Calculating Time Spent on Different Modes (for 5th & 6th graders)

**Problem Description**

U.S. Map Showing Origin and Destination Cities

**5 & 6th Grades Activity**

Calculation Table

- Miles to Disneyland in Anaheim, CA using mode of transit
- Additional stops and estimated time
- Carbon output per Sam’s family member

Further Discussion

**Problem Description**

Sam’s family (2 adults and 2 kids) is having a family reunion in Disneyland. About how long will it take Sam’s family from (city, state pulled at random from a hat or app) to arrive at Disneyland in Anaheim, California if they traveled by ______.

- Also discuss which is most direct route
- Personal vehicles will need to stop for bathroom/food breaks vs trains
- May encounter other obstacles more likely to slow vehicles (poor weather, fatigue of driver, road blockages, congestion, etc.)
- 7 suggested originating cities for students to do the calculations
  - Albuquerque, NM
  - Portland, OR
  - Seattle, WA
  - Salt Lake City, UT
  - Phoenix, AZ
  - Denver, CO
  - Helena, MT
U.S. Map Showing Origin and Destination Cities
## 5 & 6th Grades Activity

### Calculation Table

<table>
<thead>
<tr>
<th>Team (city, state):</th>
<th>Car (sedan)</th>
<th>Electric Car (sedan)</th>
<th>Bus</th>
<th>Electric Train</th>
<th>High Speed Rail</th>
<th>Passenger plane</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Average miles per fuel tank: 400</td>
<td>Average miles per charge: 250</td>
<td>Average miles per tank: 500</td>
<td>Average miles: 150</td>
<td>Average miles per trip: 150</td>
<td>Average miles per trip: 100</td>
</tr>
<tr>
<td>Average Number of Passengers</td>
<td>4</td>
<td>4</td>
<td>50</td>
<td>150</td>
<td>150</td>
<td>100</td>
</tr>
<tr>
<td><strong>Miles to Anaheim, CA using mode of transit</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Additional stops (i.e. restroom, food, sleep, etc.) and estimated time</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average speed</td>
<td>70mph</td>
<td>60mph</td>
<td>70mph</td>
<td>90mph</td>
<td>150mph</td>
<td>575mph</td>
</tr>
<tr>
<td>Direct carbon output</td>
<td>404 grams of CO₂ per mile</td>
<td>190 grams of CO₂ per mile</td>
<td>2,680 grams of CO₂ per mile</td>
<td>67 grams of CO₂ per mile</td>
<td>10 grams of CO₂ per mile</td>
<td>900 grams of CO₂ per mile</td>
</tr>
<tr>
<td>Carbon output per Sam’s family member</td>
<td>117,261 g CO₂ or 117 kg CO₂ per mile</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Estimated total travel time</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
How to Solve the Problems

Miles to Disneyland in Anaheim, CA using mode of transit
Research how far your assigned city is from Anaheim, CA. You can use Google Maps to calculate the distance from the originating city to the destination.

Additional stops and estimated time
Discuss with your group how many times along the way Sam and his family have to stop for restroom, meal, and sleep breaks. How long will each stop take? And how will the stops affect the total travel time?

Carbon output per Sam’s family member

\[
\frac{(\text{Carbon output of transportation mode } \times \text{miles traveled})}{\text{Average number of passengers}} = \text{Carbon output per passenger per mile}
\]

For example, Seattle to Anaheim by Car \( = \frac{(404 \text{ g} \times 1161 \text{ mile})}{4} = 117,261 \text{ g CO}_2 \text{ per mile per passenger OR 117 kg CO}_2 \text{ per mile per passenger}\)

To determine which transportation option is the most efficient, look for the lowest number of carbon output per passenger per mile.

Further Discussion
What if the bus, train or plane was mostly empty? What if the bus, train or plane carried the same amount of people? Then which would be more efficient?