

From Disease, to Personality, to Culture, to the Future of Civilization

- Weird infectious diseases exist
- Syphilis makes people go crazy
- Guinea worms eat their way through the body

Guinea worm disease

- Worms typically chemically burn a hole or blister in the skin of the lower leg
 - (from the inside out)
- The victim eases the pain by soaking the limb in the nearest water supply
- The worm senses the water and immediately lays many thousands of eggs into the water

Guinea worm disease (cont.)

- The **eggs** hatch and the **larvae** are eaten by **water fleas**
- **People** drink the **fleas** with the **water**
- The larvae then burrow into the body, turn into worms, mate, the male dies and the female begins her painful journey
 - (Painful to us, that is)
- To remove a worm that burned its way through the skin:
 - Wrap it around a stick, pulling a few mm out every day, for weeks until worm is out
 - Up to 3' long; “as wide as a paper clip wire” (<http://www.dhpe.org/infect/guinea.html>)

Guinea worm disease

– broader picture

- The Carter Center leads the eradication campaign
- People need to filter their water with a cloth to remove the fleas before drinking
 - Simple, but one needs to understand why
- People also need to not dunk painful exit wounds in the drinking water supply!
- Children tend to forget the most
- The disease can be wiped out forever

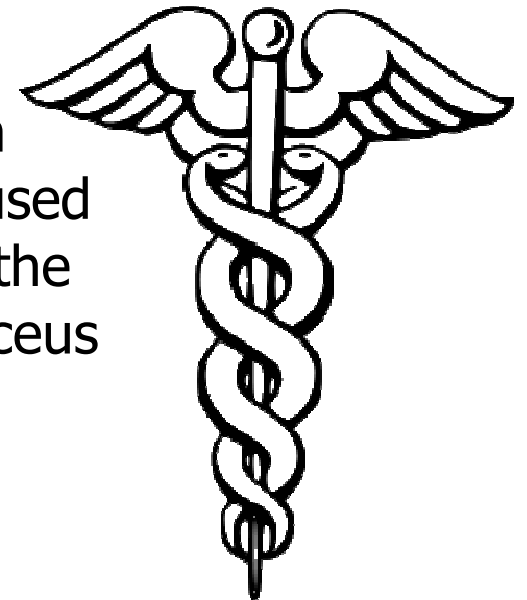
Guinea worm – historical note

- First described by the ancient Greeks
- At one time millions were infected
- May have inspired the long-time symbol of medicine: the rod of Asclepius

EMS (Emergency
Medical Services)
symbol



Often
confused
with the
caduceus



- Do you think you might have guinea worm disease (dracunculiasis)??

Warning!



You

may
have

something
weirder than
guinea worm
disease

About this disease

- Sufferers look healthy but have **changes in personality**
- Many changed personalities can **change a culture**
- Changing culture can **change the course of nations**
- Changing the course of nations could **change the future of civilization**

What spreads it?

How the disease spreads...

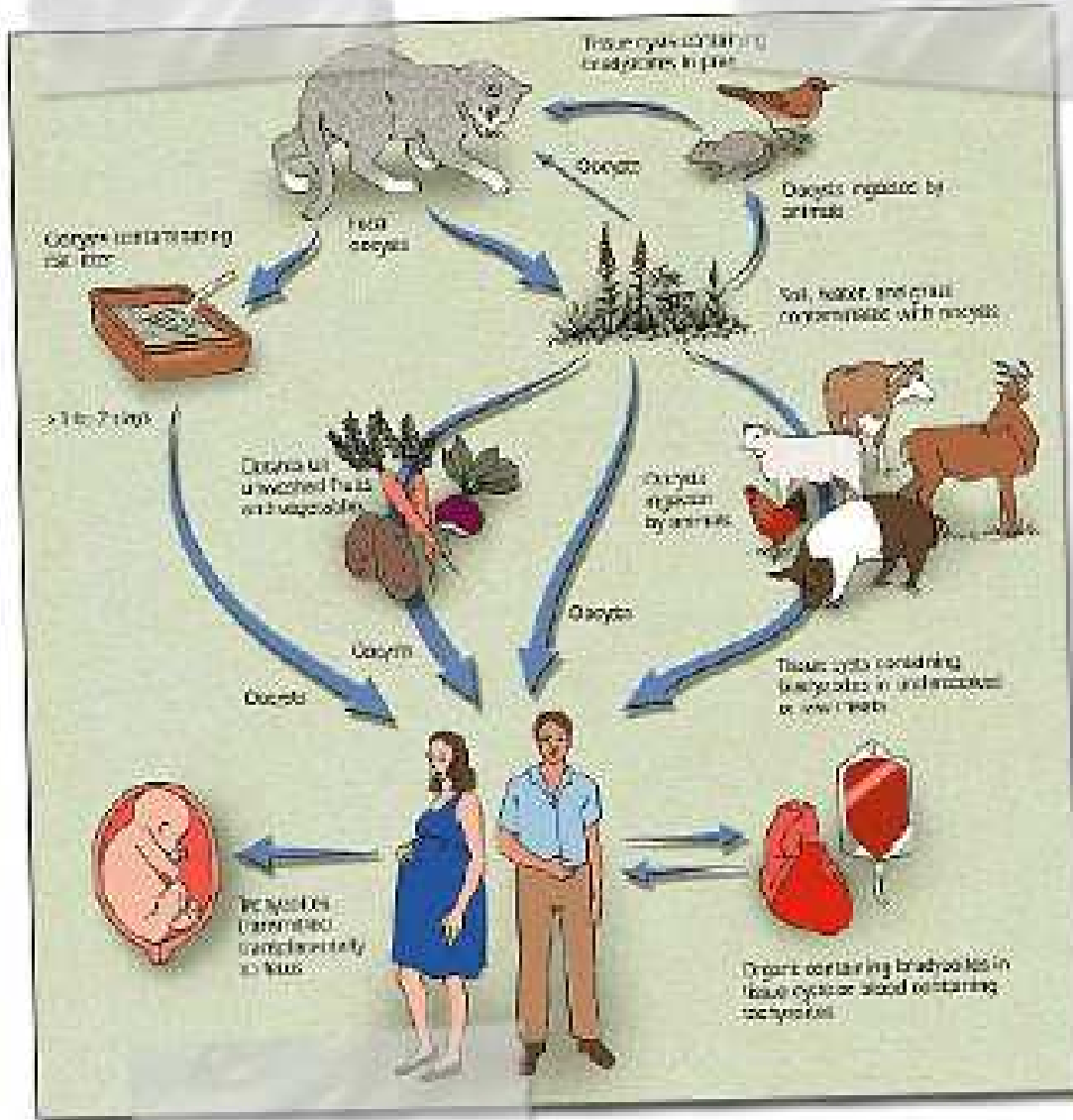


Cats

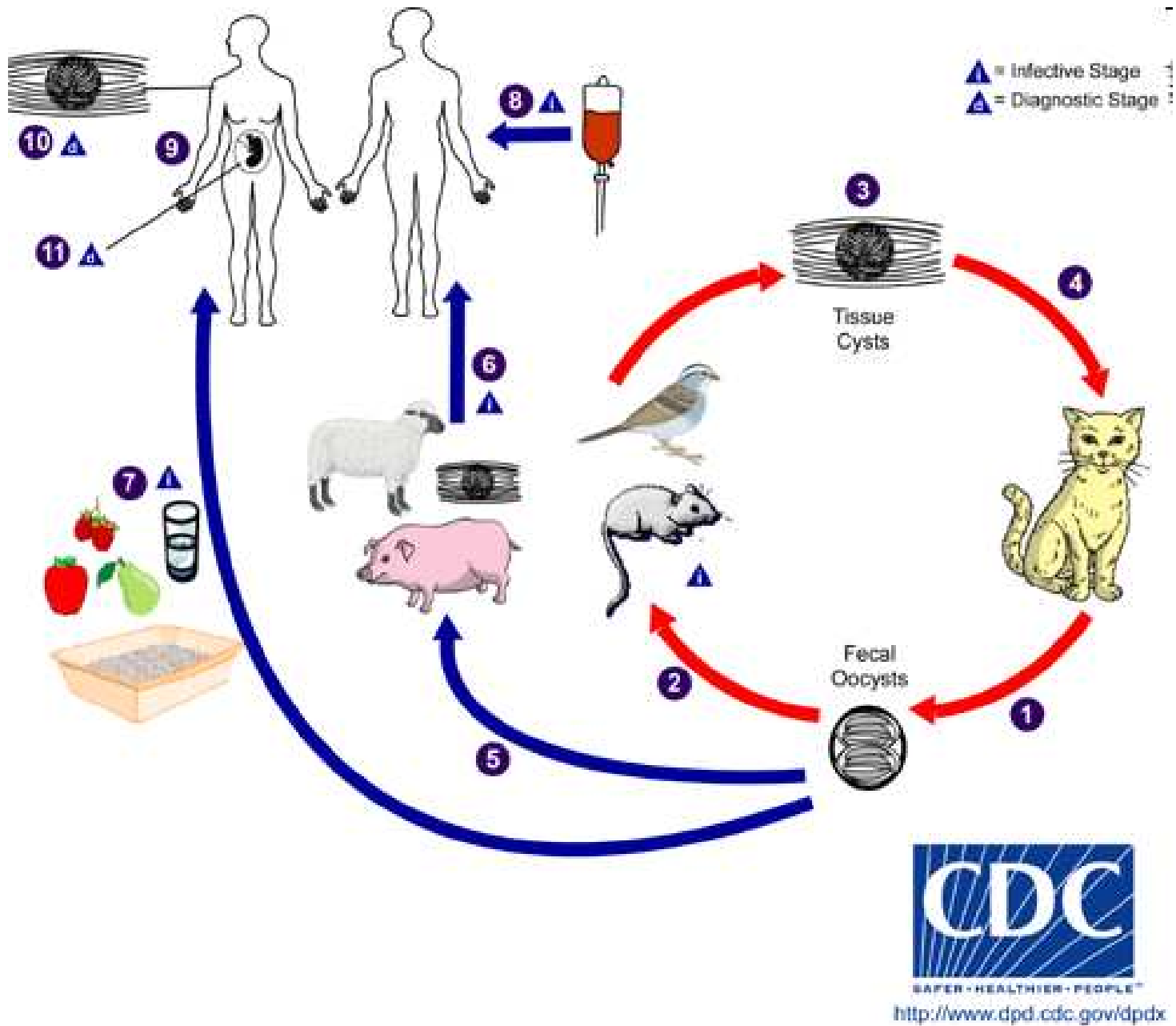
Credits: <http://www.animals-in-need.org/Images/Cat.jpg>

Many in the U.S. have **toxoplasmosis**

- **12.3%** (normalized by age - **KD Lafferty, 2006**, Can the common brain parasite, *Toxoplasma gondii*, influence human culture? *Proc. R. Soc. B*, vol. 273, pp. 2749-2755)
- **22.5%** (Centers for Disease Control, <http://www.dpd.cdc.gov/dpdx/HTML/Toxoplasmosis.htm>, accessed 10/11/09)
- **How it spreads:**
 - Cat eats infected small animal (e.g. mouse)
 - Cat does not get sick, but sheds many microscopic “oocysts” in droppings
 - Animal eats oocysts; **mice get less fearful of cats**
 - Another cat eats the animal and the cycle is complete
- **We get it by eating oocysts (or transplacentally)**
 - From undercooked meat, handling cat litter, etc.



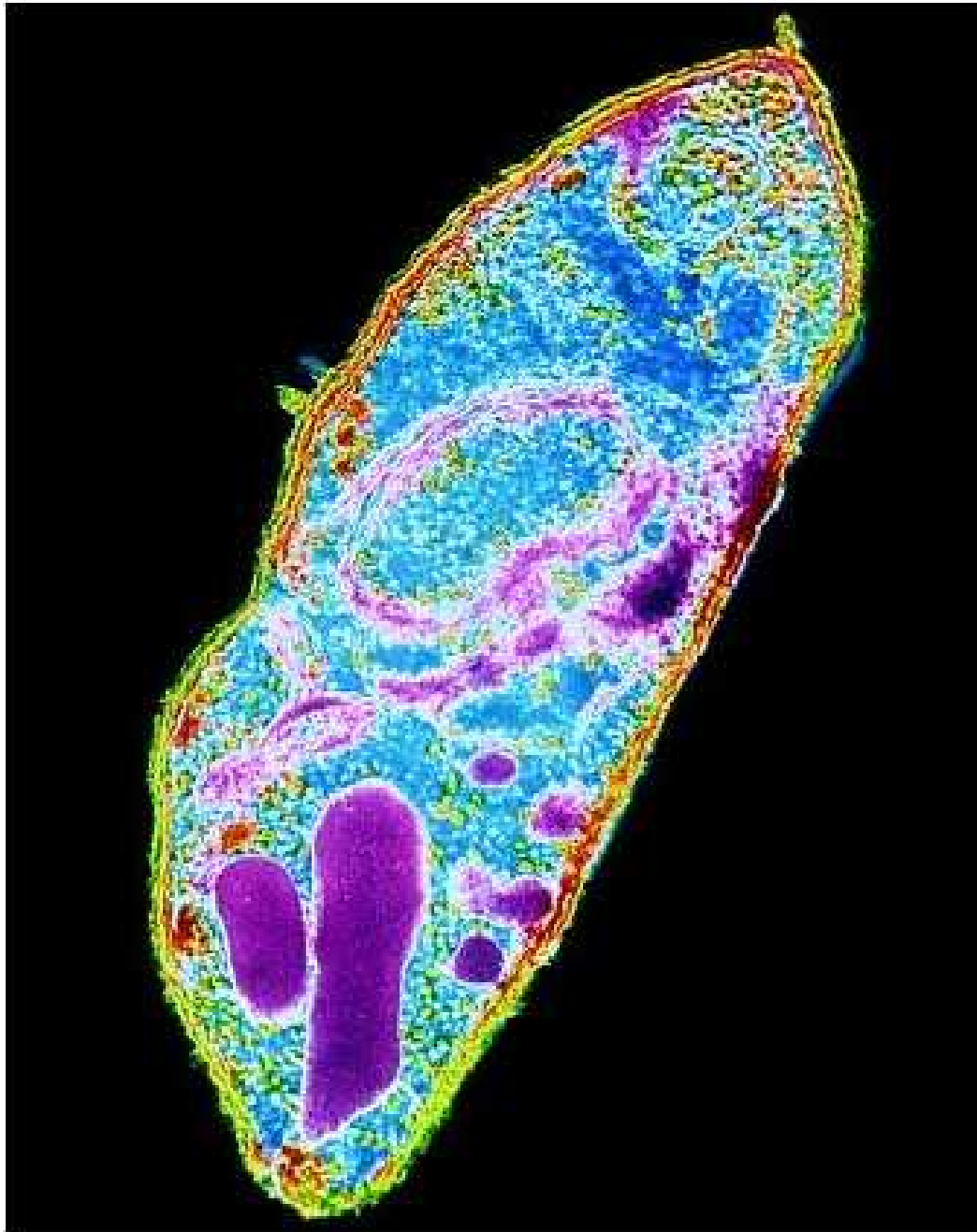
Source: <http://www.mascotissimo.com/wp-content/uploads/2007/07/toxoplasmosis.jpg>



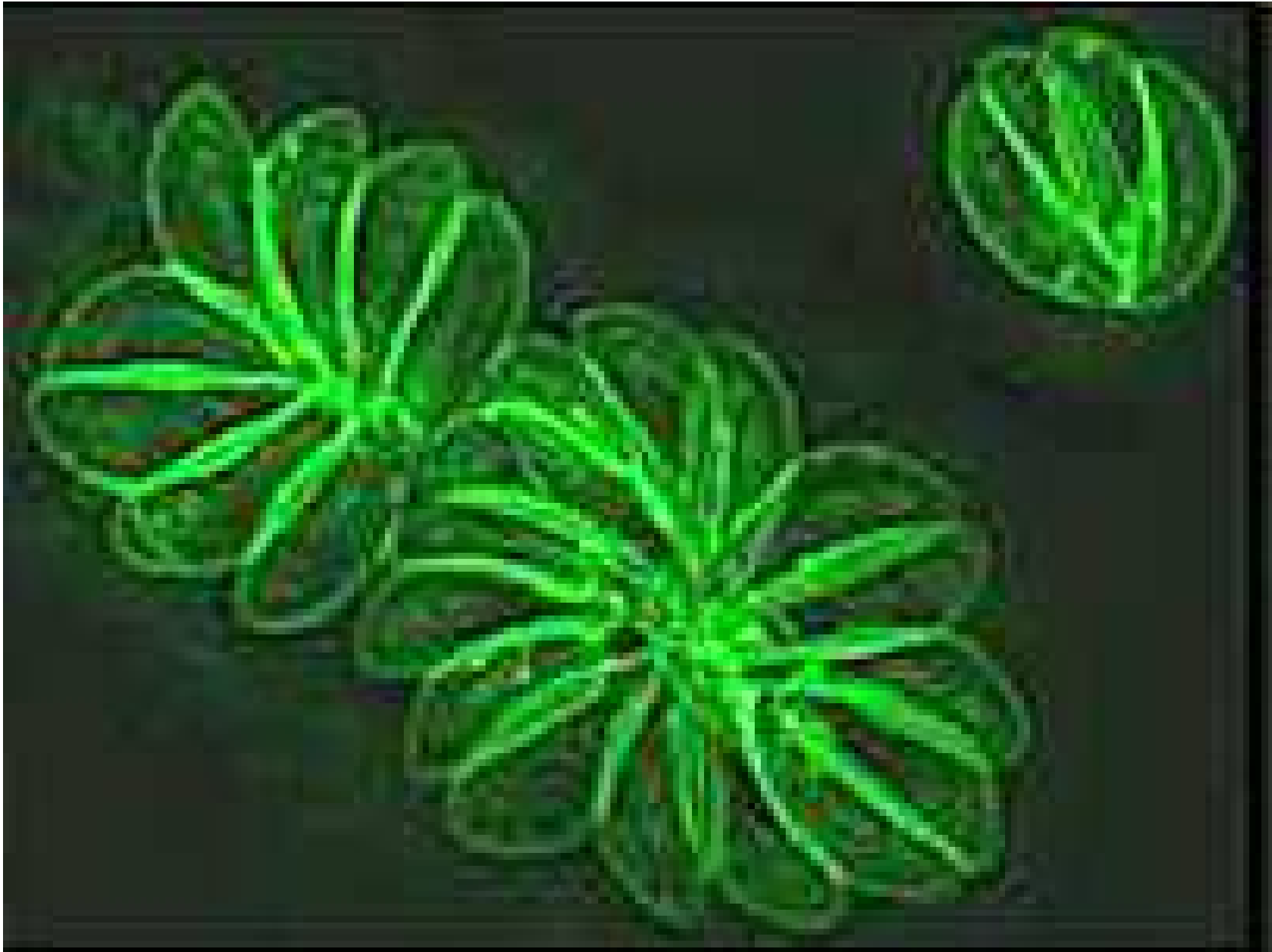
Source: http://www.dpd.cdc.gov/dpdx/images/ParasiteImages/S-Z/Toxoplasmosis/Toxoplasma_LifeCycle_BAM1.gif



T. gondii
parasites
(source:
CDC)



Source:
brianmclark.com/images/texts_images/toxoplasma_gondii.jpg



Toxoplasma gondii. Source:

http://newsimg.bbc.co.uk/media/images/41351000/jpg/_41351230_toxoplasma203.jpg

Toxoplasmosis Symptoms

- Infection by *Toxoplasma Gondii* is **usually symptom-free**
 - Some people get temporary flu-like symptoms or swollen lymph glands in the neck
 - Prenatal & natal infection can lead to retinochoroiditis & vision loss many (even 20+) years later
- According to Flegr (2007) it is “the most common protozoan parasite in developed nations”

Yet apparently there *are* symptoms

- See J. Flegr, Effects of Toxoplasma on human behavior, Schizophrenia Bulletin, vol. 33 no. 3 pp. 757-760, 2007
- Infection causes
 - poorer motor coordination
 - (2.65x higher traffic accident risk)
 - more apprehensiveness
 - less novelty-seeking
 - clothes tidiness
 - decreases in men, increases in women
 - self control decreases in men, increases in women

Gender differences in symptoms

– Men

- tend to disregard rules more
- are more “expedient, suspicious, jealous, and dogmatic”

– Women

- are more “warm hearted, outgoing, conscientious, persistent, and moralistic”

Symptoms increase over time

- In general,

longer duration of infection

increases the differences

between

infected and uninfected individuals

but...Why?

- *Toxoplasma Gondii* manipulates behavior of mice
 - so cats can catch them easier!
- Does it manipulate monkey and chimp behavior?
 - at any rate, leopards etc. (“cats”) eat them in the wild
- So why not accidentally manipulate humans too?
 - more car accidents = easier to eat us?
 - Or “on purpose” ...make us want to own cats...
- Important: correlation \neq causality
 - What if the causality was reversed?
 - What if both things were caused by a third factor?
 - We could look back at the previous slides...

Toxoplasmosis: mechanisms of behavior change

- It is thought that *T. gondii* increases dopamine in the brains of mice and men
 - Dopamine modification can explain some behavioral changes
- *T. gondii* is also thought to increase testosterone
 - Testosterone affects behavior
 - (thereby improving transmission? What do you think?)
 - Testosterone reduces immune function
 - (thereby improving transmission?)

From Behavior to Culture

- **Source:** KD Lafferty, Can the common brain parasite, *Toxoplasma gondii*, influence human culture? Proc. Royal Society B, 2006, vol. 273, pp. 2749-2755
 - If many people have behavior changes
 - then their culture may be changed as well
 - We might describe part of culture in terms of
 - Individualism
 - Sex roles
 - Uncertainty avoidance
 - Class distinctions

Personalities and *T. gondii* infection

More effects of latent toxoplasmosis infection...

(according to Lafferty, p. 2753, but not fully proven)

- Men:
 - Less intelligent, more reflective, rigid, stoic, loyal, slow-tempered, frugal, emotionally reactive, changeable, affected by feelings, emotionally less stable, easily upset
- Women:
 - More intelligent, rule-conscious, dutiful, conscientious, conforming, moralistic, staid, rule-bound, warm, outgoing, attentive to others, kindly, easy-going, participating

Personalities and culture

- Collective behavior could change culture
 - Maybe collective behavior **is** culture?
- “Environmental determinism”
 - the theory that the physical environment controls the course of civilizations
 - *T. Gondii* is part of the physical environment
 - It affects people by accident, because it affects rodents
 - Infected rodents are
 - » more active, prone to enter traps, less fearful of cats and cat smells like urine, and mice have more brain dopamine
 - » But what’s that got to do with people?

T. gondii and people

- “Currently, cats rarely eat humans, so there should be little selective advantage for *T. gondii* to specifically manipulate human behaviour. Still, *T. gondii* cysts infecting a human have nothing to lose, evolutionarily speaking, in trying manipulative strategies adaptive in other intermediate host species.” – Lafferty, p. 2750
- I predict:
 - infection and cat ownership are correlated
 - Does A cause B? B cause A? C cause A and B? Accident?

More effects on people

- Men often have different (even opposite) effects from women
- Increases ratio of newborn boys to girls up to 2.6:1 (<http://discovermagazine.com/2007/feb/toxoplasma-gondii-culture-sex-ratio>)
- Guilt-proneness increases for both genders
 - Implies greater apprehensiveness, self-doubt, worry, insecurity, tendency self-blame
- Guilt-proneness “corresponds” to neuroticism
 - “Male control, materialism, rules and structure” are “associated with neuroticism”
- Do these traits propagate to the larger culture?

Results: *T. gondii* and Culture

- Positive, but weak association with infection rate was found with
 - A national culture of uncertainty avoidance
 - Masculine sex roles (male control)
- What are the implications of this for
 - technology, law, politics, war, ...?

Results: *T. gondii* and Culture II

- Highly infected countries play soccer better!
- See e.g. <http://www.slate.com/id/2259350>
 - The 5 top FIFA team countries won 8 of last 10 World Cups
 - Toxo increases testosterone in men (& mice)

Results: *T. gondii* and Culture III

- *T. gondii* has a gene for making tyrosine hydroxylase
 - Has a mammalian version of this, in fact!
 - (How might that have happened?)
 - Tyrosine hydroxylase upregulates dopamine
 - A neurotransmitter also upregulated by, e.g., cocaine
- Motorcycle fatalities have high rates of infection
- 3-4x risk of fatal auto wrecks “involving reckless speeding” - http://www.edge.org/3rd_culture/sapolsky09/sapolsky09_index.html

Some notes...

- Recall the correlation-causation fallacy:
 - Did A cause B?
 - Or did B cause A?
 - Or did C cause both A and B?
- “38% of meat products...in the UK test...positive for *T. gondii*, some...probably viable” – p. 2753
- Cultural effects of *T. gondii* might differ for western cultures vs. asian, african, etc.
- “Both anti-toxoplasma drugs and dopamine antagonists normalize the behaviour of infected rats” – p. 2750

Toxoplasmosis and the future

- If culture is affected, so may other things
 - Laws
 - Politics
 - War and peace (also title of novel by Tolstoy)
 - Career choices
 - Technological change
 - Economic growth
 - Disaster preparedness (inc. existential disasters)
 - Nuclear weapon policies
- Imagine a world mostly without *T. gondii* . . .
 - This is possible!
- How much of the future of civilization, and even the survival of humanity, at stake?

Toxoplasmosis and the future II

- Perhaps biotech engineers could mutate toxo and fine tune it for psychiatric use
- Military types are interested in toxo
 - Is it a national security issue?!!



<http://verydemotivational.memebase.com/2010/07/13/demotivational-posters-security-alert/>



<http://blog.omy.sg/aussiepete/files/2010/08/fear01.jpg>



<http://www.clker.com/clipart-28744.html>



http://www.skydivekc.com/Uploads/jagarrett/300x300_alert.jpg

Toxoplasmosis and the future II

- Perhaps biotech engineers could mutate toxo and fine tune it for psychiatric use
- Military types are interested in toxo
 - Is it a national security issue?!!
 - Might laws be passed requiring testing and antibiotic treatment?
 - Might it be deliberately spread in an enemy country?
- Will employers require testing?
- Would you want people running for office to be tested, treated/not, and/or disclose results?

What do you think?

- Get tested. There is a standard lab test for it
- If positive, get treated(?). It can be treated
- Vaccinate your cat(s). There is a vaccine
- Demand politicians reveal infection status
- Employment screening; other screenings
- Support research into more-resistant cats
- Cover sand boxes that children play in
- Consider not owning a cat(!?).
 - Rats are friendly, social animals and make great pets! And “rat” rhymes with “cat” so they’re almost the same thing

<http://www.woodplay.com/images/accessories/sandbox.jpg>

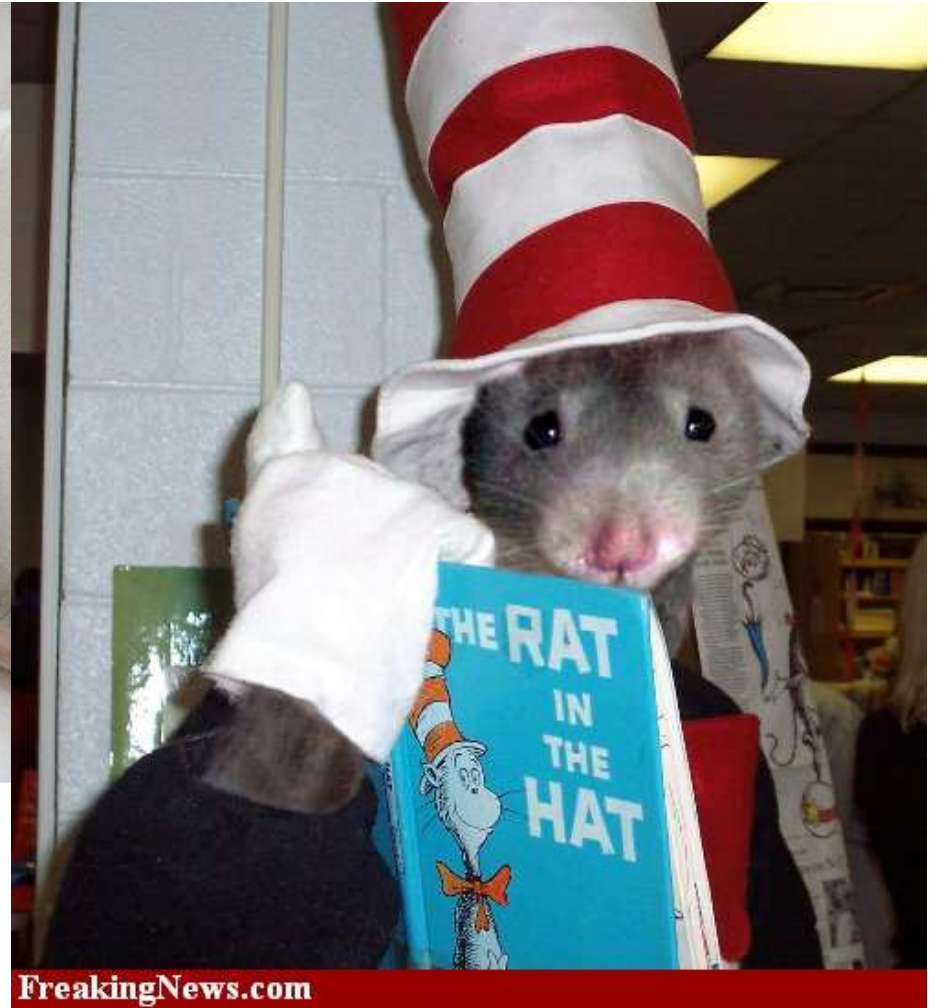




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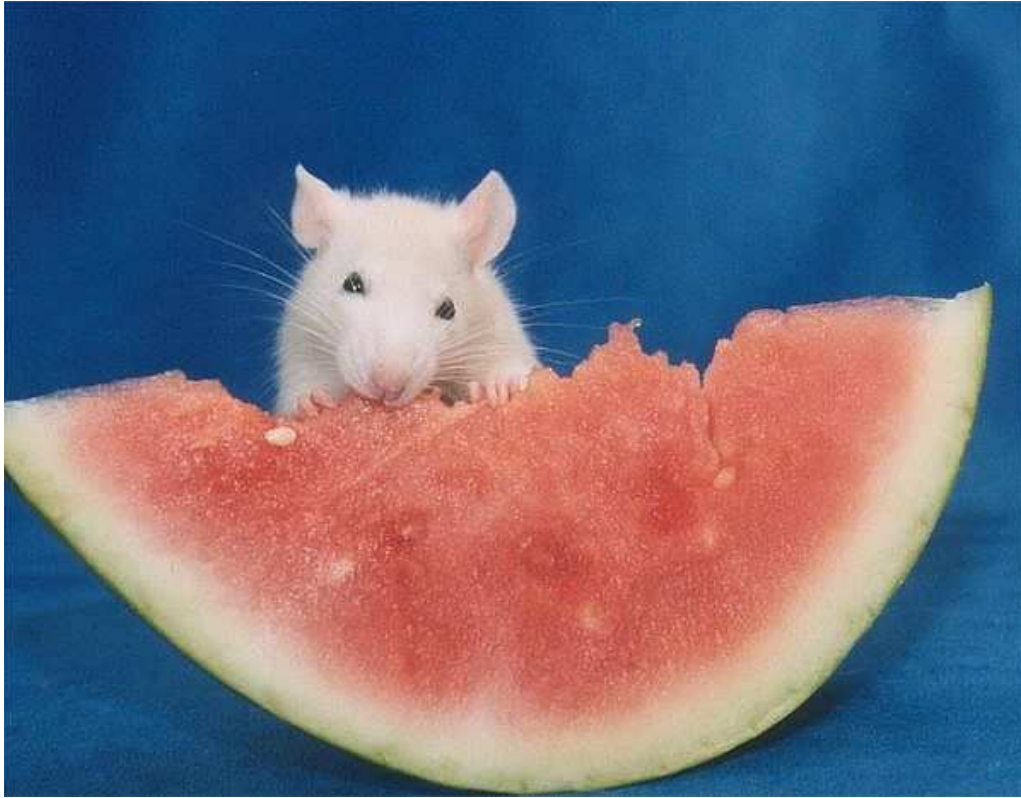


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<http://www.freakingnews.com/pictures/27000/Pet-Rats--27284.jpg>



http://i.ehow.com/images/GlobalPhoto/Articles/2111920/Fancyrat1-main_Full.jpg



<http://discovermagazine.com/2007/jan/letters/rathhead300.jpg>



<http://pattihaskins.files.wordpress.com/2008/02/rat.jpg>