Explore: (Student version begins pg 3)

Teacher Version

Materials: ratio data cards, worksheet, graph paper, calculators

In pairs, students analyze Karlsruhe's layout using simplified two-quantity ratio-based data cards. Example cards include:

Card A: Residential area = 40%; Green space = 25%
Answer: Residential to Green Space ratio = 40:25 or 8:5. This proportional relationship shows how land is allocated, and students can scale this ratio to model different sized cities.

Card B: For every 3 miles of tram lines, there are 2 miles of bike paths
Answer: Tram to Bike ratio = 3:2. Students can use this relationship to construct a graph and write an equation, such as $y = \frac{3}{2}x$

Card C: A new eco-district was developed with 4 blocks of green space for every 1 block of residential
Answer: Green to Residential ratio = 4:1. This illustrates how environmental priorities are reflected in city design.

Card D: A community garden covers 0.75 km² for every 3 km² of residential area
Answer: Garden to Residential ratio = 0.75:3 or 1:4. This proportional relationship allows students to analyze how green space supports residential density.

Card E: 5 renewable energy stations serve 20 zones
Answer: Energy Station to Zone ratio = 1:4. This ratio is used to explore resource distribution and scalability across cities.

Each card presents a real-world context in which two related quantities maintain a constant ratio. Students will use this constant of proportionality to build tables, represent data on graphs, and derive equations. These representations help students visualize and quantify sustainable planning practices.
Tasks:

- Complete tables and graphs showing proportional use of space
- Calculate unit rates and write equations for data trends
- Compare with proportions from their own community layout

Rubric Criteria:

- Accuracy of table, graph, and equation representation (10 pts)
- Reasoning in proportional comparisons (10 pts)
- Connection to sustainability concepts (10 pts)

Note: Cards including data from other aspects of the Karlsruhe's sustainable urban development may also be included for enrichment or differentiation. Students may be provided or create their own cards using publicly available or teacher-curated data related to other aspects of Karlsruhe's sustainable urban development. These can include:

- **Ratio of Green Spaces to the City's Population Density**
- **Proportional Development of Pedestrian Infrastructure Compared to Traditional Roadways**
- **Proportion of Waste Management and Recycling Infrastructure to the Population**
- **Proportional Allocation of Resources for Water Management Systems**
- **Proportion of Community Gardens and Urban Agriculture Spaces to the Overall Urban Landscape**
- **Proportional Allocation of Spaces for Biodiversity Conservation**
- **Public Transportation Accessibility (e.g., number of stops per square km)**

- **Number of Buildings with Green Certification vs. Total Number of Buildings**

Sources of Data for Ratio Cards:

- Karlsruhe Open Data Portal: https://transparenz.karlsruhe.de/
- Karlsruhe Institute of Technology (KIT) Urban Planning Reports
- German Federal Environment Agency (Umweltbundesamt): https://www.umweltbundesamt.de
- Statista (Germany Urban Infrastructure and Transport Datasets)
- Google Earth / OpenStreetMap layout for Karlsruhe city mapping

Student Version

Instructions:
You will explore how city design and sustainability are connected by analyzing proportional relationships in Karlsruhe, Germany. Use the ratio cards provided below. For each card:

1. Write the ratio in simplest form.
2. Create a table to model the relationship.
3. Plot the data on a graph.
4. Write an equation for the proportional relationship.

Card A
Scenario: The city of Karlsruhe dedicates 40% of its space to residential areas and 25% to green spaces.

1. What is the ratio of residential area to green space?
2. Simplify the ratio.
3. Fill in a table for every 10 units of green space.
4. Graph the relationship.
5. Write the equation for the ratio.

Card B
Scenario: For every 3 miles of tram lines, there are 2 miles of bike paths.

1. What is the tram-to-bike path ratio?
2. Simplify the ratio.
3. Create a table showing tram lines from 3 to 15 miles.
4. Graph the data.
5. Write an equation showing the number of bike path miles (y) for x miles of tram lines.

Card C
Scenario: An eco-district in Karlsruhe uses 4 blocks of green space for every 1 block of residential space.

1. What is the ratio of green space to residential blocks?
2. Simplify the ratio.
3. Create a table increasing residential blocks from 1 to 5.
4. Graph the results.
5. What equation represents this relationship?

Card D
Scenario: A community garden covers 0.75 km^2 for every 3 km^2 of residential space.

1. What is the garden-to-residential space ratio?
2. Simplify the ratio.
3. Complete a table increasing residential area from 3 to 15 km^2.
4. Graph the relationship.
5. Write an equation.

Card E
Scenario: Karlsruhe has 5 renewable energy stations serving 20 zones.

1. What is the ratio of stations to zones?
2. Simplify the ratio.
3. Create a table for 4 to 24 zones.
4. Graph the values.
5. What equation represents this proportional relationship?

Discussion Questions:

- How does each relationship reflect sustainable planning?
- What would you change in your own city based on these proportions?

Rubric Criteria:

- Accuracy of table, graph, and equation representation (10 pts)
- Reasoning in proportional comparisons (10 pts)
- Connection to sustainability concepts (10 pts)

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