



WELCOME TO TB 101

This course is designed to educate health care workers about basic TB concepts related to TB prevention and control in the United States.

ACKNOWLEDGEMENTS

This course was developed in partnership with:

- Curry International Tuberculosis Center: currytbcenter.ucsf.edu
- Heartland National Tuberculosis Center: heartlandntbc.org
- New Jersey Medical School Global Tuberculosis Institute: www.umdnj.edu/globaltb/home.htm
- Southeastern National Tuberculosis Center: sntc.medicine.ufl.edu

LEARNING OBJECTIVES

At the end of this lesson, you will be able to:

1. Describe what causes tuberculosis (TB).
2. Describe the global situation of TB.
3. List three factors that contributed to the global resurgence of TB.
4. List continuing challenges to TB control in the United States.

What is TB?

TB is a disease caused by a bacterium called *Mycobacterium tuberculosis* (*M tuberculosis*). The bacteria usually attack the lungs, but can attack any part of the body such lymph nodes, bones and joints, the brain, and other organs.

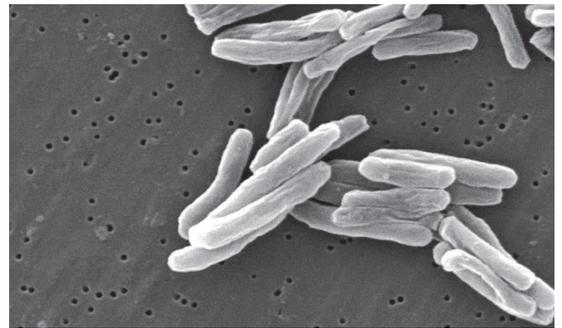
- If TB is treated properly, most people can be cured of TB
- If TB is NOT treated properly, people can die from TB or develop drug-resistant forms of TB

TB: An Ancient Disease

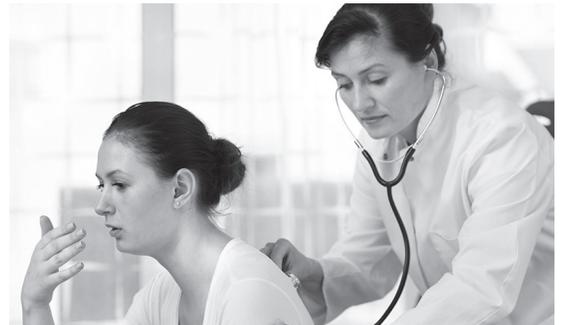
TB is an ancient disease that has plagued humans for thousands of years. Evidence of TB in humans dates back to over 4,000 years ago in ancient Egyptian mummies. Historically, TB was known by a variety of names, including:

- Consumption
- Wasting disease
- White plague

Before there was treatment for TB, a diagnosis of TB was considered by many to be a death sentence.



- Lesson 1: Introduction
- Lesson 2: TB Transmission and the Development of TB Disease
- Lesson 3: Testing for TB Infection



- Lesson 4: Diagnosis of TB Disease
- Lesson 5: Treatment of Latent TB Infection
- Lesson 6: Treatment of TB Disease

THE GLOBAL THREAT OF TB

Although TB is preventable and treatable it is not just a disease of the past. It is still one of the world's deadliest diseases.

An estimated 2 billion people, or one third of the world's population, are infected with *M. tuberculosis*

Each year, approximately 9 million people develop TB disease

1.4 million people die of TB disease



On average, one person dies of TB every 15 seconds

A Global Perspective on TB

The global resurgence of TB has been fueled by the HIV/AIDS pandemic, the emergence of **drug-resistant TB** strains, and weakened public health systems.

HIV/AIDS

Worldwide, TB is the leading cause of death among persons with HIV/AIDS.

People living with HIV have weakened immune systems, which puts them at a much higher risk for developing TB disease.

DRUG-RESISTANCE

The emergence of drug-resistant TB, including multidrug-resistant TB (MDR TB) and extensively drug-resistant TB (XDR TB) is a major public health threat.

Drug-resistant TB is very difficult, complicated, and expensive to treat.

HEALTH SYSTEMS

Effective TB control efforts depend on political commitment and a strong public health infrastructure.

Countries with limited resources often have weakened public health systems, making TB control efforts difficult to maintain.

TB in the United States (1)

TB disease was once the leading cause of death in the United States. After the discovery of drugs that could treat TB in the 1950s, death rates began to drop dramatically. However, even today, TB is still a problem in the United States!

- Approximately 9 to 14 million people are infected with *M. tuberculosis*
- Over 11,000 people developed TB disease in 2010

TB in the United States (2)

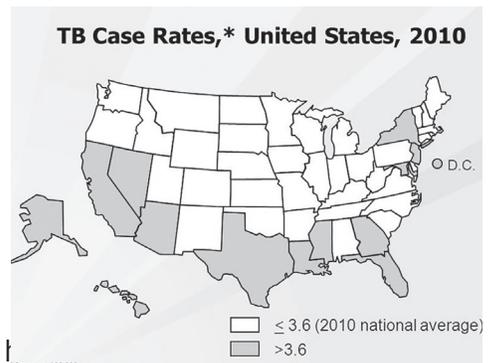
Although the number of people with TB disease in the United States has been declining over the past several years, there remain continuing challenges to controlling TB:

- TB is reported in almost every state and is actually increasing in some areas
- TB affects racial and ethnic minorities disproportionately
- Drug-resistant TB is increasingly challenging to treat
- Management of patients with comorbidities, such as HIV, diabetes, and other immunocompromising conditions, is difficult
- More than half of all persons in the United States who have TB disease are foreign-born residents

Summary

TB has affected humans for thousands of years and continues to be a major public health problem. The HIV/AIDS pandemic, drug-resistant TB, and weakened health systems have contributed to the global resurgence of TB.

TB has been steadily declining in the United States for the past several years; however, TB is still a problem. To eliminate TB, prevention and control efforts must be maintained.



LESSON 2: TB TRANSMISSION & THE DEVELOPMENT OF TB DISEASE

LEARNING OBJECTIVES

At the end of this lesson, you will be able to:

1. Explain how TB is spread.
2. Explain how latent TB infection and TB disease develop.
3. Explain the difference between latent TB infection and TB disease.

TB Transmission

TB is spread through the air from person to person. Tiny water particles containing *M. tuberculosis* may be expelled into the air when a person with infectious TB of the lungs, airway, or larynx:

Coughs | Sneezes | Speaks | Sings

These particles, called *droplet nuclei*, can remain in the air for several hours, depending on the environment.



TB Transmission and the Development of TB Disease

If another person inhales air that contains droplet nuclei, they may become infected. However, not every person that is exposed to TB becomes infected with *M. tuberculosis*.

Additionally, not everyone infected with *M. tuberculosis* becomes sick. People who are infected but not sick have latent TB infection. Some people with latent TB infection go on to develop TB disease.

Thus, there are 2 TB-related conditions:

- **Latent TB infection**
- **TB disease**

About 5% to 10% of persons with normal immune systems will develop TB disease at some point in their lives. The risk of developing TB disease is the highest in the first 2 years after infection.

Risk of Developing TB Disease

The risk of developing TB disease is much higher for persons with weakened immune systems than for persons with normal immune systems. For example, for people with TB infection and **untreated HIV infection** and with no treatment for TB infection, the risk is about **7% to 10% PER YEAR**, a very high risk over a lifetime. **HIV infection is the strongest known risk factor for progressing to TB disease.**

Other people that have weak immune systems that put them at high risk for developing TB disease include:

- Children younger than 5 years of age
- Persons who are receiving immunosuppressive therapy
- Persons with silicosis, diabetes, chronic renal failure, leukemia, lymphoma, or cancer of the head, neck, or lung
- Persons who have had a gastrectomy or jejunioileal bypass
- Persons who weigh less than 90% of their ideal body weight
- Persons who abuse drugs and alcohol

About 5% to 10% of persons with normal immune systems will develop TB disease at some point in their lives. The risk of developing TB disease is the highest in the first 2 years after infection.



How TB Develops in the Body (1)

Persons become infected with TB when they inhale droplet nuclei that contain tubercle bacilli and the bacilli begin to multiply in the small air sacs of the lungs. A small number of bacilli enter the bloodstream and spread throughout the body. Usually within 2 to 8 weeks, the immune system intervenes, preventing further spread. At this point, the person is considered to have latent TB infection. Since the immune system is keeping the tubercle bacilli under control, people with latent TB infection do not feel sick and they cannot spread TB to others.

How TB Develops in the Body (2) If, however, the immune system cannot keep the tubercle bacilli under control, the bacilli multiply and destroy tissue. The bacteria usually attack the lungs, but can attack any part of the body such as lymph nodes, bones and joints, the brain, and other organs. At this point, the person has TB disease. People with TB disease may feel sick and may spread TB to others.



Symptoms of TB Disease

Persons with TB disease usually have one or more symptoms. Because different parts of the body can be affected by TB, symptoms can vary.

General symptoms of TB disease

- Fever • Chills • Night sweats • Weight loss
- Appetite loss • Fatigue • Malaise

Symptoms of pulmonary TB disease

- Cough lasting 3 or more weeks
- Chest pain
- Coughing up blood or sputum (phlegm)



Symptoms of *extra-pulmonary TB disease* depend on the part of the body that is affected.

FOR EXAMPLE

- TB disease in spine may cause back pain
- TB disease in kidneys may cause blood in urine
- TB disease in lymph nodes may cause swelling in the neck

Differences Between Latent TB Infection and TB Disease

Persons with Latent TB Infection:

- Do not feel sick • Do not have any symptoms
- Cannot spread TB to others • Are at risk for developing TB disease

Persons with TB Disease:

- Usually feel sick • Usually have one or more symptoms
- May be able to spread TB bacteria to others

Summary TB is spread through the air from person to person. Persons become infected with TB when they inhale tubercle bacilli and the bacilli multiply in the small air sacs of the lungs. Usually, the immune system intervenes, preventing further spread. At this point, the person has latent TB infection. If the immune system cannot keep the tubercle bacilli under control, the bacilli multiply and destroy tissue. At this point, the person has TB disease.

Persons with latent TB infection:

- Do not feel sick
- Do not have any symptoms
- Cannot spread TB to others
- Are at risk for developing TB disease

Persons with TB disease:

- Usually feel sick
- Usually have one or more symptoms
- May be able to spread TB bacteria to others

TB Contacts Anyone can get TB. Persons who spend a lot of time in enclosed spaces with people who have TB disease are at the highest risk of becoming infected with *M. tuberculosis*.

This may include family members, friends, roommates, or coworkers. These persons, or contacts, are identified by public health workers through interviews with patients who have TB disease. Public health workers are responsible for ensuring that these high-risk individuals are evaluated for TB infection and TB disease, and treated when appropriate. This activity is called a contact investigation.

Infection Control Since TB is an airborne disease that can be transmitted from one person to another, it is important to practice appropriate infection control procedures to protect others from getting TB. This is especially important for health care facilities and other congregate settings. All health care facilities need an infection-control program. This program should be designed to ensure:

- Prompt detection of TB
- Airborne precautions to prevent the spread of TB
- Treatment of persons who have suspected or confirmed TB

Personal respirators should be worn by health care workers to prevent the inhalation of droplet nuclei. Surgical masks should be worn by infectious TB patients to prevent droplet nuclei from being expelled into the air.



LESSON 3: TESTING FOR TB INFECTION

LEARNING OBJECTIVES

At the end of this lesson, you will be able to:

1. Briefly explain the concept of targeted testing.
2. List groups at high risk for infection with *M. tuberculosis*.
3. List groups at high risk for progression to TB disease after infection with *M. tuberculosis*.
4. List the methods that can be used to test for TB infection.

Targeted Testing (1)

Targeted testing is an essential TB prevention and control strategy in the United States. Targeted testing is used to identify and treat persons who are at high risk for latent TB infection or at high risk of developing TB disease once infected with *M. tuberculosis*.

Identifying and treating persons who have latent TB infection is important because treatment can prevent these persons from developing TB disease in the future. This helps to stop the further spread of TB in communities.

All TB testing activities should be accompanied by a plan for follow-up care, medical evaluation, and treatment for persons diagnosed with latent TB infection or TB disease.

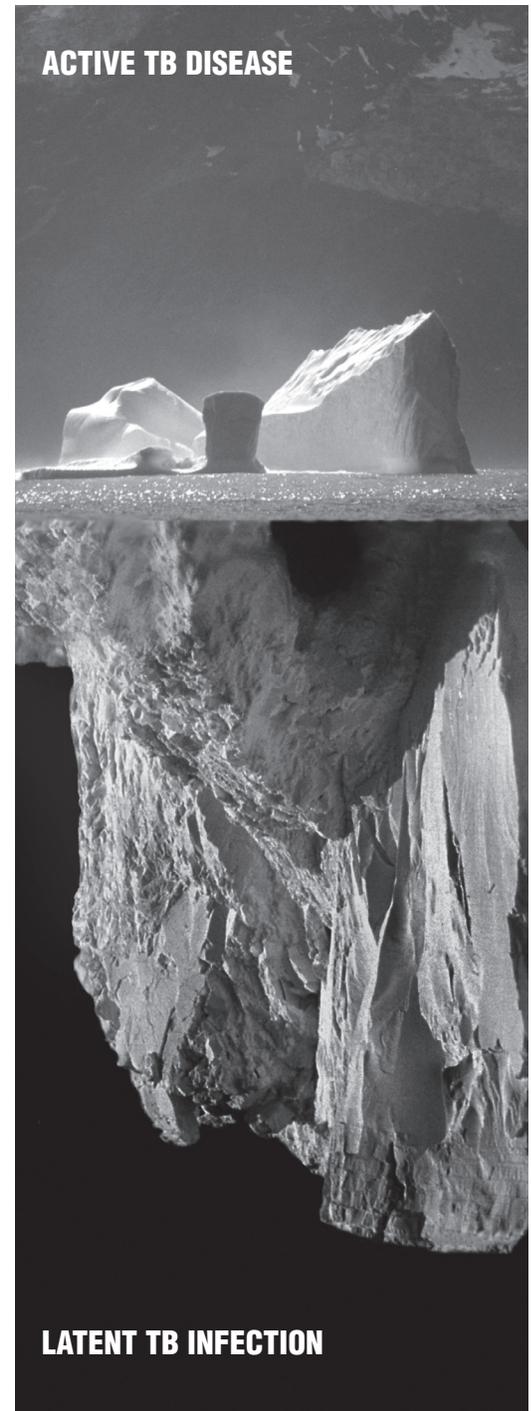
These particles, called *droplet nuclei*, can remain in the air for several hours, depending on the environment.

Targeted testing should be used to identify and treat persons who are at high risk for:

- Infection with *M. tuberculosis*
- Developing TB disease once infected with *M. tuberculosis*

Because of differences in populations from one community to another, definitions of high-risk populations should be made at the local level according to local demographics and TB epidemiology.

Targeted testing can help identify latent TB infection that lurks beneath the surface but can eventually emerge as active TB disease



Groups at High Risk for TB Infection

In general, people at high risk for infection with *M. tuberculosis* include:

- Contacts of persons known or suspected to have infectious TB disease
- People who have come to the United States within the last 5 years from areas of the world where TB is common (for example, Asia, Africa, Eastern Europe, Latin America, and Russia)
- Persons who visit areas of the world where TB is common, especially if visits are frequent or prolonged
- People who live or work in congregate settings whose clients are at increased risk for TB disease
- Health care workers who serve clients who are at increased risk for TB disease
- Populations defined locally as high risk for latent TB infection or TB disease, such as medically underserved, low-income persons, or persons who abuse drugs or alcohol
- Infants, children, and adolescents exposed to adults at increased risk for infection or disease

Groups at High Risk for Developing TB Disease

In general, people at high risk for developing TB disease once infected with *M. tuberculosis* include:

- People living with HIV/AIDS
- Children younger than 5 years of age
- Persons who are receiving immunosuppressive therapy
- Persons who were recently infected with *M. tuberculosis* (within the past 2 years)
- Persons with a history of untreated or inadequately treated TB disease
- Persons with . diabetes, chronic renal failure, leukemia, lymphoma, or cancer of the head, neck, or lung
- Persons who have had a gastrectomy or jejunioileal bypass
- Persons who weigh less than 90% of their ideal body weight
- Cigarette smokers and persons who abuse drugs or alcohol
- Populations defined locally as having an increased incidence of TB disease, possibly including medically underserved or low-income populations

TESTING FOR TB INFECTION

Diagnostic tests that can be used to detect TB infection include:

The Mantoux tuberculin skin test (TST)

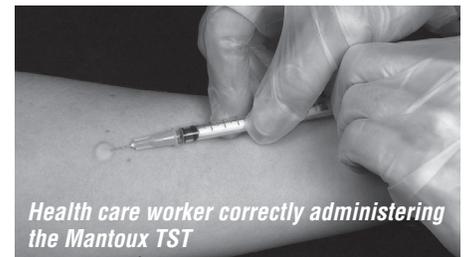
Interferon-gamma release assays (IGRAs)

A positive TST or IGRA result only indicates if someone has been infected with *M. tuberculosis*. These tests cannot identify if a person has TB disease.

Mantoux Tuberculin Skin Test

The TST is done by using a needle and syringe to inject tuberculin between the layers of skin on the forearm. Most people who have TB infection will have a reaction at the injection site. The reaction is the area of induration.

A person given the TST must have a trained health care worker examine their forearm within 48 to 72 hours. If

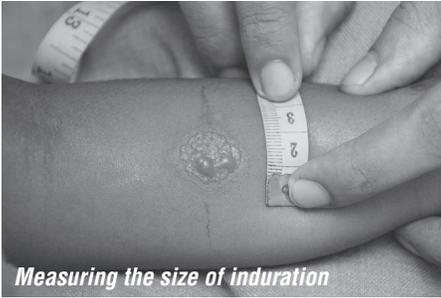


the person does not return within 72 hours, the test results are not valid and the person will need another skin test. To determine whether a TST reaction should be considered positive, a health care worker needs to interpret the reaction based on:

- 1 Size of induration (measured in millimeters)
- 2 Patient's risk factors for TB

Redness around the injection site is not measured. This is because the presence of redness does not indicate that a person has TB infection.

Mantoux Tuberculin Skin Test (continued)



Measuring the size of induration

An induration of **5 or more mm** is considered positive for:

- People living with HIV
- Recent contacts of persons with infectious TB disease
- Persons with chest x-ray findings suggestive of previous TB disease
- Patients with organ transplants and other immunosuppressed patients

An induration of **10 or more mm** is considered positive for:

- People who have come to the United States within the last 5 years from areas of the world where TB is common (for example, Asia, Africa, Eastern Europe, Latin America, and Russia)
- Injection drug users
- Residents and employees of high-risk congregate settings
- Mycobacteriology laboratory personnel
- Persons with conditions that increase risk for progressing to TB disease
- Children less than 4 years of age
- Infants, children, and adolescents exposed to adults in high-risk categories

An induration of 15 or more mm is considered positive in anyone, including persons with no known risk factors for TB.

Interferon-gamma release assays (IGRAs)

Interferon-gamma release assays (IGRAs) are blood tests that measure a person's immune reactivity to *M. tuberculosis*.

There are two IGRA tests available in the United States:

- QuantiFERON®-TB Gold In-Tube (OFT-GIT)
- T-SPOT®. TB

To conduct an IGRA, a blood sample is taken from the patient and sent to a laboratory. If the patient is infected with *M. tuberculosis*, their blood cells will release interferon-gamma (IFN-γ) in response to the test.

- A positive result suggests *M. tuberculosis* infection is likely.
- A negative result suggests infection is unlikely.
- An indeterminate result suggests the test cannot be interpreted.

If the test result is indeterminate, the test should be repeated with a new blood sample. Or, another test may be used to test for TB infection (such as another IGRA or the TST).

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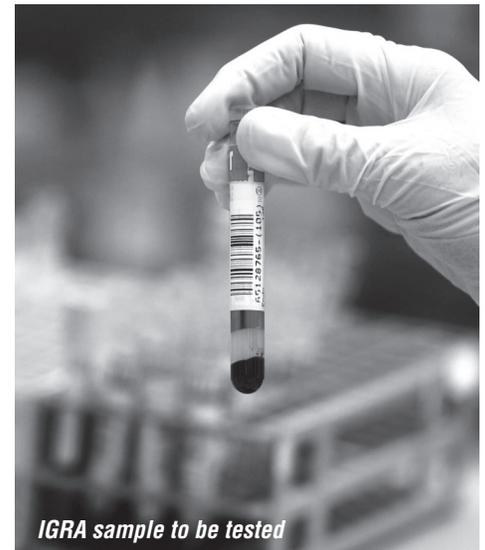
If the test result is indeterminate, the test should be repeated with a new blood sample. Or, another test may be used to test for TB infection (such as another IGRA or the TST).

Summary Targeted testing is used to identify and treat persons who are at high risk for latent TB infection or at high risk of developing TB disease once infected with *M. tuberculosis*.

The diagnostic tests that can be used to detect TB infection include:

- TST
- IGRAs (blood tests)

Persons with positive test results for TB infection should always be furthered evaluated for TB disease.



IGRA sample to be tested



TUBERCULOSIS TRAINING TEST

Required annual
and intake training for
all DSP

Lesson 1: Introduction



KNOWLEDGE CHECK

True or False: TB is caused by a bacterium called *M. tuberculosis*.

- True False

What has contributed to the global resurgence of TB? (Check all that apply.)

- HIV/AIDS pandemic
 Obesity
 Drug-resistant TB
 Weakened public health systems
 Global warming

Approximately how many people are infected with *M. tuberculosis* worldwide?

- 2 million
 10 million
 200 million
 2 billion

Approximately how many people in the United States developed TB disease in 2010?

- 500
 5000
 11,000
 25,000

Instructor Name: _____

Employee Name: _____

Employee Signature: _____

Date: _____



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Lesson 2: TB Transmission and the Development of TB disease



KNOWLEDGE CHECK

How is TB transmitted?

- Sharing food or drink
- Person to person through the air
- Sharing toothbrushes
- Kissing

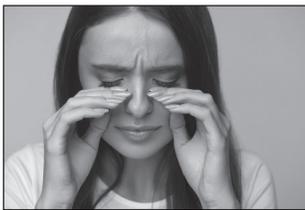
True or False: TB disease develops when the immune system of an infected person cannot keep the TB bacteria under control.

- True
- False

True or False: People with latent TB infection can spread TB bacteria to others.

- True
- False

After reading the description, **mark the check box** under each person who is displaying signs and symptoms of TB disease. (Check all that apply.)



Andrea



Michael



Hal



Paul

Andrea has had itchy eyes for the past two days.

Michael has had a severe cough for about 1 month.

Hal has had a sore throat, runny nose, and a cough for about 4 days.

Paul has been complaining of night sweats and a severe cough for several weeks. He has also lost a lot of weight.

Instructor Name: _____

Employee Name: _____

Employee Signature: _____

Date: _____



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Lesson 3: Testing for TB Infection



KNOWLEDGE CHECK

True or False: Targeted testing is a TB control strategy that is used to identify persons who have TB disease.

- True False

Which of the following are at high risk for becoming infected with *M. tuberculosis*? (Check all that apply.)

- People who have unprotected sex
- Contacts of people known or suspected of having infectious TB disease
- People who live or work in congregate settings whose clients are at increased risk for TB disease
- Health care workers who serve clients who are at an increased risk for TB disease
- People who have come to the US within the last 5 years from areas of the world where TB is common

True or False: People with latent TB infection can spread TB bacteria to others.

- True False

Instructor Name: _____

Employee Name: _____

Employee Signature: _____

Date: _____



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CASE STUDY



KNOWLEDGE CHECK

Now that you have learned how people are tested for infection with *M. tuberculosis*, apply your knowledge with the following case study.

David is a 32-year old man living with HIV in New York City. During a recent health care visit to the HIV clinic, David received a TST His TST result was 7 mm. Why was David tested for TB infection?

- Everyone should be tested for TB during routine health visits
- Because he is living with HIV
- Because he lives in a big city

Should David's TST result of 7 mm be considered a positive reaction?

- Yes
- No

The HIV clinic refers David to the local TB clinic for further evaluation. At the TB clinic, the nurse asks David about his medical history. David is then examined by a physician. Why did David receive further evaluation at the TB clinic?

- To determine if he is really infected with *M. tuberculosis*.
- To determine whether he needs an IGRA test.
- To assess whether he has latent TB infection or TB disease and to provide him with the appropriate treatment.

Instructor Name: _____

Employee Name: _____

Employee Signature: _____

Date: _____