```
# Install Qiskit if not already installed
!pip install qiskit matplotlib

from qiskit.quantum_info import Statevector
from qiskit.visualization import plot_bloch_multivector
import numpy as np
import matplotlib.pyplot as plt

# 1. Define a quantum state (qubit)
# Example 1: Ground state |0>
qubit_state_0 = Statevector([1, 0])
print("Ground state |0>:")
display(qubit_state_0.draw('latex'))

# Example 2: Excited state |1>
qubit_state_1 = Statevector([0, 1])
print("Excited state |1>:")
display(qubit_state_1.draw('latex'))

# Example 3: Superposition state (|0> + |1>)/sqrt(2)
qubit_state_plus = Statevector([1/np.sqrt(2), 1/np.sqrt(2)])
print("Superposition state |+>:")
display(qubit_state_plus.draw('latex'))

# Example 4: A general qubit state (e.g., 30 degrees from |0> towards |1>)
# You can define any complex amplitudes a and b such that |a|^2 + |b|^2 = 1
alpha = np.cos(np.pi/4) # Example: 45 degrees
beta = np.sin(np.pi/4)  # Example: 45 degrees
general_qubit_state = Statevector([alpha, beta])
print("General qubit state (alpha|0> + beta|1>):")
display(general_qubit_state.draw('latex'))

# 2. Visualize the states on a Bloch sphere
print("\nVisualizing states on Bloch sphere:")

# Plotting multiple states on the same Bloch sphere visualization
# Note: plot_bloch_multivector expects statevectors or density matrices

fig_0 = plot_bloch_multivector(qubit_state_0, title="Ground State |0>")
display(fig_0)

fig_1 = plot_bloch_multivector(qubit_state_1, title="Excited State |1>")
display(fig_1)

fig_plus = plot_bloch_multivector(qubit_state_plus, title="Superposition State |+>")
display(fig_plus)

fig_general = plot_bloch_multivector(general_qubit_state, title="General Qubit State")
display(fig_general)

plt.show()
```

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Collecting qiskit
  Downloading qiskit-2.4.1-cp310-abi3-manylinux_2_28_x86_64.whl.metadata (12 kB)
Requirement already satisfied: matplotlib in /usr/local/lib/python3.12/dist-packages (3.10.0)
Collecting rustworkx>=0.15.0 (from qiskit)
  Downloading rustworkx-0.17.1-cp39-abi3-manylinux_2_17_x86_64.manylinux2014_x86_64.whl.metadata (10 kB)
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Downloading rustworkx-0.17.1-cp39-abi3-manylinux_2_17_x86_64.manylinux2014_x86_64.whl (2.2 MB)
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Downloading stevedore-5.8.0-py3-none-any.whl (54 kB)
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Installing collected packages: stevedore, rustworkx, qiskit
Successfully installed qiskit-2.4.1 rustworkx-0.17.1 stevedore-5.8.0
Ground state |0>:
```

$$|0\rangle$$

```
Excited state |1>:
```

$$|1\rangle$$

```
Superposition state |+>:
```

$$\frac{\sqrt{2}}{2}|0\rangle + \frac{\sqrt{2}}{2}|1\rangle$$

```
General qubit state (alpha|0> + beta|1>):
```

$$\frac{\sqrt{2}}{2}|0\rangle + \frac{\sqrt{2}}{2}|1\rangle$$

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Visualizing states on Bloch sphere:
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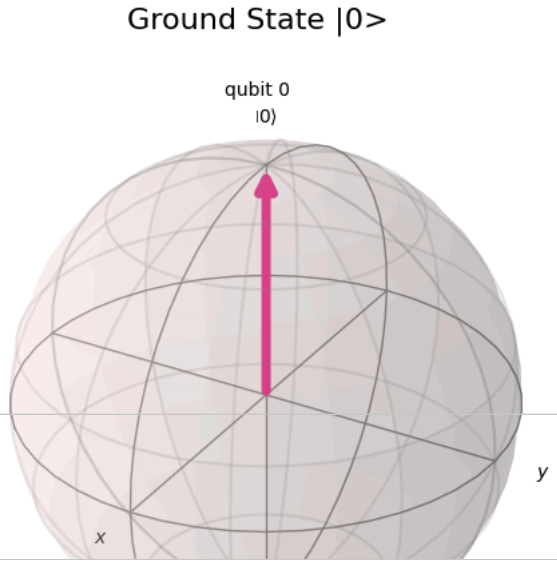

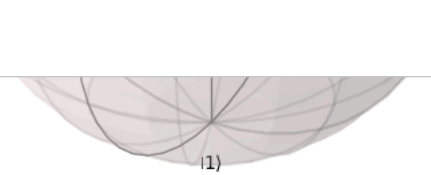

Excited State |1>

qubit 0

|0⟩