```
# Visual Analytics of Waste Management in Cities
import pandas as pd
import matplotlib.pyplot as plt

# ---------------------------
# 1️⃣ Create sample dataset
# ---------------------------
data = {
    'City': ['Chennai', 'Mumbai', 'Bengaluru', 'Hyderabad', 'Kolkata'],
    'Total_Waste_Tonnes': [4500, 5200, 4800, 4000, 3800],
    'Recycled_Tonnes': [1200, 1600, 1500, 1000, 900],
    'Organic_Tonnes': [2000, 2200, 2100, 1800, 1700],
    'Hazardous_Tonnes': [300, 350, 320, 280, 260]
}

df = pd.DataFrame(data)

# Calculate recycling percentage
df['Recycling_Rate(%)'] = (df['Recycled_Tonnes'] / df['Total_Waste_Tonnes']) * 100

# ---------------------------
# 2️⃣ Visualization 1: Total waste per city
# ---------------------------
plt.figure(figsize=(8,5))
plt.bar(df['City'], df['Total_Waste_Tonnes'], color='teal')
plt.title('Total Waste Generated by City')
plt.xlabel('City')
plt.ylabel('Total Waste (Tonnes)')
plt.grid(axis='y', alpha=0.3)
plt.show()

# ---------------------------
# 3️⃣ Visualization 2: Recycling rate per city
# ---------------------------
plt.figure(figsize=(8,5))
plt.bar(df['City'], df['Recycling_Rate(%)'], color='orange')
plt.title('Recycling Rate by City')
plt.xlabel('City')
plt.ylabel('Recycling Rate (%)')
plt.grid(axis='y', alpha=0.3)
plt.show()

# ---------------------------
# 4️⃣ Visualization 3: Waste composition (Pie chart for Chennai)
# ---------------------------
city = 'Chennai'
city_data = df[df['City'] == city].iloc[0]
```

```
labels = ['Recycled', 'Organic', 'Hazardous', 'Others']
sizes = [
    city_data['Recycled_Tonnes'],
    city_data['Organic_Tonnes'],
    city_data['Hazardous_Tonnes'],
    city_data['Total_Waste_Tonnes'] - (city_data['Recycled_Tonnes'] +
city_data['Organic_Tonnes'] + city_data['Hazardous_Tonnes'])
]
colors = ['green', 'brown', 'red', 'grey']

plt.figure(figsize=(6,6))
plt.pie(sizes, labels=labels, autopct='%1.1f%%', colors=colors, startangle=90)
plt.title(f'Waste Composition in {city}')
plt.show()

# ---------------------------
# 5️⃣ Visualization 4: Comparison of Waste Types
# ---------------------------
waste_types = ['Recycled_Tonnes', 'Organic_Tonnes', 'Hazardous_Tonnes']
df.plot(x='City', y=waste_types, kind='bar', figsize=(10,6))
plt.title('Comparison of Different Waste Types by City')
plt.ylabel('Tonnes')
plt.grid(axis='y', alpha=0.3)
plt.show()
```