



Section 2: Building Cities

The math we use comes from many different sources. Sometimes math comes from practical problems, like trying to build a bridge. But, sometimes math comes from the games we play and puzzles we try to solve.

Our next experience is a puzzle.
We start the puzzle by building a city .



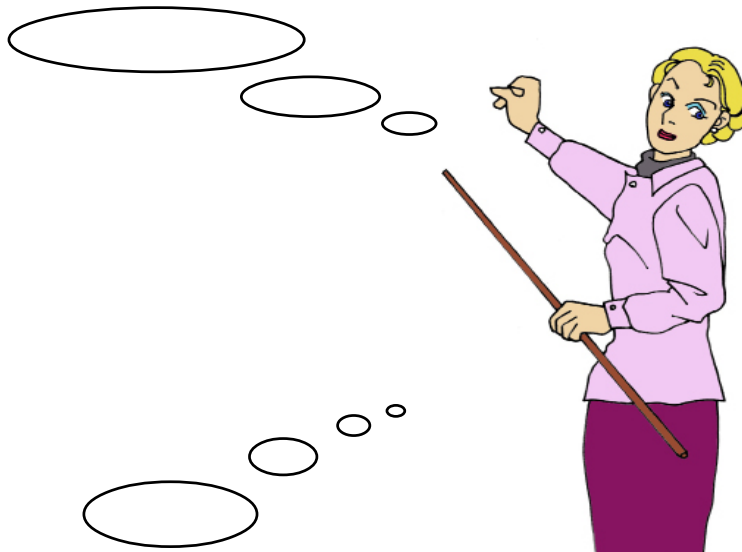
For our puzzle, a city will be a collection of buildings connected to each other by one way roads. None of the roads has a name (yet!). A city will have certain properties that it satisfies so we can try to solve the puzzle.

Properties of a City

- Property 1. Each building must have exactly two roads leading away from it.
- Property 2. From whatever building you start in, there have to be roads that will get you to every other building in your city.



Notice that property 1 only talks about how many roads leave from a building. It doesn't say anything about how many roads go to a building. There can be one or more roads going to a building



A road can leave from a building and come right back to the same building. We'll call this kind of road a loop. Also both roads from a building can go to the same place.



Exercise 2.1

A: Each team should use the materials provided to build a city with 3 buildings that satisfies the properties of a city.

B: Next, each team should build a city with 4 buildings that satisfies the properties of a city.

Each team will report to the class on the cities that they build. Draw your cities on chart paper, so they can be posted in the class. We'll display what each team builds and decide if it satisfies both properties of a city

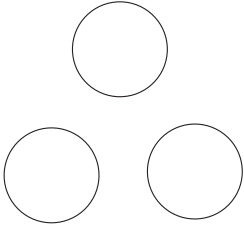
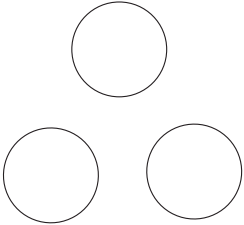
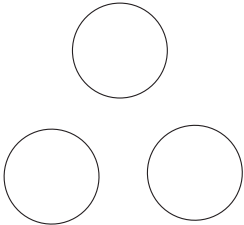
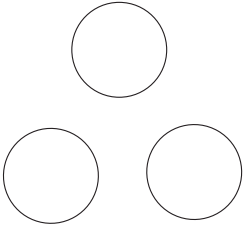
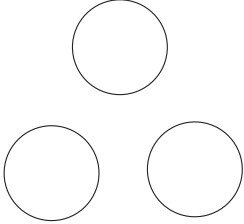




The Road Coloring Problem



Exercise 2.2 Each team should inspect everything that has been built by the class. Each student should make a record below of all 3 building diagrams that were built. If a team built something that did not satisfy the properties of a city, explain what is wrong in the space provided.











Diagram	Is it a city?	If No, what is wrong?
	<p>Yes</p> <p>No</p>	
	<p>Yes</p> <p>No</p>	
	<p>Yes</p> <p>No</p>	
	<p>Yes</p> <p>No</p>	
	<p>Yes</p> <p>No</p>	



The Road Coloring Problem

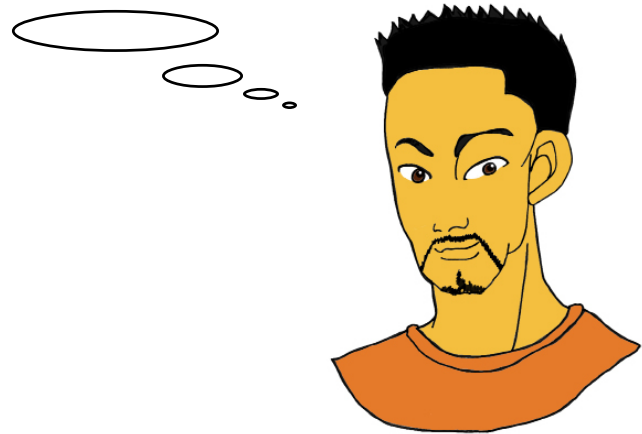


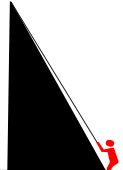

Exercise 2.3 Each team should inspect everything that has been built by the class. Each student should make a record below of everything that has been built. If a team built something that did not satisfy the properties of a city, explain what is wrong in the space provided.

Diagram	Is it a city?	If No, what is wrong?
 	Yes No	
 	Yes No	
 	Yes No	
 	Yes No	
 	Yes No	



Sometimes in math it is important to find out if you can construct something which doesn't satisfy the properties.

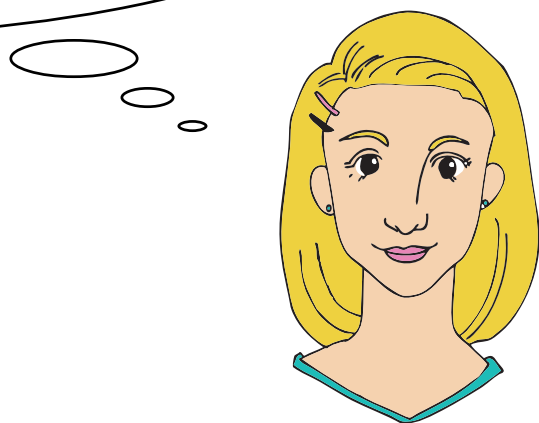


Challenge  **Team Work**  Exercise 2.4

A: Put together some buildings and roads in a way that satisfies property 1 of a city, but doesn't satisfy property 2. You can use either 3 or 4 buildings.

B: Put together some buildings and roads in a way that satisfies property 2 of a city, but doesn't satisfy property 1. You can use either 3 or 4 buildings.

This team exercise requires a team report to the class.





Exercise 2.5 This was our first challenge problem. Were any teams able to “meet the challenge”? Draw any “attempt at a city” in the box below and explain what is wrong with it. If no teams were able to solve the challenge, keep trying on your own. You can always add the solution to a challenge problem to your portfolio.

“Attempt at a city”	Problem



Exercise 2.6 Describe in your own words below, some possible differences between a city (a collection of buildings which satisfies the properties of a city) and an “attempt at a city” which does not satisfy the properties.