# Defining sets

To define a set using **roster method**, explicitly list its elements. That is, start with { then list elements of the set separated by commas and close with }.

To define a set using **set builder definition**, either form "The set of all $x$ from the universe $U$ such that $x$ is ..." by writing

$$\{x \in U \mid ...x...\}$$

or form "the collection of all outputs of some operation when the input ranges over the universe $U$" by writing

$$\{...x... \mid x \in U\}$$

We use the symbol $\in$ as "is an element of" to indicate membership in a set.

**Example sets**: For each of the following, identify whether it's defined using the roster method or set builder notation and give an example element.

$\{-1, 1\}$

$\{0, 0\}$

$\{-1, 0, 1\}$

$\{(x, x, x) \mid x \in \{-1, 0, 1\}\}$

$\{\}$

$\{x \in \mathbb{Z} \mid x \geq 0\}$

$\{x \in \mathbb{Z} \mid x > 0\}$

$\{\mathtt{A}, \mathtt{C}, \mathtt{U}, \mathtt{G}\}$

$\{\mathtt{AUG}, \mathtt{UAG}, \mathtt{UGA}, \mathtt{UAA}\}$

# Rna def

RNA is made up of strands of four different bases that match up in specific ways.
The bases are elements of the set $B = \{\mathtt{A}, \mathtt{C}, \mathtt{U}, \mathtt{G}\}$.

Formally, to define the set of all RNA strands, we need more than roster method or set builder descriptions.

**New! Recursive Definitions of Sets**: The set $S$ (pick a name) is defined by:

| | |
|---|---|
| Basis Step: | Specify finitely many elements of $S$ |
| Recursive Step: | Give rule(s) for creating a new element of $S$ from known values existing in $S$, and potentially other values. |

The set $S$ then consists of all and only elements that are put in $S$ by finitely many (a nonnegative integer number) of applications of the recursive step after the basis step.

**Definition** The set of nonnegative integers $\mathbb{N}$ is defined (recursively) by:

Basis Step:
Recursive Step:

Examples:

**Definition** The set of all integers $\mathbb{Z}$ is defined (recursively) by:

Basis Step:
Recursive Step:

Examples:

**Definition** The set of RNA strands $S$ is defined (recursively) by:

| | |
|---|---|
| Basis Step: | $\mathtt{A} \in S, \mathtt{C} \in S, \mathtt{U} \in S, \mathtt{G} \in S$ |
| Recursive Step: | If $s \in S$ and $b \in B$, then $sb \in S$ |

where $sb$ is string concatenation.

Examples:

**Definition** The set of bitstrings (strings of 0s and 1s) is defined (recursively) by:

Basis Step:
Recursive Step:

*Notation:* We call the set of bitstrings $\{0, 1\}^*$.

Examples: