

## 7.1: Experiments, Sample Spaces, and Events

- An **experiment** is an activity with observable results.
- The results of the activity are called **outcomes or sample points**.
- **Sample space** (denoted  $S$ ) is the set consisting of all possible sample points.
- **Event** is a subset of a sample space of an experiment. An **elementary (simple) event** is an event that has a single outcome.
- The empty set,  $\emptyset$ , represents an **impossible event**. It can NOT happen.
- Each repetition of an experiment is called a **trial**.
- The sample space is called the **certainty event**.

EXAMPLE 1. *A box contains 13 red chalks, 41 blue chalks, 20 yellow chalks, and 1 white chalk. One chalk is drawn from the box and the color is noted. What is the sample space?*

EXAMPLE 2. *Describe the sample space associated with an experiment of tossing a coin and observing whether it falls heads or tails. What are the events of this experiment?*

EXAMPLE 3. *An experiment consists of selecting a letter at random from the letters in the word MULTIPLICATION and observing the outcomes.*

(a) *What is an appropriate sample space for this experiment?*

(b) *Describe the event “the letter selected is a vowel”.*

EXAMPLE 4. A box contains 2010 yellow items, 2011 green items, and a purple item. Two items are drawn in succession from the box without replacing the item drawn. The colors of the items are noted. What is the sample space?

- The **union of two events**,  $E$  and  $F$ , is the event  $E \cup F$ . (Thus, the event  $E \cup F$  consists of the set of outcomes of  $E$  and/or  $F$ .)
- The **intersection of two events**,  $E$  and  $F$ , is the event  $E \cap F$ . (Thus, the event  $E \cap F$  consists of the set of outcomes common to  $E$  and  $F$ .)
- The **compliment of the event**  $E$ , is the event  $E^c$ . (Thus, the event  $E^c$  is the set containing all outcomes in the sample space  $S$  that are not in  $E$ .)
- **Mutually exclusive** means the same as disjoint.

EXAMPLE 5. True/False. For events  $E, F$ , and  $G$  of the same experiment, if  $E$  and  $F$  are mutually exclusive and  $E$  and  $G$  are mutually exclusive, then are  $F$  and  $G$  mutually exclusive? Explain.

EXAMPLE 6. A six sided die is rolled (numbered 1 – 6). If a six or a one is rolled the die is rolled a second time. The total sum of the numbers rolled is recorded.

(a) What is the sample space?

(b) Give the event,  $E$ , that an odd sum was recorded.

(c) Give the event,  $F$ , that a sum greater than 7 was recorded.

(d) Determine if  $E$  and  $F$  are mutually exclusive.

EXAMPLE 7. An experiment consists of studying the composition of a 3-child family in which the children are born at different times.

(a) Describe an appropriate sample space for this experiment.

(b) Describe the event,  $E$ , that there are 2 girls and 1 boy.

(c) Describe the event,  $F$ , that the oldest child is a girl.

(d) Describe the event,  $G$ , that the oldest child is a girl, and the youngest child is a boy.