## Defining sets

To define 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.

## Rna def

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

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:  $A \in S, C \in S, U \in S, G \in S$ 

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: