directional change

predicting change

cyclic change

monitoring change

9-12

Trends that follow a pattern that can be described mathematically can be used to estimate how long a process has been going on.

The precise future of a system is not completely determined by its present state and circumstances but also depends on the fundamentally uncertain outcomes of events on the atomic scale.

Cyclic change is commonly found when there are feedback effects in a system -- as, for example, when a change in any direction gives rise to forces or influences that oppose the change.

It is not always easy to recognize meaningful patterns of change in a set of data. Data that appear to be completely irregular may be shown by statistical analysis to have underlying trends or cycles. On the other hand, trends or cycles that appear in

The present arises from the conditions of the past and, in turn, affects what is possible in the future.

Most systems above the molecular level involve so many parts that it is not practical to determine the existing conditions, and thus the precise behavior of every part of the system cannot be predicted.

Graphs and equations are useful (and often equivalent) ways for depicting and analyzing patterns of change.

6-8

Small differences in how things start out can sometimes produce large differences in how they end up. Some events are so sensitive to small differences in initial conditions that their outcomes cannot be predicted.

Symbolic equations can be used to summarize how the quantity of something changes over time or in response to other changes.

The way some systems behave is so erratic that patterns of change are not apparent.

The graphic display of numbers may help to show patterns such as trends, varying rates of change, gaps, or clusters that are useful when making predictions about the phenomena being graphed.

Cyclic patterns evident in past events can be used to make predictions about future events. However, these predictions may not always match what actually happens.

Trends based on what has happened in the past can be used to make predictions about what things will be like in the future. However, these predictions may not always match what actually happens.

Cycles, such as the seasons or body temperature, can be described by what their cycle length or frequency is, what their highest and lowest values are, and when these values occur. Different cycles range from many years down to

3-5

Graphical display of quantities may make it possible to spot patterns that are not otherwise obvious, such as cycles and trends.

Some things, such as a person's age, change in only one direction.

Some things in nature have a repeating pattern, such as the day-night cycle, the phases of the moon, and seasons.

Often the best way to tell which kinds of change are happening is to make a table or graph of measurements.

Things change in steady, repetitive, or erratic ways -- or sometimes in more than one way at the same time.

K-2

Objects change in some ways and stay the same in some ways.

Small changes can sometimes be detected by comparing counts or measurements at different times.

An object can change in various ways, such as in size, weight, color, or temperature.

Some things change so slowly or so quickly that the changes are hard to notice while they are taking place.

People can keep track of some things, seeing where they come from and where they go.