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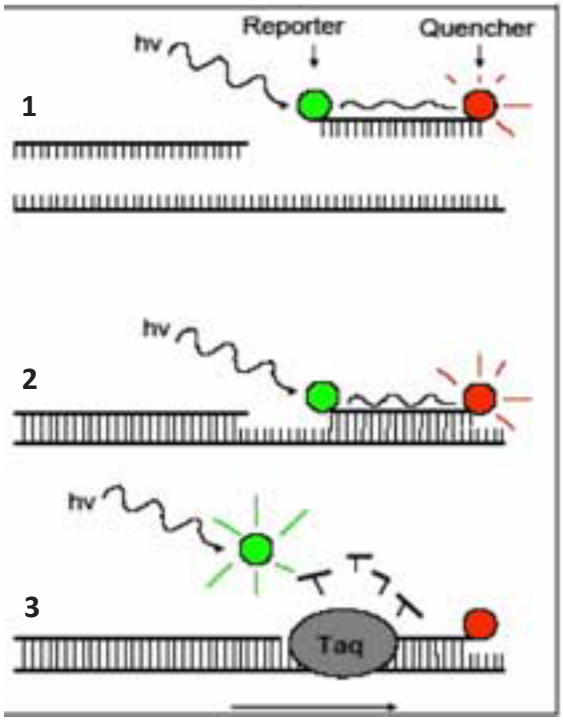
Discovering Bacteria Genes

E. coli is used as an indicator organism to identify the presence of fecal contamination in environmental waters, but standard tests don't tell us the species of origin. The solutions to urban *E. coli* contamination as well as the relative health risks for humans may depend on the source.

One method of determining which species' poop is in environmental waters is Microbial Source Typing (MST). MST uses a probe that detects species-specific combinations of DNA from water samples. The TaqMan® method is used by Metro State University's Biology Department for Groundwork Denver's Bear Creek project.

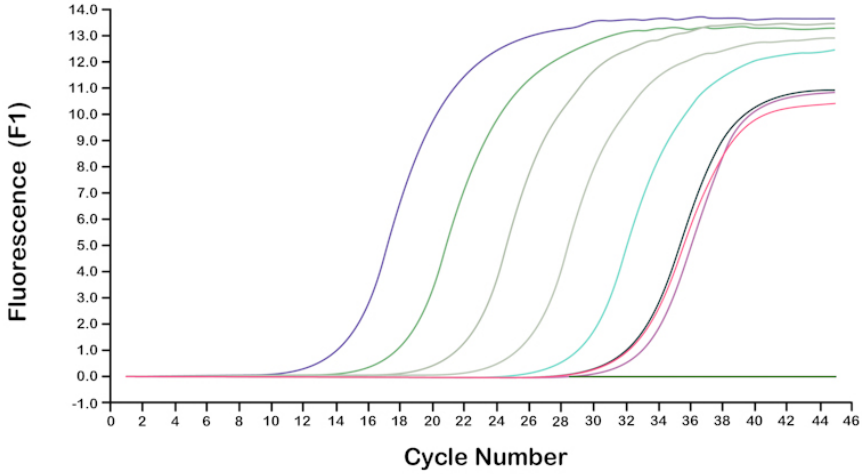
The diagram below illustrates how TaqMan® works. Bacterial DNA from a water sample is placed in a qPCR machine (quantitative Polymerase Chain Reaction) with a TaqMan® primer and probe. A qPCR replicates DNA.



(1) As the DNA is heated, the double helix of DNA unzips and the TaqMan ® primer with the species-specific DNA section (2) binds to the single helix. A Reporter and Quencher molecule are on either end of the TaqMan® primer. As the DNA begins to replicate, the TaqMan® probe binds new amino acids to the single helix the primer is attached to. (3) When the probe reaches the primer, it cuts the Reporter molecule free and it begins to fluoresce. As the DNA replication cycle continues, more DNA with the species-specific code will be made, and more Reporter molecules will be released and begin to glow.

Depending on how much of the target DNA is in the sample, the replication cycles and fluorescence will vary. The more of the DNA in the sample, the fewer cycles before fluorescence is evident, and the stronger the fluorescence. The less target DNA there is in a sample, the more replication cycles will be necessary to produce fluorescence. The graph below shows a graph from a qPCR machine. The purple line on the left illustrates a sample that has more of the target DNA, and the pink line on the far right illustrates a sample with less of the target DNA present.

Groundwork Denver and the Metro State University Biology Department will begin MST for urban Bear Creek this year.



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As Storm water flows into storm drains, it collects material from all the land in a drainage basin including contaminants from lawns, streets and parking lots. All this material (trash, cigarette butts, motor oil, grease, fertilizers) is washed directly into our streams and rivers.

Resources for Septic Systems/On-site Wastewater Treatment Systems

Denver Environmental Health
Board of Environmental Health
200 W. 14th Ave. Suite 300
Denver, CO 80204
Phone: 720.865.5365
Email: beh@denvergov.org

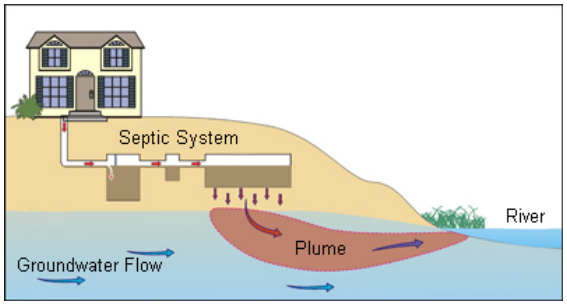
City and County of Denver On-site Wastewater Treatment System Regulations

Tri County Health Department
(Adams, Arapahoe & Douglas counties)
Environmental Health Division
6162 South Willow Drive, Suite 100
Greenwood Village, CO 80111
Phone: 720.200.1670
Web: www.tchd.org/269/Septic-Systems

Colorado Department of Public Health & Environment
Systems less than 2,000 gallons per day
Chuck Cousino
chuck.cousino@state.co.us

Septic Systems and Water Quality

While many homes in the Denver Metro area were connected to the sanitary sewer system decades ago, there are still some houses that use septic systems to treat plumbing waste. A septic system takes



wastewater from a house to an underground septic tank and then to a drainfield. The septic tank separates solids from liquids and the drainfield is responsible for releasing water to be cleaned by percolation through soil layers before it is reintroduced in groundwater or surface water.

When septic systems fail or are not properly maintained, groundwater and surface water contamination is possible. Urban Bear Creek is in close proximity to at least 69 septic systems. The following signs may indicate a problem with a septic system:

- Odors, surfacing sewage, wet spots, or lush vegetation growth in the drainfield area
- Plumbing or septic tank backups (often a black liquid with a disagreeable odor)
- Slow draining fixtures
- Gurgling sounds in the plumbing system
- If you have a well and tests show the presence of coliform (bacteria) or nitrates, your drainfield may be failing
- Lush green grass over the drainfield, even during dry weather

If you have a septic system, take the "Risk of Septic System Failure Quiz" on page 3. Resources are provided at left.

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Risk of Septic System Failure Quiz

1. How old is your septic system?

   A. 5 years or less

   B. 6 to 20 years

   C. More than 20 years

2. How often is your tank pumped?

   A. On a regular basis (at least every 3 to 5 years)

   B. Occasionally (more than 5 years)

   C. Has not been pumped (or don't know)

3. Do your pour oil, grease, or coffee grounds down the sink?

   A. Never

   B. Occasionally

   C. Often

4. Do you put paints, solvents, or pesticides down the drain?

   A. Never

   B. Occasionally

   C. Often

5. Do you use a garbage disposal?

   A. Never

   B. Occasionally (once or twice a week)

   C. Often (more than twice a week)

6. Does your sinks, tub, or shower drain slowly?

   A. Never

   B. Occasionally (2 to 3 times a year)

   C. More than 3 times a year

7. Do you practice water conservation?

   A. Use water-saving fixtures and practices

   B. Some water-saving fixtures and practices

   C. No water-saving fixtures and practices

8. How frequently do you run high-water usage appliances?

   A. Spread laundry and dishwasher loads over the week, doing only 1 or 2 full loads a day

   B. Run the washer and dishwasher at the same time

   C. Do all your laundry in one day (3 or more loads)

9. Do you flush cigarette butts, dental floss, kitty litter, diapers, sanitary napkins, or tampons down the toilet?

   A. Never

   B. Occasionally

   C. Often

10. How close are trees and shrubs to the drainfield?

    A. More than 30 feet

    B. Within 15 to 30 feet

    C. Less than 15 feet

11. Do vehicles or heavy equipment drive over the drainfield?

    A. Never

    B. Occasionally

    C. Often

Scoring

Score 1 point for every A answer.
Score 2 points for every B answer.
Score 3 points for every C answer.

1-16 points – Low risk
17-23 points – Moderate risk
24 or more – High risk

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