Unit 3 Lesson 5: Negative Rational Exponents

1 Math Talk: Don't Be Negative (Warm up)

Student Task Statement

Evaluate mentally.

9^2 9^{-2} $9^{\frac{1}{2}}$ $9^{-\frac{1}{2}}$

2 Negative Fractional Powers Are Just Numbers

Student Task Statement

1. Complete the table as much as you can without using a calculator. (You should be able to fill in three spaces.)

x	-2	$-\frac{5}{3}$	$-\frac{4}{3}$	-1	$-\frac{2}{3}$	$-\frac{1}{3}$	0
2^x (using exponents)	2^{-2}	$2^{-\frac{5}{3}}$	$2^{-\frac{4}{3}}$	2^{-1}	$2^{-\frac{2}{3}}$	$2^{-\frac{1}{3}}$	2^0
2^x (decimal approximation)							

a. Plot these powers of 2 in the coordinate plane.

b. Connect the points as smoothly as you can.

c. Use your graph of $y = 2^x$ to estimate the value of the other powers in the table, and write your estimates in the table.
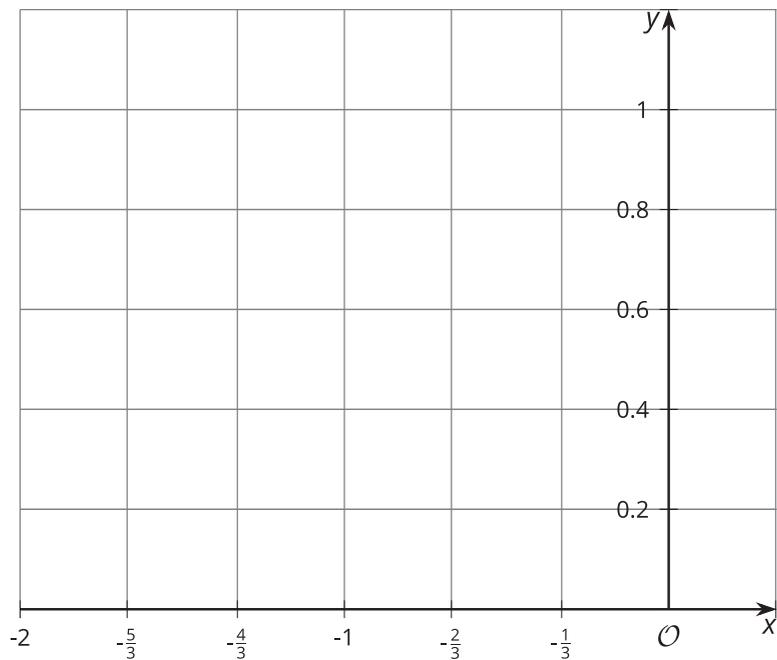
2. Let's investigate $2^{-\frac{1}{3}}$.

a. Write $2^{-\frac{1}{3}}$ using radical notation.

b. What is the value of $\left(2^{-\frac{1}{3}}\right)^3$?

c. Raise your estimate of $2^{-\frac{1}{3}}$ to the third power. What should it be? How close did you get?

3. Let's investigate $2^{-\frac{2}{3}}$.

a. Write $2^{-\frac{2}{3}}$ using radical notation.

b. What is $\left(2^{-\frac{2}{3}}\right)^3$?

c. Raise your estimate of $2^{-\frac{2}{3}}$ to the third power. What should it be? How close did you get?

3 Any Fraction Can Be an Exponent

Student Task Statement

1. For each set of 3 numbers, cross out the expression that is not equal to the other two expressions.

   a. $8^{\frac{4}{5}}$, $\sqrt[4]{8}^{5}$, $\sqrt[5]{8}^{4}$

   b. $8^{-\frac{4}{5}}$, $\dfrac{1}{\sqrt[5]{8^{4}}}$, $-\dfrac{1}{\sqrt[5]{8^{4}}}$

   c. $\sqrt{4^{3}}$, $4^{\frac{3}{2}}$, $4^{\frac{2}{3}}$

   d. $\dfrac{1}{\sqrt{4^{3}}}$, $-4^{\frac{3}{2}}$, $4^{-\frac{3}{2}}$

2. For each expression, write an equivalent expression using radicals.

   a. $17^{\frac{3}{2}}$

   b. $31^{-\frac{3}{2}}$

3. For each expression, write an equivalent expression using only exponents.

   a. $\left(\sqrt{3}\right)^{4}$

   b. $\dfrac{1}{\left(\sqrt[3]{5}\right)^{6}}$

4 Make These Exponents Less Complicated (Optional)

Student Task Statement

Match expressions into groups according to whether they are equal. Be prepared to explain your reasoning.

$$\left(\sqrt{3}\right)^4 \qquad\qquad \sqrt{3^2} \qquad\qquad \left(3^{\frac{1}{2}}\right)^4 \qquad\qquad (\sqrt{3})^2 \cdot (\sqrt{3})^2$$

$$\left(3^2\right)^{\frac{1}{2}} \qquad\qquad 3^2 \qquad\qquad 3^{\frac{4}{2}} \qquad\qquad \left(3^{\frac{1}{2}}\right)^2$$