Microbiology 101

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MICROBIOLOGY 101

What are Germs?

- Germs are tiny organisms that can cause infection.

- Invisible to the human eye and exist everywhere – including in the air, soil and water, and on food, plants and animals.

- Different germs have favorite places they like to live, different ways to spread and their own unique ways of causing infections.

- All germs have one thing in common: When they find a place that is good for them to live, they set up a home for themselves and multiply.
How Do Germs Spread?

80% of all infectious diseases are transmitted via contaminated hand-to-hand or surface-to-hand contact.

It takes just 4 hours for germs to spread from one person's hands to 50% of surfaces.

Germs spread rapidly between hands, surfaces and clothes. Multiple people in any “community” can be infected by this chain.
How Do Germs Spread?
Chain of infection is a series of events that has to happen to enable germs to cause infection.

**Reservoir:**
A place where germs can live and multiply

**Portal of exit:**
Means by which the germ can escape from the reservoir

**Mode of transmission:**
How the germs move, or spread, from one place to another

**Portal of entry:**
How organisms enter host

**Susceptible host:**
Limited availability to fight off infection

**Infectious agent:**
Simply the germ that causes the infection
How to Break the Chain of Infection

• Proper Hand Hygiene

• Getting your flu shot

• Covering coughs and sneezes

• Cleaning and disinfecting high touch surfaces

High touch surfaces are items like desks, work tops, countertops, sink and toilet seat handles, computer keyboards, door knobs or any other surfaces that you touch frequently with your hands.

1. The Organism

The coronavirus, COVID-19 is the illness caused by the virus. (For more information, visit the CDC, WHO, and NIH websites.)

**Break the chain:**
- Prevention, not panic. Take calm, decisive action.
- Kill the virus with proper hand washing. Don’t touch your face with unwashed hands, practice social distancing, and sanitize personal surfaces frequently touched.

2. Reservoir

The virus thrives in our respiratory tract, but it can survive on surfaces outside the body for three to four hours. Infected people can be contagious before symptoms present themselves or without ever experiencing symptoms.

**Break the chain:**
- Treat everyone as though they have the virus.
- Take precautions to reduce transmission (read on).

3. Exit portal

The virus exits the body in infected droplets sprayed into the air by coughing, sneezing or talking and can contaminate surfaces touched by unwashed hands.

**Break the chain:**
- Cough/sneeze into your sleeve or a tissue, not your hands.
- Viruses can spread by shaking hands and touching public surfaces such as credit cards, money, gas pumps, keyboards, store products, etc.
- Throw used tissues directly into the trash.
- Wash hands thoroughly as soon as you get home.
- Self-isolate. Avoid crowds. (Social distancing)
- Stay at least 6 feet away from others.

4. Transmission

The virus spreads to a new host through direct or indirect contact.

**Break the chain:**
- Do not shake hands or hug.
- Avoid touching infected droplets from someone coughing, sneezing or talking in your face. (Infected droplets are thought to survive for 3 hours in a closed space.)*

5. Entry portal

The virus can enter the human host through the respiratory system (nose, mouth), and eyes.

**Break the chain:**
- Assume everyone is infected and maintain a safe distance of at least 6 feet.
- Do not touch your face unless your hands are clean.

6. New host

The immune system is the final link to stop the virus. Older adults and people with severe medical conditions seem to be at higher risk.

**Break the chain:**
- Support your immune system (e.g., sleep well, drink lots of water, exercise, eat healthy foods, manage stress).
- If caring for someone with the disease, take precautions to minimize your exposure to the virus.

* CDC; WHO; APIC; Dr. Theresa Bernard; Dr. Francene Dickens; Infographics by Karl Guide, and Carol Naveen, RN. 
* CDC: Centers for Disease Control; WHO: World Health Organization; NIH: National Institutes of Health. **Study pending peer review.
** You can make disinfectants. Visit Consumer Reports article “These Common Household Products Can Destroy the Novel Coronavirus.”

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Microbiology 101
### MICROBIOLOGY 101

Chain of Infection

#### What are the differences between these types of products?

<table>
<thead>
<tr>
<th>CLEANER</th>
<th>SANITIZER</th>
<th>DISINFECTANT</th>
<th>VIRUCIDE</th>
<th>STERILANT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aids in Soil Removal</td>
<td>Reduces the Number of Bacteria</td>
<td>Kills Fungi, Bacteria, and Viruses</td>
<td>Kills Viruses</td>
<td>Eliminates all Fungi, Bacteria Viruses, and Spores</td>
</tr>
</tbody>
</table>

- **CLEANER**: Simply aids in the removal of soil from a surface. Although cleaning does remove germs from a surface, it doesn’t kill them.
- **SANITIZER**: Lowers the number of bacteria on surfaces to levels that are considered safe by public health orgs.
- **DISINFECTANT**: Kills infectious fungi, bacteria, and viruses but not bacterial spores on hard environmental surfaces.
- **VIRUCIDE**: Destroys or irreversibly inactivates viruses in the inanimate environment.
- **STERILANT**: A sterilant is used to destroy or eliminate all forms of microbial life including fungi, viruses, and all forms of bacterial spores.

Any product that claims to kill bacteria, viruses, mold, or fungi must be registered with the EPA as a pesticide.

*Image Credit: Perform to Transform*
## Germiest Spots in Schools

<table>
<thead>
<tr>
<th>SAMPLE LOCATION</th>
<th>(COLONY FORMING UNITS / IN SQ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Fountain Spigot (classroom)</td>
<td>2,700,000 CFU/in sq</td>
</tr>
<tr>
<td>Water Fountain Spigot (cafeteria)</td>
<td>62,000 CFU/in sq</td>
</tr>
<tr>
<td>Plastic Reusable Cafeteria Tray</td>
<td>33,800 CFU/in sq</td>
</tr>
<tr>
<td>Faucet (cold water handle)</td>
<td>32,000 CFU/in sq</td>
</tr>
<tr>
<td>Faucet (hot water handle)</td>
<td>18,000 CFU/in sq</td>
</tr>
<tr>
<td>Cafeteria Plate</td>
<td>15,800 CFU/in sq</td>
</tr>
<tr>
<td>Keyboard (classroom)</td>
<td>3,300 CFU/in sq</td>
</tr>
<tr>
<td>Toilet Seat</td>
<td>3,200 CFU/in sq</td>
</tr>
<tr>
<td>Student’s Hand</td>
<td>1,200 CFU/in sq</td>
</tr>
<tr>
<td>Animal Cage</td>
<td>1,200 CFU/in sq</td>
</tr>
</tbody>
</table>

Germ Significance for School Rooms

- Desks before cleaning
- Desks after cleaning (immediate, hours, days)
<table>
<thead>
<tr>
<th>Microbiology 101</th>
<th>Breaking the Chain of Infection in the Classroom</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Proper Hand Hygiene</td>
<td>• Stay home when you are sick</td>
</tr>
<tr>
<td>• Covering coughs and sneezes</td>
<td>• Keep hands away from their nose, mouth, and eye</td>
</tr>
<tr>
<td>• Cleaning and disinfecting high touch surfaces</td>
<td>• Match cleaning to the germ you are targeting</td>
</tr>
<tr>
<td>• Limit desk or supply sharing</td>
<td>• Access to the right cleaning and disinfection supplies</td>
</tr>
<tr>
<td></td>
<td>Educate students, staff, parents</td>
</tr>
</tbody>
</table>
Operational Strategy for K-12 Schools through Phased Mitigation

Greta Massetti, PhD
CDC Community Interventions and Critical Populations Task Force

cdc.gov/coronavirus
Disclaimer

- This presentation is meant to convey critical information for K-12 administrators, school district administrators, and K-12 teachers to consider when developing plans for continuing school operations during the COVID-19 pandemic.
- The information covered in this presentation is not exhaustive.
- For access to CDC's full suite of materials and resources for K-12 settings, please see Schools and Child Care Programs: https://www.cdc.gov/coronavirus/2019-ncov/community/schools-childcare/index.html

The information in this presentation is current as of March 21, 2021.
Overview

- Data and Statistics

- Science Brief: Transmission of SARS-CoV-2 in Schools

- Operational Strategy for K-12 Schools through Phased Mitigation
Data and Statistics
US COVID-19 cases reported to the CDC in the Last 7 Days, by State/Territory

- As of March 21, 2021
  - Cases in last 7 days
    • 380,584
  - Deaths in the last 7 days
    • 7,226
  - Total number of cases
    • 29,613,017
  - Total deaths
    • 539,038

https://covid.cdc.gov/covid-data-tracker/#cases_casesinlast7days
COVID-19 cases in children, adolescents, and young adults have increased since summer 2020, with weekly incidence higher in each successive age group.

Trends among children and adolescents aged 0–17 years paralleled those among adults.

https://www.cdc.gov/mmwr/volumes/70/wr/mm7003e1.htm?s_cid=mm7003e1_w
Key Question on School-Related Transmission

Which **activities** pose the greatest risk of school-related transmission?

- **Activities where participants cannot:**
  - Maintain physical distance
  - Wear face masks consistently and correctly

- **Examples**
  - Social gatherings
  - Extracurricular activities
Limited Transmission in Educational Settings

- US-based and international studies of secondary transmission in schools
- CDC investigations in Mississippi (December 2020 MMWR) and Wisconsin (January 2021 MMWR)

With proper prevention strategies, K-12 schools can open for in-person learning with minimal in-school transmission of SARS-CoV-2

- COVID-19 outbreaks associated with high school sports in Florida (January 2021 MMWR)

To maximize in-person education, high-contact athletic activities should be postponed during periods with high levels of SARS-CoV-2 community transmission

Operational Strategy for K-12 Schools
Operational Strategy for K-12 Schools through Phased Prevention

- Studies show that K-12 schools that used prevention strategies were able to safely open for in-person instruction and remain open with limited spread of SARS-CoV-2.
  - In-person instruction in schools should prioritize masking and physical distancing, along with other prevention strategies.

- Revised physical distancing recommendations on March 19
  - Use 3 feet between students in classrooms and use cohorting when possible.
  - In areas of high community transmission, middle and high schools that cannot use cohorting should place students 6 feet apart in classrooms.

- Maintain 6 feet: between adults and other adults and students; when masks cannot be worn; during activities when increased exhalation occurs; in common areas.

- Other changes:
  - Removed recommendation for physical barriers.
  - Added guidance on interventions when clusters occur in schools.
  - Added a consideration for schools to use screening testing for sports.
Health Equity Considerations

- The absence of in-person education may disadvantage children from under-resourced communities (including those with large representation of racial and ethnic minority groups, English learners, and students with disabilities).
- In-person instruction in K-12 schools must consider efforts to promote fair access to healthy educational environments for students and staff.
- Health equity considerations built into all aspects of K-12 Operational Strategy
  - Prevention strategies
  - Phased mitigation
  - Testing
  - Vaccination
Essential Elements of Safe In-person Learning

- Consistent implementation of **layered prevention strategies** to reduce transmission of SARS-CoV-2 in schools
- **Indicators of community transmission** to reflect level of risk
- **Phased prevention** and learning modes based on levels of community transmission

Additional layers of COVID-19 prevention

- **Testing** to identify people with SARS-CoV-2 infection
- **Vaccination for teachers and school staff**
Core Concepts for Safe K-12 School Reopening

- Schools should be the **last setting to close and the first to reopen** when they can do so safely
- At all levels of community transmission, there are **options for in-person instruction**
- In-person learning for elementary school students might have less risk of in-school transmission than for middle school and high school students
- Students, teachers, and staff who are at high risk of severe illness or who live with people at high risk should be provided virtual options
- Schools are encouraged to use cohorting or podding of students, especially in moderate (yellow), substantial (orange), and high (red) levels
- In-person instruction should be prioritized over sports, extracurricular activities, and school events
Prevention Strategies to Reduce Transmission

- All schools should use and layer 5 key prevention strategies:
  - Universal and correct use of masks
  - Physical distancing
  - Handwashing and respiratory etiquette
  - Cleaning and maintaining healthy facilities
  - Contact tracing in combination with isolation and quarantine

- Two prevention priorities:
  - Universal and correct use of masks should be required for all
  - Physical distancing should be maximized to the greatest extent possible
Levels of Community Transmission

<table>
<thead>
<tr>
<th>Indicator ¹</th>
<th>Low Transmission Blue</th>
<th>Moderate Transmission Yellow</th>
<th>Substantial Transmission Orange</th>
<th>High Transmission Red</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total new cases per 100,000 persons in the past 7 days ²</td>
<td>0-9</td>
<td>10-49</td>
<td>50-99</td>
<td>≥100</td>
</tr>
<tr>
<td>Percentage of NAATs that are positive during the past 7 days ³</td>
<td>&lt;5.0%</td>
<td>5.0%-7.9%</td>
<td>8.0%-9.9%</td>
<td>≥10.0%</td>
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¹If the two indicators suggest different levels, the actions corresponding to the higher threshold should be chosen. County-level data on total new cases in the past 7 days and test percent positivity are available on the County View tab in CDC’s COVID Data Tracker.

²Total number of new cases per 100,000 persons within the last 7 days is calculated by adding the number of new cases in the county/community in the last 7 days divided by the population in the county and multiplying by 100,000.

³Percentage of positive diagnostic and screening nucleic acid amplification tests (NAATs) during the last 7 days is calculated by dividing the number of positive tests in the county during the last 7 days by the total number of tests resulted over the last 7 days. Additional information can be found on the Calculating Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) Laboratory Test Percent Positivity: CDC Methods and Considerations for Comparisons and Interpretation webpage.
### Recommended Prevention in K-12 Schools

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#### Elementary Schools
- Physical distancing: at least 3 feet between students in classrooms
- Cohorting recommended when possible

#### Middle and High Schools
- Physical distancing: at least 3 feet between students in classrooms
- Cohorting recommended when possible

#### Sports and Extracurricular Activities
- Occur with at least 6 feet of physical distancing to the greatest extent possible
- Occur with at least 6 feet of physical distancing required
- Occur only if they can be held outdoors, with more than 6 feet of physical distancing
Additional Considerations in Phased Mitigation

- Making decisions about learning modes
  - Monitoring cases, number of people in quarantine, prevention strategies
  - Input of members of school community and public health
  - Assessing trends over time

- Unplanned school closures
  - Classrooms or schools experiencing an active outbreak
  - Schools in areas experiencing rapid or persistent rises in case incidence or severe burden on healthcare capacity
# Testing Recommendations: K-12 Schools Operational Strategy

## Transmission Levels

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</tr>
<tr>
<td><strong>Diagnostic testing</strong>: 1 symptomatic students, teachers, and staff and close contacts referred for diagnostic testing</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Screening testing

| **Screening testing of teachers and staff** offered at least once per week |
| No screening testing for students |
| **Screening testing for students** offered at least once per week |

| **Testing for high-risk sports**: testing recommended at least once per week |
| **Testing for low and intermediate-risk sports**: testing recommended at least once per week |

| **Testing for high-risk sports**: testing recommended twice per week |
| **Testing for low and intermediate-risk sports**: testing recommended at least once per week |

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1. Diagnostic testing for SARS-CoV-2 is intended to identify occurrence of SARS-CoV-2 infection at the individual level and is performed when there is a reason to suspect that an individual may be infected, such as having symptoms or suspected recent exposure.
2. Screening testing is intended to identify infected asymptomatic individuals who may be contagious so that measures can be taken to prevent further transmission.
3. Schools may consider testing a random sample of at least 10% of students or may conduct pooled testing of cohorts/pods for screening testing in areas of moderate and substantial community transmission.
4. Schools may consider using screening testing for student athletes and adults (e.g., coaches, teacher advisors) who support these activities to facilitate safe participation and reduce risk of transmission. For an example risk stratification for sports, see [NCAA Transmission Risk Summary](#).
Considerations in Implementing Screening Testing in K-12 Schools

- Priorities for testing when applicable
  - Teachers and staff
  - High school students, then middle school students
  - Elementary school students

- Prioritize access to testing in schools that serve populations who are disproportionally affected by COVID-19
  - Communities with moderate or large proportions of groups that experienced disproportionately high rates of COVID-19
  - Geographic areas with limited access to testing
Elements Needed for Screening Testing in K-12 Schools

- Dedicated infrastructure, staffing, and resources to support school-based testing
- CLIA certificate of waiver
- Mechanism to report all testing results
- Timely reporting of results (<24 hours) is key
- Ways to obtain parental consent for minors and informed consent for adults
- Physical space to conduct testing safely and privately, protocols to maintain confidentiality of results
- Plans to confirm result of screening testing, if applicable need to be established
Vaccination for Teachers and School Staff Prioritized in 1b

- Added layers of prevention and protection
- More than 30 states have already taken steps to vaccinate educators—on March 2nd, the President directed all states, territories, and the District of Columbia to do the same.
- Minimizing barriers to accessing vaccination for teachers and other frontline essential workers is critical. Vaccine clinics at or close to the place of work are optimal
- Access to vaccination should not be a precondition for reopening schools for in-person instruction
- Even after teachers and staff are vaccinated, schools need to continue prevention measures
CDC COVID-19 School Resources


For K-12 School Administrators:
- Interim Considerations for K-12 School Administrators for SARS-CoV-2 Testing: https://www.cdc.gov/coronavirus/2019-ncov/community/schools-childcare/k-12-testing.html
CDC COVID-19 School Resources


For Parents, Guardians, Caregivers:


In Conclusion

Many K-12 schools that have implemented prevention strategies have been able to offer for in-person instruction safely. This operational strategy presents a pathway to reopen schools and help them remain open through consistent use of prevention strategies, especially universal and correct use of masks and physical distancing.
For more information, contact CDC
1-800-CDC-INFO (232-4636)

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.