WILLIAM PATERSON UNIVERSITY

Office of Field Experiences

Lesson Plan

Name: **School:** Middle School **Grade:** 7th

I. **Subject Area(s):** Mathematics

II. **Topic and Core Standards: Data Analysis**

N.J.C.C.C.S.: *Patterns and Algebra 4.3.7.C.1*

Analyze functional relationships to explain how a change in one quantity can result in a change in another, using pictures, graphs, charts, and equations.

Data analysis, Probability, and Discrete Mathematics 4.4.7.A.2

Make inferences and formulate and evaluate arguments based on displays and analysis of data.

N.C.T.M.: *Algebra 6-8*

Relate and compare different forms of representation for a relationship. Use graphs to analyze the nature of changes in quantities in linear relationships.

Data Analysis & Probability 6-8

Use observations about differences between two or more samples to make conjectures about the populations from which the samples were taken. Use conjectures to formulate new questions and plan new studies to answer them.

III. **Concept:** Apply proportional reasoning.

IV. **Concept Statement:** Proportional reasoning is when we use proportions, one number related to another, to discover results.

V. **Objectives/Student Learning Outcomes:**

Students will be able to…

(Low)

1. …understand what proportional reasoning is.
2. …apply proportional reasoning.
3. …look for and recognize proportional patterns.
4. …relate proportional changes in quantities.

(High)

5. …make conjectures from proportional patterns.
6. …compare proportional graphs.
7. …correlate time and change as a proportion.
8. …judge the importance of using proportional reasoning to find results.

VI. Teacher Actions:

1. Planning:

- **Seating arrangement:** groups of three or four.
- **Student grouping:** Preferred heterogeneous mixture by ability.
- **Prior knowledge:** Students should have a prior knowledge of how to read a graph and understand that a fraction is a ratio.
- **Materials:** Motivation cartoon (attached), Worksheets (attached).

2. Motivate:

Show the students the tree house cartoon.

Ask: "What do you think about the picture?"
"Why is the bottom monkey questioning the height?"
"If the picture is drawn to scale, and the bottom monkey is 3ft. tall, can the tree house only be 10 ft. high?"
"What do I mean by scale?"
"I want everyone to spend a minute or two figuring out how high they think the house is."

Give the students an opportunity to express their answers and how they determined them. This will also give the teacher a preliminary evaluation of their reasoning when relating proportions.

3. Teach:

Using the motivation, discuss their answers and guide them to the equations behind the reasoning. Show that x numbers of the bottom standing monkey are required to reach the top. Use the second monkey and tree house picture to show that the height is about 3.5 monkeys. Assuming the bottom monkey is 3ft. tall, the height must be 3 times the estimated 3.5 monkeys needed to reach the top.

Using these the teacher can create the proportion to show that 3.5 monkeys and 3 ft. tall monkeys are needed to reach that height and that is proportional reasoning like this:

Height (h) = # of monkeys (m) times height of monkey (t) OR

$h = mt$ OR $\frac{h}{t} = m$ OR $\frac{h}{m} = t$

Continue by showing when they know some values like # of monkeys (m = 3.5) times height of monkey (t=3) it is easy to calculate the remaining value h, hence:

$h = 3.5x3$ OR $\frac{h}{3} = 3.5$ OR $\frac{h}{3.5} = 3$

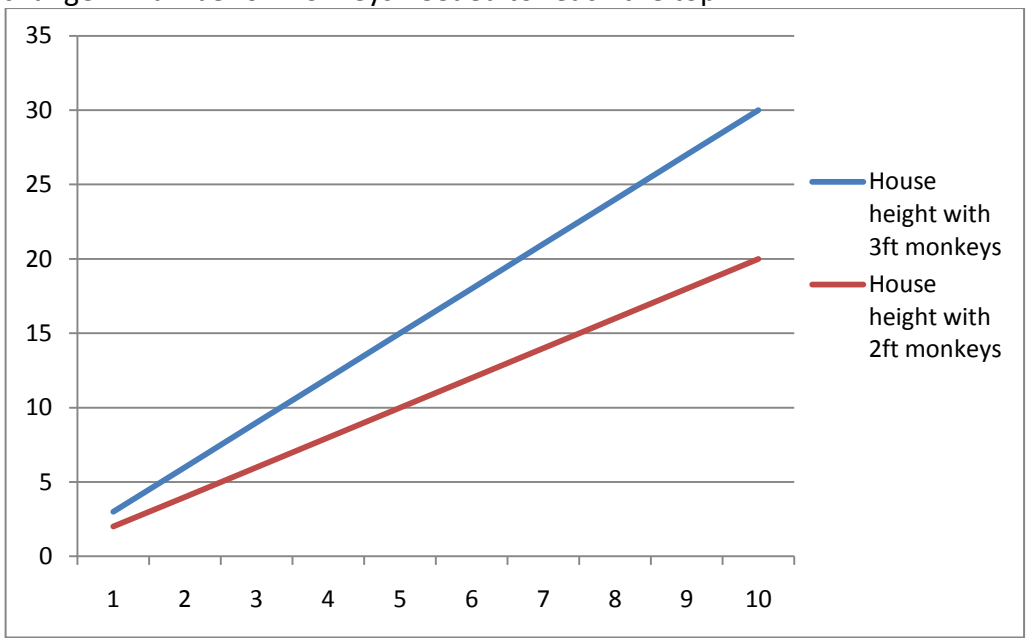
Now explain that they can recalculate and change the problem based on these proportions like “what if the bottom monkey was 2 ft. tall?” or “How many monkeys would be used if the height of the house was 12 ft.?”

Expand that to talk about how proportions can be related to real life – i.e. If I drive the first hour at 60 mph, the second at 50 mph and the third at 25 mph, how far did I travel?

Reinforce the process of solving proportions with examples and strictly mathematically being sure to show how the two relate.

For example if the you have a proportion of a:b as 1:5, show that when a = 5, b = 25.

Use the line graph and demonstrate how the change in height is related to the change in number of monkeys needed to reach the top.



Discuss with class what other things could be shown in this type of linear proportions – perhaps height and age. Use this to discuss what the limitations may be to using the formula – i.e. “is it practical/possible to build a 7000 foot high house?” This will help their reasoning for real life proportions and limitations to those rates.

Give the students the following word problem:

James created a new invention to recycle plastic that will save companies thousands of dollars a year. The machine is shipped in 3 boxes for each

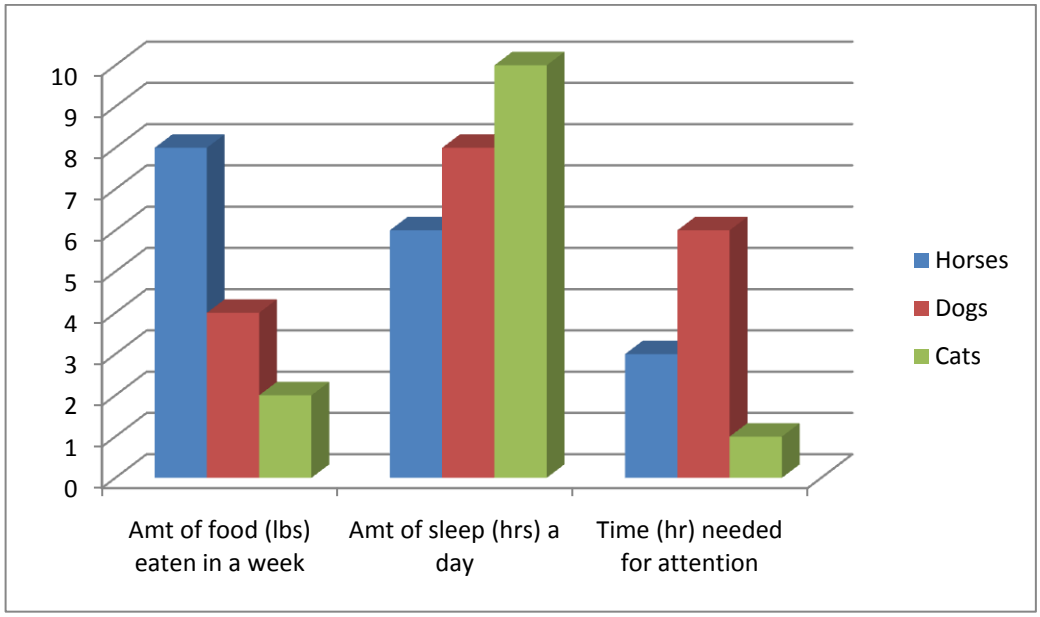
machine and assembled on site. James just sold his first 50 machines. How many boxes will he need to ship them?

Guide them to see that 3 boxes to 1 machine can be used to find X boxes to 50 machines.

Summarize the concept that using portions the student can reason to other values.

4. **Image:**

Use the following graph and proportion on overhead of computer to demonstrate how other proportions can be taken from patterns:



Some proportions that can be found:

Amt of food eaten by cats compared to amount of hours they sleep during the day.

The amount of hours a horse sleeps in a day compared to the amount of attention they need.

After showing the proportions ask questions like “Using those proportions what happens if the amount of hours slept went up or down?” etc.

5. **Ask Low and High Level Questions:**

Low

- Describe proportional reasoning. [compare to concept statement]
- When can we use proportional reasoning? [to help determine other values]
- Are all proportions a direct relation? [2:1, 1:1, etc – when comparing the correct sets - the total class height is proportional to an average height and the number of students]
- When you have a proportion, what happens when you change one of the values? [the other values change in relation]

  High
- What happens when one side of the proportion stops? [the rate is limited]
- Why is distance measured as a proportion between a measurement and time or speed? [think mph/mpg – evaluation of values remains consistent]
- Are there things that never stop changing? [the age of the world]
- Are there other proportions that directly relate to population? [resource use/waste]
- What can applying proportions tell us about our future? [space and resources may be an issue as population grows]

6. **<u>Practice Skills</u>:**

   Each group (table) will attempt to solve the attached worksheet. They will be encouraged provide as many ways as they can to show their work, pictures, graphs, etc.

7. **<u>Create (Performance Task):</u>** Each group will present their strategies and how they tested the process and results.

8. **<u>Presentation/Closure:</u>** Use the class presentations as a catalyst to close the lesson. Explain that there are varied ways to predict information based off prior data. In the event that all the students complete it the same way, offer other ways that reach the same conclusions. For example, if they all divided 1 billion by 50 then divided that by 19 seconds, show them that taking the smaller 50 per 19 to calculate a day (24 hours * 60 minutes * 60 seconds) as an alternative route.

9. **<u>Evaluation:</u>** Use the following rubric to determine credit for the worksheet.

<table>
<tr><th>0 – Unsatisfactory</th><th>1 – Needs work</th><th>2 – Satisfactory</th><th>3 – Proficient</th></tr>
<tr><td rowspan="2">Nothing handing in</td><td rowspan="2">Partially completed / answers left blank.</td><td>Answers completed.</td><td>Answers completed.</td></tr>
<tr><td>Most answers correct or show correct process</td><td>All answers and processes accurate.</td></tr>
</table>

10. **<u>Accommodations:</u>**

    Hearing impaired: Give the student preferential seating to where you will be centrally speaking from. Speak loudly, to the student, and repeat as necessary.

Allow the students to have a hard copy of the notes and put everything you say on the board.

Visually impaired: Allow students to have preferential seating to best see any visual aids used. Allow student to have a tape-recorder. Make sure notes are big and bold and the lines on the paper are big. Make sure student has enough, or extra time.

Physically Impaired: Have student work with a partner.

Gifted: Have higher thinkers also think of the walls in their map, adding a third dimension to the process.

ESL: Have a printed set of the instruction in alternative language or give a traditional English set to any ESL assistants ahead of time.

No access to web: Because the group practice uses information from the web. If the students cannot access it, we should print out the values ahead of time.

11. **Role of Auxiliary Personnel:** If auxiliary personnel are available, have them help during group work to provide extra support.

12. **Summary of Assessment Data:** To be determined after lesson

13. **Family/Community:** Use a letter to parent explaining lesson.

14. **Reflection:**

- Are any further clarifications or modifications needed?
- Read through completed worksheets and determine if some concepts need more or less reinforcement.
- Did I get their attention?
- Was the motivator effective?
- Did I manage my time effectively?
- Did I include enough variation in the lesson?
- Did anything occur that I didn't plan for?
- If I repeat the lesson, what should I change?

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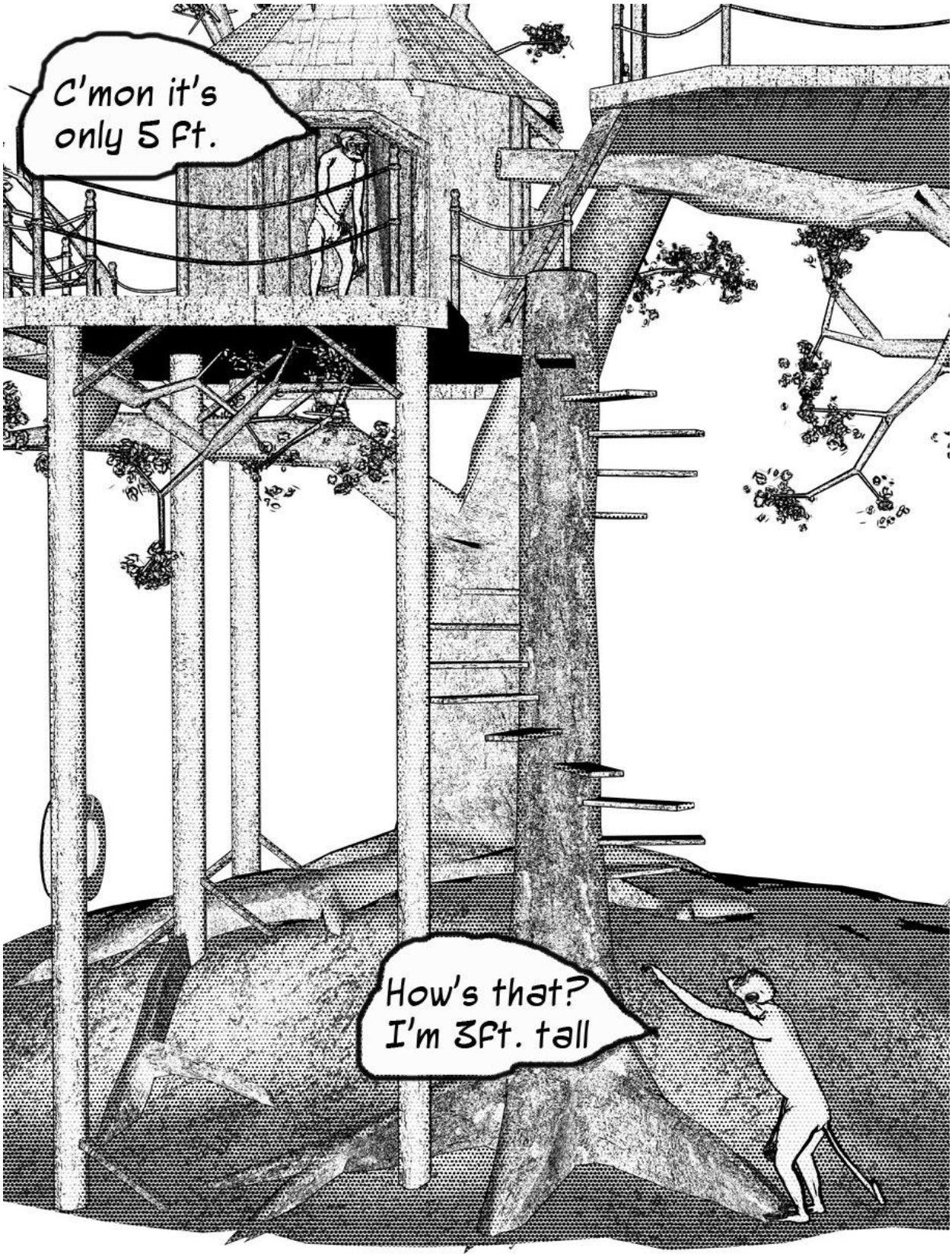
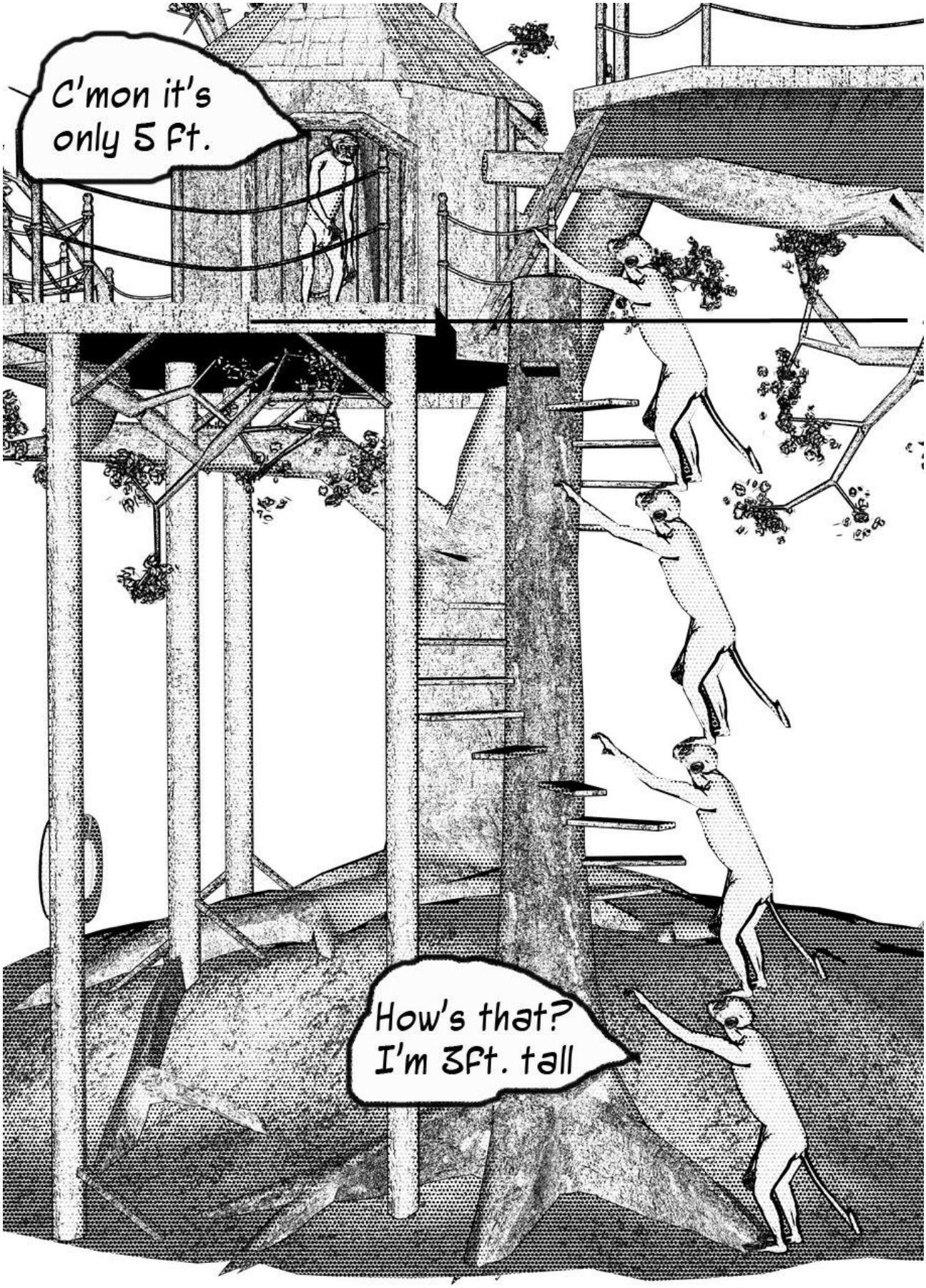
Tree House Cartoon




C'mon it's only 5 ft.
How's that? I'm 3ft. tall

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Name: _____

On October 12, 1999 the world population reached 6,000,000,000 people. If on average the world population grows by 50 people every 19 seconds answer the following questions:

1. a) When will the world population reach 7 billion? Show your work and explain your answer.
   b) Draw a bar or line graph on the back to show your results.

2. The earth will continue to age, can you see a problem if we continue to grow the population at this rate? Explain your answer.

3. Using the given proportion, calculate the expected population today. Go to the website: http://www.census.gov/ipc/www/popclockworld.html and compare your results. What are some reasons they may be different?