# Instructions for creating and facilitating Genome Cache™

Along with these instructions, you have been provided with the following documents:

- A pdf of the "Gene Signs" needed for the pathways in the package(s) you selected. This document will contain between 80-150 signs depending on how many paths you selected.
- A pdf of the "Chromosome Signs." These signs help provide a framework for your Genome Walk and orient participants to what part of the genome they are exploring.
- A pdf of "Gene Sign Distances." This document tells you where to place each sign on *your* Genome Walk.
- A pdf of "Paths." This document lists the genetic points of interest along each pathway. This document can serve as a cheat-sheet as you help participants find their next stop.
- Paper versions of the activity, if requested*.

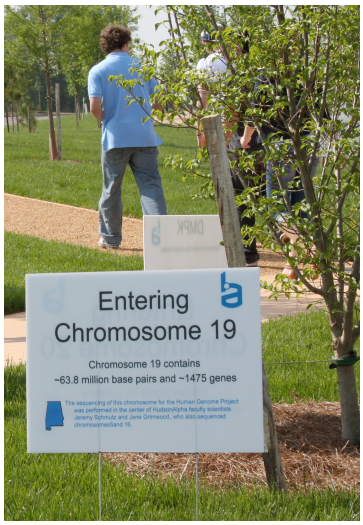
**Paper versions of the GenomeCache™ app activity are available. If you would like the paper versions, simply select the "paper path" option on the website when you are generating your files.*

Supplies needed:

- Printer paper to print "Gene Signs" and "Chromosome Signs"
- Method for displaying signs along your Genome Walk
- Access to iPads, iPhones, or iPod touches with the free Genome Cache™ app installed, or printed copies of the paper version of the activity.

## Instructions

Setting up your Genome Walk:




1. Print gene and chromosome signs
2. Decide how you will display your signs (see helpful tips below)
3. Use the formula at the end of this document to determine the location of each Chromosome Sign.
4. Use the "Gene Sign Distances" document to determine the location of each Gene Sign.
5. Using a measuring tool, place signs along your Genome Walk.
6. The Genome Walk should be set up in a linear fashion along a path. The beginning of the walk marks the beginning of chromosome 1. Students will walk through chromosome 1, then chromosome 2, then chromosome 3, all the way through chromosomes 22, X and Y at the other end.

7. Assign each student group a pathway to explore. When assigning groups, keep in mind which type of Genome Walk you have created (basic, advanced, themed, or all) and only assign paths in that group.

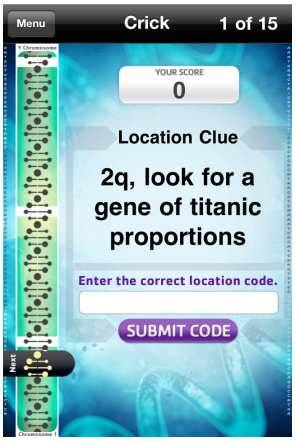
| Basic Paths | Advanced Paths | Themed Paths |
|---|---|---|
| Watson | Mendel | Pauling |
| Crick | Punnett | Carver |
| Avery | Chase | Gage |
| Chargaff | Franklin | Keller |
| Drew | Hershey | McKusick |
| Meischer | Lyon | Varmus |
| Stevens | McClintock | |

8. Provide, or make sure each student group has access to, an ipad, iphone, or ipod touch with Genome Cache™ installed. Or provide each student with a paper version of the activity.
9. The time it will take for students to complete the activity is variable depending on the length of the Genome Walk and which type of activity is used (digital versus paper). Students complete HudsonAlpha's half-mile Genome Walk in approximately a 1-1.5 hours, using the digital app. We expect students could complete a smaller scaled Genome Walk within a single class period.

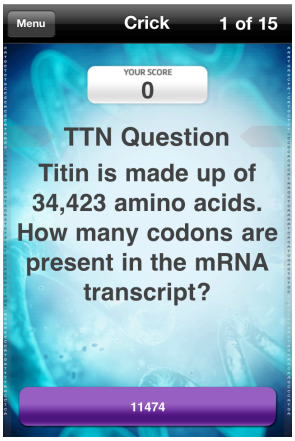
## Using the Genome Cache™ app:

1. After you have opened the application, tap the "Start" Button and select the pathway you would like to explore.
2. Each pathway is named after a famous scientist or historical figure. Read the background information provided about your path's namesake, then tap continue.

3. You are provided with a general location and clue for the first stop along your path.
    a. Gene location is written with a number typically followed by either a "p" or a "q." Most chromosomes are divided into two segments, a short arm (p) and a long arm (q).
    b. For example, location "2q" means you are looking for a gene on the long arm of chromosome number 2.
    c. Clues are words or phrases that help direct you to a particular gene. Students may need to look at both the name of the gene and its description to decipher the meaning of the clue.



    d. For example, a clue might be *"Look for a gene of titanic proportions."* – This would hopefully lead you to the titin gene.
4. The Genome Cache™ app will prompt you to type in a code. All gene signs have their genome location in the bottom left corner, and a code in the bottom right corner. The code is a series of two letters followed by two numbers.
    a. Enter the code found on the sign and tap "Submit"
    b. If you are correct, the app will take you to the next step
    c. If you are incorrect, the app will ask you to try again. If you enter an incorrect code three times, the app will automatically give you the correct code.
5. Read the fun fact about the gene you are standing in front of, and then tap "continue."
6. Answer the trivia question on the screen. If you answer incorrectly, the app will allow you to try again.
    a. Trivia questions vary widely in difficulty and scope. Many questions require some background knowledge in basic biology.
7. Regardless of whether you answered correctly on the first, or fourth, try, you will be provided with an explanation of the question and correct answer. Read the question explanation and then tap "continue."
8. This will bring you to your next location and clue. Continue the process until you have completed all 15 stops along your Genome Walk.




Scoring Points in Genome Cache™:

- Points are awarded for finding genes and answering questions
- Maximum points are awarded for entering the correct gene code and answering questions correctly on the first try
- Upon completing of the activity, you will be given the option to upload your score to the Genome Cache™ website. This requires an Internet connection.

**Note about the paper activity* – The paper version of GenomeCache™ was designed to simulate the digital activity as much as possible. Students are provided the location and clue for each point along the path. When students have identified the appropriate gene, they should write the gene name on the blank provided. The paper activity also provides additional information about each gene and 4 selected trivia questions. A teacher key with the answers to the trivia questions is provided.

## Helpful tips:

- Consider laminating signs or placing them in sheet protectors. This allows you to use the same signs again and again.
- Let students help in measuring and placing signs along the Genome Walk.
- If the Genome Walk is occurring indoors, signs may be taped along walls to increase visibility. If the Genome Walk will take place outside, the gene signs may be taped or stapled to wooden stakes so the signs can be stabilized in the ground.
- A more lasting, although expensive, option is to have the signs professionally printed on vinyl and held in place with wire frames or stakes.

## Extension activities:

- The human genome contains approximately 3.2 billion base pairs of DNA. Have your students calculate how many base pairs are represented by one foot or meter on your Genome Walk.
    - Divide 3.2 billion (3,200,000,000) by the length of your Genome Walk. For example, the HudsonAlpha Genome Walk is 3,175 feet (967.74 meters) in length. One foot on the HudsonAlpha Genome Walk corresponds to approximately 1,007,874 base pairs of DNA. One meter corresponds to 3,306,673 DNA base pairs.
- Determine the scale of your Genome Walk.
    - Begin by determining the total length of the human chromosomes if the DNA were unraveled and stretched end to end. A single base pair of DNA is 0.34nm ($3.4 \times 10^{-10}$ meters) long. Multiply this by 3.2 billion base pairs of DNA to determine the total length of DNA = 1.09 meters (3.58 feet). This is the length of the genome walk at its true cellular scale. (Note that the Genome Walk only covers one set of chromosomes 1-22 plus the X and Y. Inside most human cells, there are two sets of chromosomes 1-22, plus either two X chromosomes or an X and Y. The often quoted “all the DNA in a human cell is more than 6 feet long” includes the lengths of all 46 human chromosomes.)
    - Now compare this length to the total length of the Genome Walk you have created. Divide your total length by 1.09 meters (3.58 feet) to determine your relative scale. For example, the HudsonAlpha Genome Walk is approximately 887 times longer than the actual cellular length.

Questions, Comments, Suggestions? Use the feedback button on the Genome Cache™ website or contact us at edoutreach@hudsonalpha.org.

Formula for calculating location of Chromosome Signs:

| | | | | |
|---|---|---|---|---|
| Chromosome 1 | Total path length | X | 0 | = _____ ft/meters |
| Chromosome 2 | Total path length | X | .0787 | = _____ ft/meters |
| Chromosome 3 | Total path length | X | .1575 | = _____ ft/meters |
| Chromosome 4 | Total path length | X | .2205 | = _____ ft/meters |
| Chromosome 5 | Total path length | X | .2835 | = _____ ft/meters |
| Chromosome 6 | Total path length | X | .3465 | = _____ ft/meters |
| Chromosome 7 | Total path length | X | .4016 | = _____ ft/meters |
| Chromosome 8 | Total path length | X | .4488 | = _____ ft/meters |
| Chromosome 9 | Total path length | X | .4961 | = _____ ft/meters |
| Chromosome 10 | Total path length | X | .5433 | = _____ ft/meters |
| Chromosome 11 | Total path length | X | .5827 | = _____ ft/meters |
| Chromosome 12 | Total path length | X | .6299 | = _____ ft/meters |
| Chromosome 13 | Total path length | X | .6693 | = _____ ft/meters |
| Chromosome 14 | Total path length | X | .7087 | = _____ ft/meters |
| Chromosome 15 | Total path length | X | .7480 | = _____ ft/meters |
| Chromosome 16 | Total path length | X | .7795 | = _____ ft/meters |
| Chromosome 17 | Total path length | X | .8031 | = _____ ft/meters |
| Chromosome 18 | Total path length | X | .8346 | = _____ ft/meters |
| Chromosome 19 | Total path length | X | .8583 | = _____ ft/meters |
| Chromosome 20 | Total path length | X | .8740 | = _____ ft/meters |
| Chromosome 21 | Total path length | X | .8976 | = _____ ft/meters |
| Chromosome 22 | Total path length | X | .9134 | = _____ ft/meters |
| Chromosome X | Total path length | X | .9291 | = _____ ft/meters |
| Chromosome Y | Total path length | X | .9764 | = _____ ft/meters |
| Leaving Genome | Total path length | X | 1.0 | = _____ ft/meters |