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**Learning Objective:** We will convert repeating decimals to fractions. (Lesson 73)

**Activating Prior Knowledge:**
We can solve systems of equations using substitution

| | |
|---|---|
| $\begin{cases} x+y=15 \\ y=3x-3 \end{cases}$<br>$x+3x-3=15$<br>$4x-3=15$<br>$+3 \quad +3$<br>$\frac{4x}{4}=\frac{18}{4}$<br>$\boxed{x=\frac{9}{2}}$<br>$\frac{9}{2}+y=\frac{30}{2}$<br>$\boxed{y=\frac{21}{2}}$ | $y=-2x+21$<br>$\begin{cases} 2x+y=21 \\ y=3x+1 \end{cases}$<br>$-2x+21=3x+1$<br>$-1 \quad -1$<br>$-2x+20=3x$<br>$+2x \quad +2x$<br>$20=5x$<br>$\boxed{4=x}$<br>$y=3(4)+1$<br>$y=12+1$<br>$\boxed{y=13}$ |

$.31=\frac{31}{100}$

**Concept Development:**

**Repeating Decimals:** Numbers with infinite decimal expansions that repeat are rational numbers.

Example: $\frac{4}{11}$, $0.\overline{253}$

$11\overline{)4}=.\overline{36}$

We would know what to do to convert 0.35 to a fraction, but what about $0.\overline{35}$?

$\frac{35}{100}=\frac{7}{20}$  $\frac{35}{99}$

**We can use linear equations to convert repeating decimals into fractions.**

Even though repeating decimals are infinite, when we work with them, we treat them as finite. Why? After a certain number of decimals, the difference is insignificant.

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## Guided Practice:

**Steps to Converting from a Repeating Decimal to a Fraction**

1. Let $x$ equal the repeating decimal.
2. Multiply both sides of the equation by a power of ten depending on how many digits are repeating.
3. Rewrite the right side as a whole number plus $x$.
4. Use properties of equality to isolate your variable.

| | |
|---|---|
| $0.\overline{81} = 0.818181\ldots$<br>Let $x = 0.\overline{81}$<br>$100x = 100(0.\overline{81})$<br>$100x = 81.\overline{81}$<br>$100x = 81 + x$<br>$-x \quad -x$<br>$\frac{99x}{99} = \frac{81}{99}$<br>$x = \frac{81}{99} = \boxed{\frac{9}{11}}$ | $0.\overline{39}$<br>$x = 0.\overline{39}$<br>$100x = 39.\overline{39}$<br>whole number repeating<br>$100x = 39.\overline{39}$<br>$100x = 39 + x$<br>$-x \quad -x$<br>$\frac{99x}{99} = \frac{39}{99}$<br>$\boxed{x = \frac{39}{99} = \frac{13}{33}}$ |
| $0.\overline{123}$<br>$x = 0.\overline{123}$<br>$1000x = 123.\overline{123}$<br>$1000x = 123 + x$<br>$-x \quad -x$<br>$\frac{999x}{999} = \frac{123}{999}$<br>$\boxed{x = \frac{123}{999} = \frac{41}{333}}$ | $0.\overline{567}$<br>$x = 0.\overline{567}$<br>$1000x = 567.\overline{567}$<br>$1000x = 567 + x$<br>$-x \quad -x$<br>$\frac{999x}{999} = \frac{567}{999}$<br>$\boxed{x = \frac{567}{999} = \frac{189}{333} = \frac{63}{111} = \frac{21}{37}}$ |

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| | |
|---|---|
| $2.13\overline{8}$<br>$x = 2.13\overline{8}$<br>$\rightarrow 100x = 213.\overline{8}$<br>$y = .\overline{8}$<br>$10y = 8.\overline{8}$<br>$10y = 8 + y$<br>$9y = 8$<br>$y = \frac{8}{9}$<br>$100x = 213 + \frac{8}{9}$<br>$\frac{100x}{100} = \frac{\frac{1925}{9}}{100}$<br>$x = \frac{1925 \div 25}{900 \div 25} = \frac{77}{36}$ | $\rightarrow$ $1.6\overline{23}$ |

**INDEPENDENT PRACTICE:**

| | |
|---|---|
| $1.\overline{12}$ | $0.03\overline{2}$ |

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| | |
|---|---|
| $0.\overline{312}$ | $1.90\overline{32}$ |
| $0.\overline{50}$ | $3.0\overline{15}$ |

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## Closure:

What is the difference in how you'd convert the two repeating decimals to fractions:

$$2.\overline{34} \ \ v. 2.3\overline{4}$$

## Notes:

This maps to Lesson 10 from Module 7