**The Challenges**

1. Plot the heads (or WTD) of the initial steady state condition. The gradient is not uniform for the initial steady state conditions - discuss the influences of recharge and the unconfined condition on this nonlinearity
   * Chart

     Description automatically generated
   * With recharge, the head gradients shift to the right increasing the head everywhere.
   * The system being unconfined results in a decrease in the cross-sectional area that the water is traveling through. This will cause a nonlinear drop in head
2. Determine if the system has reached steady state after 10 years - consider a point at the well and another at the center of the domain.
   * Chart, bar chart, histogram

     Description automatically generated
   * Steady state means that qin = qout and that flux does not change over time. If our dH/dx does not change at its respective location over time, then our system is in steady state.
   * Our dH/dx seem to be changing over time.
3. Repeat your run this time for 100 years and reconsider question 2 again.
   * Histogram

     Description automatically generated
   * I don’t believe the system is in steady state because dH/dx is changing over time.
4. Find the zone of influence of the well defined in two ways:
   * Based on the drawdown from the initial steady state to the end of simulation time (end of final no-pumping stress period).
     + Diagram, histogram

       Description automatically generated
     + The zone of influence looks to be between x=100 and x=420
   * Based on the drawdown from the end of the last pump-on stress period to the end of simulation time.
     + Chart

       Description automatically generated
     + The zone of influence looks to be the entire domain
5. Find a constant pumping rate (same throughout the year) that matches the head time series at the middle of the domain.
   * N/A Didn’t have to answer this
6. Find a constant pumping rate (same throughout the year) that matches the head time series at the well, leaving only a regular, repeating seasonal residual. Are the two pumping rates the same?
   * N/A

**Glossary questions:**

1. Explain the concept of stress periods in MODFLOW. How should you determine stress periods when setting up your model? How do they differ from timesteps?
   * Stress periods tell us when our system is changing in time. You need as many stress periods as when something in our simulation changes temporally. Timesteps are how often modflow solves for a solution.
2. What is the period length in MODFLOW? How does the meaning of the period length differ for a steady state vs non steady state solution?
   * Period length designates the length of each stress period. In steady-state, the period length is irrelevant because the system is not time-dependent. In non-steady state we make the period lengths to what we have defined our length units to be.
3. What does the nstep variable signify in MODFLOW and how does it relate to the stress periods and period lengths? List the pros and cons of taking large timesteps vs. small timesteps. Is there any limit to how large a time step you can take and if so what determines this limit?
   * The number of steps tells modflow when to solve for solutions. It tells us what time periods we are interested in. If we are interested in smaller timesteps, a higher timestep will be needed and vice versa. If the solution is steady state, the nstep I think could theoretically be as big or as small as we wanted. If we are using a transient model, nstep would be constrained to our time interval of interest.