

## 2.3

### Designing a Fair Game

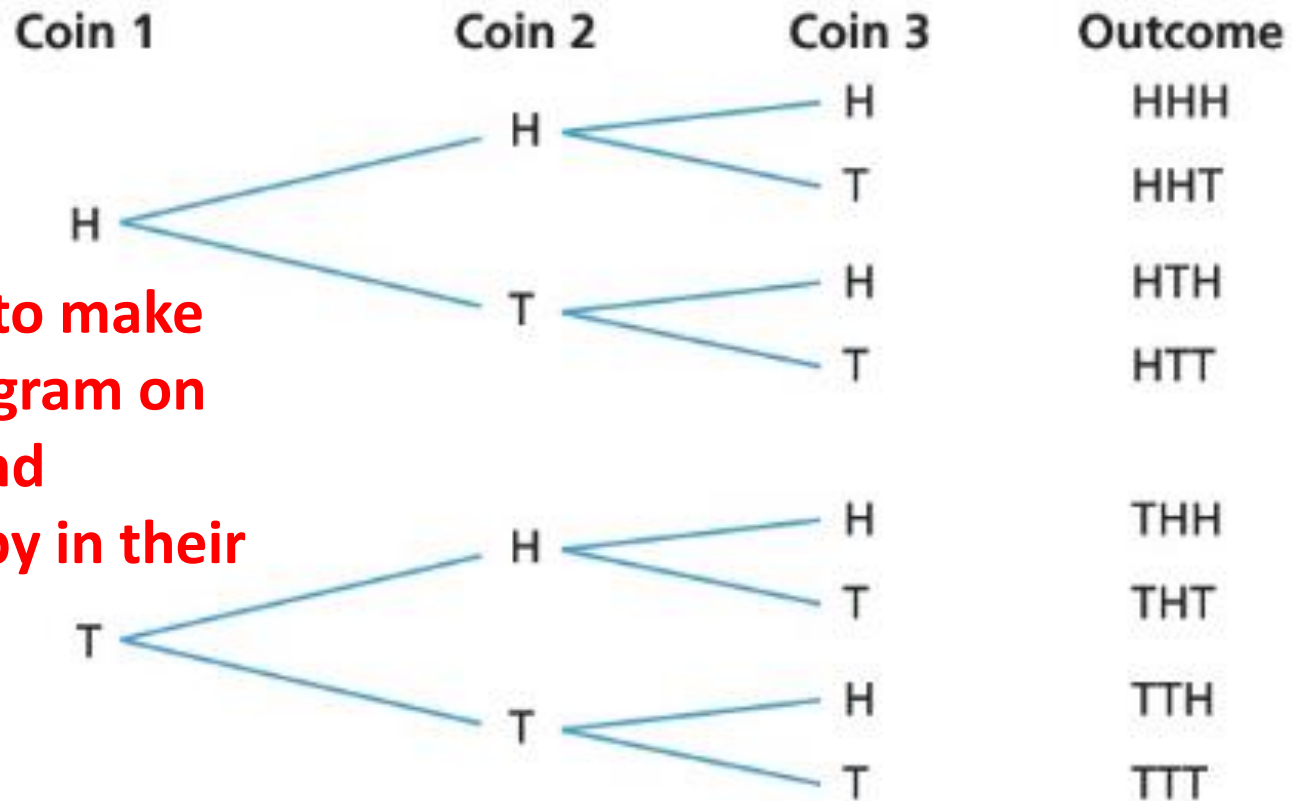
Pondering Possible and Probable

Santo and Tevy are playing a game with coins. They take turns tossing three coins. If all three coins match, Santo wins. Otherwise, Tevy wins. Each player has won several turns in the game. Tevy, however, seems to be winning more often. Santo thinks the game is unfair. A **fair game** is a game in which all players have equal chances of winning.

***Focus Question:** How can you decide whether a game is fair or not?*



Santo drew the tree diagram below to represent tossing three coins. A **tree diagram** is an illustration using branches to show the sample space of an event. The **sample space** is another name for the set of possible outcomes of an event.



Model how to make this tree diagram on the board and students copy in their journals.



How can you decide if a game is fair or not?

### Problem 2.3

**A** Use the tree diagram from above to answer the following questions:

1. What is the sample space for tossing three coins?
2. How many possible outcomes are there when you toss three coins?  
Are the outcomes equally likely?

Outcome

HHH

HHT

HTH

HTT

THH

THT

TTH

TTT

1. The **sample space** for tossing three coins is the list of **all** possible outcomes.
2. There are **8 possible outcomes**, and they are ***all equally likely***.

## Problem 2.3

3. What is the theoretical probability that the three coins will match?

Outcome

HHH ★

HHT ★

HTH ★

HTT ★

THH ★

THT ★

TTH ★

TTT ★

$$P(3 \text{ coins match}) = 2/8 \text{ or } 1/4$$

4. What is the theoretical probability that exactly two coins will match?

$$P(\text{exactly 2 coins match}) = 6/8 \text{ or } 3/4$$

5. Is the game played by Santo and Tevy a fair game? If so, explain why. If not, explain how to make it fair.

**No, this is not a fair game. Tevy has more chances to score a point (2 coins match), so he is more likely to win.**

## Problem 2.3

- B** Suppose you tossed three coins for 24 trials. How many times would you expect two coins to match?

You would expect exactly 2 coins to match  $\frac{3}{4}$  of the time.  $\frac{3}{4}$  of 24 = 18

$P(\text{exactly 2 coins match}) = 18/24$  trials

- C** Santo said, "It is *possible* to toss three coins and have them match." Tevy replied, "Yes, but is it *probable*?" What do you think each boy meant?

Santo means that all 3 coins match sometimes. Tevy is saying the probability is less than  $\frac{1}{2}$ .

If time, model building another tree diagram.



HW: p39: 11 - 12