Understand the concept of a linear or exponential function and use function notation. Recognize arithmetic and geometric sequences as examples of linear and exponential functions (F.IF.1-3)

**Standard I.F.IF.1:** Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If \( f \) is a function and \( x \) is an element of its domain, then \( f(x) \) denotes the output of \( f \) corresponding to the input \( x \). The graph of \( f \) is the graph of the equation \( y=f(x) \).

<table>
<thead>
<tr>
<th>Concepts and Skills to Master</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Understand the definition of a function in terms of mapping elements from one set (domain) to another set (range).</td>
</tr>
<tr>
<td>• Explain how a given representation of a function (graph, table, equation, context, geometric model) can be used to identify elements of the domain and corresponding elements of the range ( (x, f(x)) ).</td>
</tr>
<tr>
<td>• Understand the graph of ( f ) is the graph of the equation ( y=f(x) ).</td>
</tr>
</tbody>
</table>

**Related Standards: Current Course**

| All function standards (functions are used throughout high school mathematics courses), **I.A.REI.10, I.F.IF.5** |

**Related Standards: Future Courses**

| All function standards (functions are used throughout high school mathematics courses) |

**Support for Teachers**

**Critical Background Knowledge**

• A function is a rule that assigns to each input exactly one output (**8.F.1**)
• Multiple representations (tables, graphs, equations, context, geometric models) (**8.F.2**)

**Academic Vocabulary**

Domain, range, function, input, output, corresponding, set, element

**Resources**

**Curriculum Resources:** [http://www.uen.org/core/core.do?courseNum=5630#71625](http://www.uen.org/core/core.do?courseNum=5630#71625)
Understand the concept of a linear or exponential function and use function notation. Recognize arithmetic and geometric sequences as examples of linear and exponential functions (F.IF.1-3)

**Standard I.F.IF.2:** Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.

**Concepts and Skills to Master**
- Use function notation
- Evaluate functions, including functions created using arithmetic operations (example: \( f(x) + g(x) \) or \( f(x) - g(x) \)).
- Interpret statements that use function notation in terms of a context (example: given a context, explain \( f(5) = 12 \)).

**Related Standards: Current Course**
- All function standards (function notation is used throughout high school mathematics courses)

**Related Standards: Future Courses**
- All function standards (function notation is used throughout high school mathematics courses)

**Support for Teachers**

**Critical Background Knowledge**
- Evaluate expressions (6.EE.2c)

**Academic Vocabulary**
- Function notation, evaluate, input, domain, output, range

**Resources**
- Curriculum Resources: [http://www.uen.org/core/core.do?courseNum=5630#71625](http://www.uen.org/core/core.do?courseNum=5630#71625)
Understand the concept of a linear or exponential function and use function notation. Recognize arithmetic and geometric sequences as examples of linear and exponential functions (F.IF.1-3)

**Standard I.F.IF.3:** Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. Recognize arithmetic and geometric sequences as examples of linear and exponential functions. *For example, the Fibonacci sequence is defined recursively by* \( f(0)=f(1)=1, f(n+1)=f(n)+f(n-1) \) for \( n \geq 1 \).

### Concepts and Skills to Master
- Recognize that sequences are functions (recognize the domain is the number of the term and the range is the value of the term).
- Define and express a recursive sequence as a function.
- Recognize that a sequence has a domain which is a subset of integers.

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<tr>
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<tbody>
<tr>
<td>I.F.BF.1a, I.F.BF.2, I.F.LE.1, I.F.LE.2</td>
<td>II.F.BF.1a, III.A.SSE.4</td>
</tr>
</tbody>
</table>

### Support for Teachers

**Critical Background Knowledge**
- Use function notation (I.F.IF.2)
- Understand definition of function (B.F.1 and I.F.IF.1)
- Recognize sequences (taught concurrently with I.F.BF.1, I.F.BF.2)

**Academic Vocabulary**
- Recursive, sequence, functions, domain, range, subset, term

**Resources**
- [Curriculum Resources](http://www.uen.org/core/core.do?courseNum=5630#71625)
Interpret linear or exponential functions that arise in applications in terms of a context (F.IF.4-6)

**Standard I.F.IF.4:** For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. **Key features include intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; and end behavior.**

**Concepts and Skills to Master**

- Given a graph, identify key features including x- and y-intercepts; *intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; and end behavior.*
- Given a table of values, identify key features such as x- and y-intercepts; *intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; and end behavior.*
- Use key features to sketch a graph of the function.
- Use interval notation and symbols of inequality to communicate key features of graphs.

**Related Standards: Current Course**

| I.F.IF.4, I.F.IF.7, F.IF.9, I.F.LE.1, I.F.LE.3 |

**Related Standards: Future Courses**

| II.F.IF.4, II.F.IF.6, II.F.IF.7, II.F.IF.9, II.F.LE.3, III.F.IF.4, III.F.IF.6, III.F.IF.7 |

**Support for Teachers**

**Critical Background Knowledge**

- Ability to graph a linear *8.F.2* or exponential function from a table or equation

**Academic Vocabulary**

Increasing, decreasing, positive, negative, intervals, intercepts, interval notation, maximum, minimum, symmetry, and end behavior

**Resources**

*Curriculum Resources:* [http://www.uen.org/core/core.do?courseNum=5630#71625](http://www.uen.org/core/core.do?courseNum=5630#71625)
Interpreting Linear and Exponential Functions

Core Guide

Secondary Math I

Interpret linear or exponential functions that arise in applications in terms of a context (F.IF.4-6)

**Standard I.F.IF.5:** Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. For example, if the function \( h(n) \) gives the number of person-hours it takes to assemble \( n \) engines in a factory, then the positive integers would be an appropriate domain for the function.

**Concepts and Skills to Master**
- Identify domain of a function from any representation.
- Relate the domain to context, explaining restrictions as a result of the context.

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<th>Related Standards: Future Courses</th>
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<td>I.A.CED.2, All functions standards (domain is used throughout high school mathematics courses)</td>
<td>II.A.CED.2, All functions standards (domain is used throughout high school mathematics courses)</td>
</tr>
</tbody>
</table>

**Support for Teachers**

**Critical Background Knowledge**
- Familiarity with function notation and domain (**I.F.IF.2**)
- Understand the definition of function (**8.F.1** and **I.F.IF.1**)  
- Independent, dependent variables and input/output (**8.F.1**)

**Academic Vocabulary**
- Domain, function

**Resources**
- **Curriculum Resources:** [http://www.uen.org/core/core.do?courseNum=5630#71625](http://www.uen.org/core/core.do?courseNum=5630#71625)
Interpreting Linear and Exponential Functions

Core Guide

Secondary Math I

I.

F.IF

.6

Interpret linear or exponential functions that arise in applications in terms of a context (F.IF.4-6)

**Standard I.F.IF.6:** Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.

**Concepts and Skills to Master**

- Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Focus on linear and exponential functions.
- Estimate the rate of change from a graph.

**Related Standards: Current Course**

I.F.IF.9, I.F.LE.1, I.F.LE.3, I.S.ID.6, I.S.ID.7

**Related Standards: Future Courses**

II.F.IF.6, II.F.IF.9, II.F.LE.3, III.F.IF.6, III.F.IF.9, III.F.LE.3

**Support for Teachers**

**Critical Background Knowledge**

- Determine the rate of change from a description of a relationship or from two (x,y) values and interpret its meaning (8.F.4)
- Explain the slope \( m \) between any two points on a non-vertical line (8.EE.6)

**Academic Vocabulary**

- Average rate of change, interval

**Resources**

[Curriculum Resources](http://www.uen.org/core/core.do?courseNum=5630#71625)
Analyze linear or exponential functions using different representations (F.IF.7,9)

**Standard I.F.IF.7:** Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. □

- a. Graph linear functions and show intercepts.
- e. Graph exponential functions, showing intercepts and end behavior.

## Concepts and Skills to Master

- Given an equation of a linear or exponential function, create a graph by hand and show key features (intercepts, end behavior).
- Given an equation of a linear or exponential function, create a graph with technology and show key features (intercepts, end behavior).

### Related Standards: Current Course

- I.F.IF.4, I.F.IF.5, I.F.IF.6, I.A.REI.6, I.A.REI.11, I.A.REI.12, I.F.BF.3

### Related Standards: Future Courses

- II.F.IF.4, II.F.IF.7a, b, III.F.IF.4, III.F.IF.7b, c, d, e

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**Support for Teachers**

**Critical Background Knowledge**

- Graph linear functions (8.EE.5, 8.F.3, and 8.F.5)

**Academic Vocabulary**

- Linear, exponential, intercept, end behavior

**Resources**

- **Curriculum Resources:** [http://www.uen.org/core/core.do?courseNum=5630#71625](http://www.uen.org/core/core.do?courseNum=5630#71625)
Analyze linear or exponential functions using different representations (F.IF.7,9)

**Standard I.F.IF.9:** Compare properties of two functions, each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, compare the growth of two linear functions, or two exponential functions such as \( y=3^n \) and \( y=100\cdot2^n \).

**Concepts and Skills to Master**
- Compare properties of two functions, keeping the following in mind:
  - properties include rate of change, intercepts, end behavior
  - function pairs include linear to linear, linear to exponential, exponential to exponential
  - representations include algebraically, graphically, numerically in tables, or by verbal descriptions

**Related Standards: Current Course**
- I.F.IF.4, I.F.IF.7, I.F.LE.3, I.S.ID.7

**Related Standards: Future Courses**
- II.F.IF.4, II.F.IF.7, II.F.LE.3, III.F.IF.4, III.F.IF.7, III.F.LE.3

**Support for Teachers**

**Critical Background Knowledge (Activating prior knowledge)**
- Compare properties of two functions (linear to linear), each represented in a different way (8.F.2)
- Interpret the equation of \( y = mx+b \) as defining a linear function (8.F.3)
- Construct a function, determine and interpret a rate of change and initial value of a linear function (8.F.4)
- Analyze graphs (increasing, decreasing, linear or nonlinear) (8.F.5)

**Academic Vocabulary**
- function, slope, rate of change, intercept, interval, growth rate

**Resources**
- Curriculum Resources: http://www.uen.org/core/core.do?courseNum=5630#71625