

NTX Future City Junior, 2024

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:

- 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 electrification 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).
- 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 Educator Dashboard <http://futurecity.org>):

- Understanding Scale:
 - Introduction to Scale, Scale: Background Information, Scale: Key Terms & Concepts
 - Plan and Elevation View
 - Proportions, Ratios, and Scale Drawings
 - Scale Map
- Practice designing and building:
 - What Is a Model?
 - Model Construction: Key Terms & Concepts, Model Construction: Basic Information
 - Plan-Relief and Architectural Models
 - Building Strong
 - Tower Building Activity and Lego Structure Activity

Physical Model Assignment

Students will build a scale model of a section of their city that illustrates the solution to this year's challenge: Electrify Your Future. 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

- Model Size: Model can be no larger than 20" high, 36" long, and 25" wide.
- Scale: Each model segment must be built to scale as determined by the team. A model may use up to two distinct scales if they are clearly defined, easily determined by sight and indicated on the Model ID card.
- Moving Part(s): Each model 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 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.
- 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(s) 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).

Model Deliverable and Judging: Teams will deliver their model to the NTX Regional event tentatively scheduled for 27 January 2024. The model will be on display for the judges and the student team (max

of 3 students) will stand with their model to answer questions from the judges. The purpose is to briefly explain the model, their city concept and their solution to the annual challenge (electrify your future). No formal, rehearsed presentation is required or expected. Each set or panel of judges will spend about 5 minutes with the model and team. Adults (educators, mentors) may observe, but not participate in the Q&A process.

Competition Scoring

Teams can earn up to 70 points for their Model and Q&A session with the judges.

- City Design 15 points
- Quality & Scale 15 points
- Materials & Moving Part(s) 15 points
- Presentation and Teamwork 15 points
- Judge Assessment of Model 10 points

Total 70 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.

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

- How will your team 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 the model.)
 - Remember to choose a scale that works best for your city design and the materials your team has available. A second model scale might be used to highlight or show off a specific area or design detail in the city.
- 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 does your electric powered city 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 Electrification challenge? How will you showcase your city's power source?
- 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?
 - 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.)

	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: Electrify Your Future <ul style="list-style-type: none"> Incorporating essay topic into model: 100% electrically powered city Keep citizens, environment safe and healthy 	No illustration of theme.	Little illustration of solution.	Some illustration of an attempt at solution.	Fairly good illustration of solution.	Good overall illustration solution.	Excellent illustration and generation of safe, healthy electricity.
2. City Representation <ul style="list-style-type: none"> 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 <ul style="list-style-type: none"> Includes infrastructure and services essential to support the theme (Electrification) 	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.
II. MODEL: QUALITY AND SCALE (15 points)						
4. Quality Workmanship and Age Appropriateness <ul style="list-style-type: none"> 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 <ul style="list-style-type: none"> 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 <ul style="list-style-type: none"> Appropriate scale chosen to show structure and detail Consistent scale throughout model or model segment Applied horizontally and vertically 	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.
III. MODEL: MATERIALS AND MOVING PARTS (10 points)						
7. Innovative Construction Materials, Techniques <ul style="list-style-type: none"> 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 Relationship to the Design or Function of the City <ul style="list-style-type: none"> 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.
9. Moving Part Innovation and Quality <ul style="list-style-type: none"> At least one moving part Quality workmanship Innovative design and execution 	No moving part.	One moving part. Fair quality.	One moving part. Good quality. Little innovation.	At least one moving part. Good quality. Somewhat innovative.	At least one moving part. Very good quality. Innovative.	More than one moving part. Excellent quality. Repeatable movement. Highly innovative.
IV. PRESENTATION AND TEAMWORK (15 POINTS)						
10. Questions and answers <ul style="list-style-type: none"> 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.
11. Teamwork <ul style="list-style-type: none"> 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, 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.
12. Engineering and roles	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.
V. JUDGE ASSESSMENT OF DESIGN (10 POINTS)						
13. Innovative, Futuristic Solution <ul style="list-style-type: none"> Innovative solutions to challenges of electrification. 	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.
14. Engineering and Technology <ul style="list-style-type: none"> Demonstrates understanding of engineering and technology Innovative and plausible extrapolation of current technologies 	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.