <li>Building materials primarily recyclables to comply with \$50 budget.</li> </ul> | 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

|  | <b>0<br/>No<br/>Points</b><br>Requirements<br>missing | <b>1<br/>POOR</b><br>Poor-Fair quality. Fulfills at least 20% of requirements. | <b>2<br/>FAIR</b><br>Fair-Average quality. Fulfills at least 50% of requirements    | <b>3<br/>GOOD</b><br>Average quality. Fulfills at least 90% of requirements.                        | <b>4<br/>VERY GOOD</b><br>Above average quality. Fulfills 100% of requirements.                              | <b>5<br/>EXCELLENT</b><br>Excellent quality. Fulfills 100% of requirements. Additional distinctive features.                       |
|--|---|--|---|---|--|--|
| <b>8. Moving Part Innovation and Quality</b> <ul style="list-style-type: none"> <li>• At least one moving part</li> <li>• Quality workmanship</li> <li>• Innovative design and execution</li> <li>• Closely related to function of city</li> </ul> | No moving part.                                       | One moving part. Fair quality. But cosmetic: not relevant to city function.    | One moving part. Good quality. Little innovation. Not relevant to city function.    | At least one moving part. Good quality. Somewhat innovative and related to city function.           | At least one moving part. Very good quality. Innovative and related to city function                         | More than one moving part. Excellent quality. Repeatable movement. Highly innovative and essential to city function.               |
| <b>IV. PRESENTATION: CONTENT AND DELIVERY (20 POINTS)</b>  |   |  |   |   |  |  |
| <b>9. Presentation content and delivery</b>  | Disorganized and unclear.                             | Poorly organized. Needs more practice  | Fair organization. Covers major elements. Lacks detail. Presenters lack confidence. | Covers all major elements. Details could be clearer. Presenters good, but could be better prepared. | Well organized and detailed. Team delivery confident and prepared.   | Extremely well organized with excellent details. Confident delivery by entire team.  |
| <b>10. Use of demonstration aids</b> <ul style="list-style-type: none"> <li>• Model as principal demonstration aid</li> <li>• Other demonstration aids, if any, enhance presentation</li> </ul>  | Model not demonstrated.                               | Model not effectively demonstrated.  | Model demonstration good, but missed important elements.                            | Model demonstration good. Covered most of important elements, but lacking in detail.                | Very good and detailed demonstration of model. Additional demonstration aids, if any, enhanced presentation. | Extremely good demonstration and explanation of model. Detailed and thorough. Additional demonstration aids enhanced presentation. |
| <b>11. Engineering and roles</b>   | No discussion   | Mentions engineering, but little discussion of roles.                          | Demonstrates limited knowledge of engineering and roles.                            | Demonstrates good knowledge and understanding of engineering and roles.                             | Demonstrates very good knowledge and understanding of engineering and roles.                                 | Demonstrates excellent and thorough knowledge and understanding of engineering and roles.  |
| <b>12. Engineering design process related to theme challenge. Tradeoffs and compromises</b>  | No discussion.  | Little mention of design process, tradeoffs or compromises                     | Some discussion of design process, tradeoffs or compromises                         | Good analysis of tradeoffs and compromises. Discusses design process.                               | Very good analysis and discussion of design process, tradeoffs and compromises.                              | Excellent and thorough discussion of design process, tradeoffs and compromises.  |
| <b>V. JUDGE ASSESSMENT OF DESIGN (15 POINTS)</b>   |   |  |   |   |  |  |
| <b>13. Innovative, Futuristic Solution</b> <ul style="list-style-type: none"> <li>• Innovative solutions to challenges of eliminating waste.</li> </ul>  | No solutions  | Poor solution, not innovative or futuristic.                                   | Fair solution. Somewhat innovative and futuristic.                                  | Good solution. Somewhat innovative, futuristic.   | Very good solution that is innovative and futuristic.  | Excellent, innovative and futuristic solution.   |

## Scale Model Rubric (FC Jr.) – cont'd

|  | <b>0<br/>No<br/>Points</b><br>Requirements<br>missing | <b>1<br/>POOR</b><br>Poor-Fair quality. Fulfills at least 20% of requirements.   | <b>2<br/>FAIR</b><br>Fair-Average quality. Fulfills at least 50% of requirements  | <b>3<br/>GOOD</b><br>Average quality. Fulfills at least 90% of requirements.  | <b>4<br/>VERY GOOD</b><br>Above average quality. Fulfills 100% of requirements.  | <b>5<br/>EXCELLENT</b><br>Excellent quality. Fulfills 100% of requirements. Additional distinctive features.  |
|--|---|--|---|---|--|---|
| <b>14. Engineering and Technology</b> <ul style="list-style-type: none"> <li>• Demonstrates understanding of engineering and technology</li> <li>• Innovative and plausible extrapolation of current technologies</li> </ul>   | Little or no detail. No understanding.                | Limited details. Understanding of concepts seems to be lacking.  | Adequate details, but could be better. Decent understanding of concepts. Not particularly innovative or plausible.                      | Sufficient details and good understanding of concepts. Somewhat innovative and plausible.   | Very good level of detail and understanding of concepts. Innovative and plausible.   | Thorough, detailed and complete understanding of concepts. Extremely innovative and plausible.  |
| <b>15. Teamwork</b> <ul style="list-style-type: none"> <li>• Team members supported each other</li> <li>• Team members shared time equally</li> <li>• Team members displayed an equal amount of knowledge</li> <li>• Full complement of team members (three students)</li> </ul> | No teamwork, or more than three students.             | 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. |