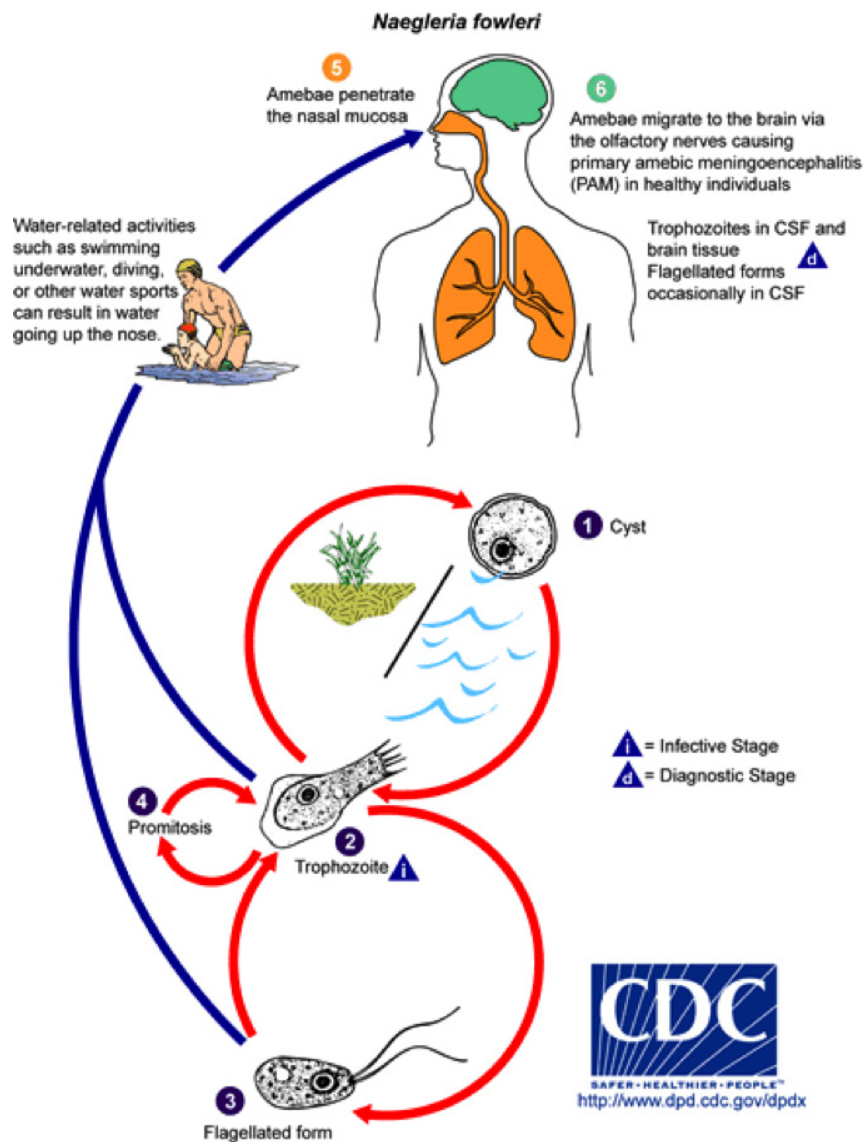
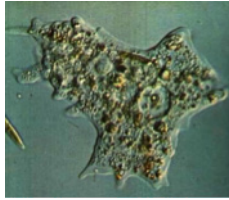


PLAYING SAFE IN NATURAL WATERS: HOW TO PROTECT YOURSELF FROM *NAEGLERIA FOWLERI* WHEN YOU GO SWIMMING

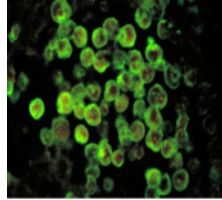
Laura Sifuentes, Charles Gerba, and Channah Rock



Life cycle of *Naegleria fowleri*. *Naegleria fowleri* has three stages, cysts ①, trophozoites ②, and flagellated forms ③, in its life cycle. The trophozoites replicate by promitosis (cell division) ④. Trophozoites can turn into temporary non-feeding flagellated forms which usually revert back to the trophozoite stage. Trophozoites infect humans or animals by penetrating the nasal mucosa ⑤ and migrating to the brain ⑥ via the olfactory nerves causing Primary Amoebic Meningoencephalitis (PAM). (ref. <http://www.dpd.cdc.gov/dpdx/>)



(a)



(b)

Microscopic images of *Naegleria fowleri* (a) amoeba and (b) cysts. Courtesy of DPDx, CDC Parasitology Diagnostic Web Site.



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Naegleria fowleri warning.

What is *Naegleria fowleri* ?

Naegleria fowleri pronounced \nā-glir-ē-ə\, is an amoeba (single-celled living organism) that can act as a parasite in animals and humans. *Naegleria* is commonly found in warm freshwater (for example, lakes, rivers, and hot springs) and soil. It has three life stages: trophozoite, flagellate, and cyst and can measure from 10 μm to 25 μm.

Where is *Naegleria fowleri* found?

Naegleria fowleri is found around the world. In the United States, the majority of infections have been caused by *Naegleria fowleri* from freshwater located in southern-tier states. The amoeba is most commonly found in warm bodies of water such as ponds, lakes, rivers, hot springs, and coastal waters and can survive temperatures of up to 45°C.

How common is *Naegleria fowleri* infection?

Infection with *Naegleria fowleri* occurrence is rare, with only 400 cases documented worldwide. From 2000 to 2009, 30 infections were reported in the U.S.; at least six of these infections occurred in Arizona. The risk of infection is estimated to be 1 in 2.6 million.



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Natural waters of Arizona.



LAURA SIFUENTES

Recreational activities.

Can I get *Naegleria fowleri* infection from a swimming pool?

No. You cannot get a *Naegleria fowleri* infection from a properly chlorinated, cleaned, and regularly maintained swimming pool.

How does infection with *Naegleria fowleri* occur?

Naegleria fowleri infects people by entering the body through the nose. This typically occurs during recreational activities such as swimming, diving, jet skiing, water skiing, and wake boarding in natural waters. It is not transferred from person to person and you cannot be infected by drinking contaminated water.

What are the symptoms of *Naegleria fowleri* infection?

Naegleria fowleri infection causes Primary Amoebic Meningoencephalitis (PAM), a brain infection that leads to the destruction of brain tissue. Initial symptoms include headache, fever, nausea, vomiting and stiff neck. These symptoms can begin 1 to 14 days following infection. Later symptoms include confusion, inability to focus, seizures, and hallucinations. After the start of symptoms, the disease progresses rapidly and usually causes death within 1 to 12 days. **If you experience any of these symptoms, seek immediate medical attention.**



Chlorinated swimming pool.



Swimming in natural waters.

Is there medical treatment for *Naegleria fowleri* infections?

Because of the rarity of the infection, there isn't substantial medical evidence at this time. Several drugs are effective against *Naegleria fowleri* in the laboratory and in some cases antibiotic treatment in conjunction with other experimental treatments have been shown to be effective if PAM is detected and diagnosed early in the course of infection.

How can I reduce my risk of *Naegleria fowleri* infection?

It is likely that a low risk of *Naegleria fowleri* infection will always exist with recreational use of warm freshwater lakes, rivers, and hot springs. The low number of infections makes it difficult to know why few people have been infected compared to the millions of other people using the same or similar waters across the U.S. The only certain way to prevent infection is to refrain from water-related activities in warm, untreated, or poorly-treated water.

If you do plan to take part in water-related activities some measures that might reduce risk include:

- Hold nose shut or wear nose plugs when jumping or diving into natural waters such as lakes, rivers, or hot springs.
- Avoid swimming or diving in warm natural water during periods of high temperatures and low water volume.
- Avoid digging in or stirring up sediment in shallow natural waters.

**For further questions contact: The Arizona Department of Health Services, Office of Infectious Disease Services at (602) 364-3676.*



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cals.arizona.edu/pubs/water/az1545.pdf

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