

DEMONSTRATED PROTOCOL

Methanol Fixation, H&E Staining & Imaging for Visium Spatial Protocols

Overview

The Visium Spatial Gene Expression Solution measures the total mRNA in tissue sections and requires a Visium Spatial slide with intact tissue sections as input. This protocol outlines methanol fixation, Hematoxylin & Eosin (H&E) staining, and imaging of tissue for use with 10x Genomics Visium Spatial protocols. Fixed and stained tissue sections are inputs for the downstream Visium Spatial Tissue Optimization and Visium Spatial Gene Expression workflows.

Additional Guidance

Consult the Visium Spatial Protocols - Tissue Preparation Guide (Document CG000240) for Tips & Best Practices on freezing, embedding, and cryosectioning tissue and placing sections on Visium Spatial Slides. Consult the Visium Spatial Gene Expression Imaging Guidelines (Document CG000241) to verify imaging settings prior to starting this Demonstrated Protocol.

Perform this Demonstrated Protocol on tissue sections placed on the correct slide.

- Use a Visium Spatial Tissue Optimization slide if performing tissue optimization.
- Use a Visium Spatial Gene Expression Slide or Visium Gateway Gene Expression Slide if proceeding with library construction.

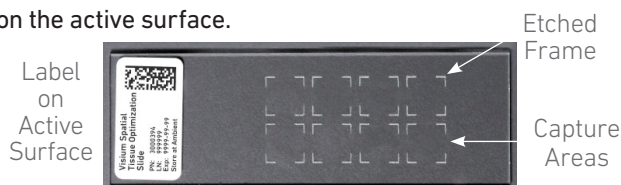
The Tissue Optimization workflow must be performed prior to the Gene Expression workflow to determine the ideal tissue section permeabilization time.

After completing this Demonstrated Protocol (CG000160), proceed with either the Visium Spatial Gene Expression Reagent Kits - Tissue Optimization User Guide (CG000238) or the Visium Spatial Gene Expression Reagent Kits User Guide (CG000239).

Visium Slide Selection

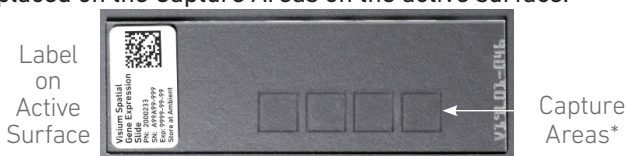
Visium Spatial Tissue Optimization Slide (PN-3000394)

- Used with Visium Spatial Gene Expression Reagent Kits – Tissue Optimization User Guide (CG000238) to identify optimal permeabilization time for a specific tissue type and section thickness.
- Includes 8 Capture Areas, each covered with oligonucleotides for mRNA capture.
- Each Capture Area is 8 x 8 mm and is surrounded by an etched frame.
- A readable label defines the active surface of the slide. Tissue sections are always placed on the Capture Areas on the active surface.



Visium Spatial Gene Expression Slide (PN-2000233) Visium Gateway Gene Expression Slide (PN-2000363)

- Used with Visium Spatial Gene Expression Reagent Kits User Guide (CG000239) to generate Visium Spatial Gene Expression libraries.
- Includes 2 or 4 Capture Areas, each with ~5,000 unique gene expression spots.
- Each Capture Area is 6.5 x 6.5 mm and is surrounded by a fiducial frame for a total area of 8 x 8 mm.
- A readable label with a serial number defines the active surface of the slide. Tissue sections are always placed on the Capture Areas on the active surface.



*Visium Gateway Gene Expression Slide contains 2 Capture Areas



Visium Spatial Reagent Kits

Perform this Demonstrated Protocol in each step on tissue sections as listed.

Ensure that tissue sections have been placed onto the appropriate slide prior to starting this Demonstrated Protocol. Consult the Visium Spatial Protocols - Tissue Preparation Guide (CG000240) for more information.

Visium Spatial Tissue Optimization Slide Kit PN-1000191 (store at ambient temperature)

| Visium Spatial Tissue Optimization Slide Kit | | PN |
|---|--|---------|
| Visium Spatial Tissue Optimization Slide | | 3000394 |
| *Slide Seals | | 3000279 |
| *Slide Cassette | | 3000406 |
| *Slide Gasket | | 3000426 |
| *Tissue Removal Buffer | | 2000221 |
| *Tissue Removal Enzyme | | 3000387 |
| *Not used in this protocol | | |

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Visium Gateway Tissue Optimization Slide Kit PN-1000313 (store at ambient temperature)

| Visium Gateway Tissue Optimization Slide Kit | | PN |
|---|--|---------|
| Visium Spatial Tissue Optimization Slide | | 3000394 |
| *Slide Seals | | 3000279 |
| *Slide Cassette | | 3000406 |
| *Slide Gasket | | 3000426 |
| *Tissue Removal Buffer | | 2000378 |
| *Tissue Removal Enzyme | | 3000387 |
| *Not used in this protocol | | |

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Visium Spatial Gene Expression Slide Kit, 16 rxns PN-1000185 (store at ambient temperature)

| Visium Spatial Gene Expression Slide Kit | | PN |
|---|--|---------------------|
| Visium Spatial Gene Expression Slide | | 2000233 |
| *Visium Slide Seals, 40-pack or 20-pack (may come in varying configurations in different lots) | | 2000284/ 3000279 |
| *Visium Slide Cassette & Gasket, 4-pack or 1-pack | | 2000282/ 2000281 |
| *Not used in this protocol | | |

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**Visium Slide Seals may come in varying configurations in different

Visium Spatial Reagent Kits

Perform this Demonstrated Protocol in each step on tissue sections as listed.

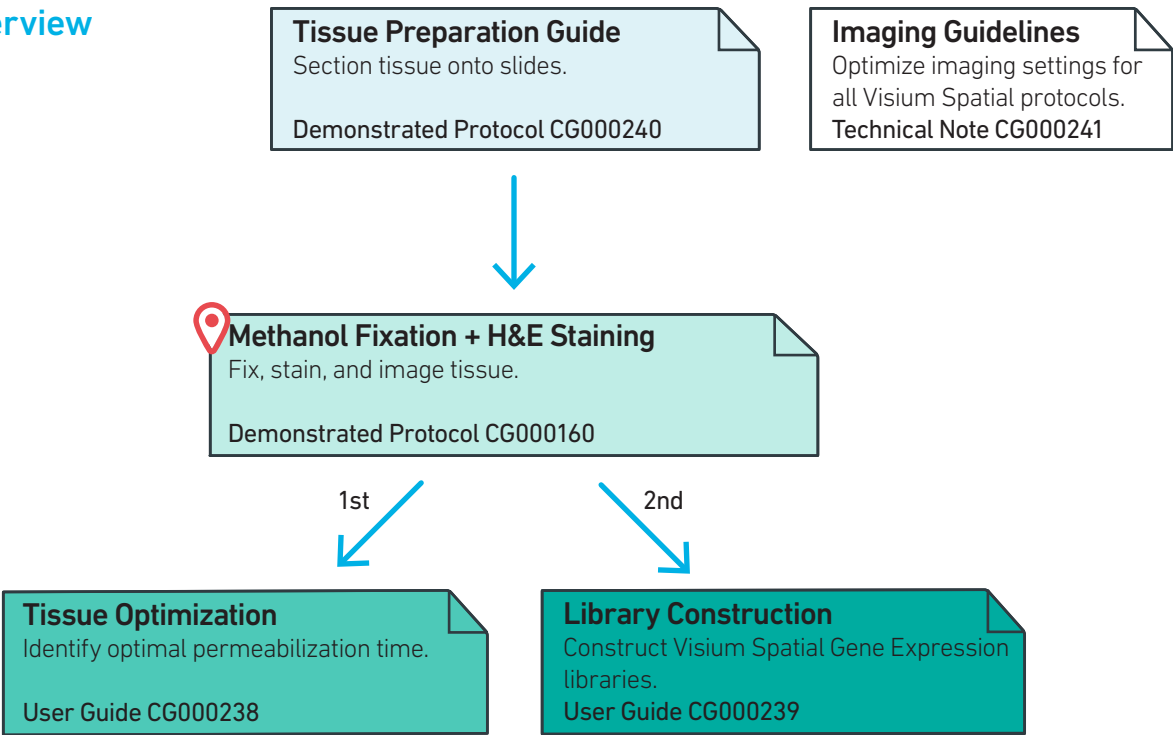
Visium Spatial Gene Expression Slide Kit, 4 rxns PN-1000188
(store at ambient temperature)

| Visium Spatial Gene Expression Slide Kit | PN |
|--|---------------------|
| Visium Spatial Gene Expression Slide | 2000233 |
| *Visium Slide Seals, 12-pack or 5-pack (may come in varying configurations in different lots) | 2000283 3000279 |
| *Visium Slide Cassette & Gasket, 4-pack or 1-pack | 2000282/ 2000281 |
| *Not used in this protocol | |
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Visium Gateway Gene Expression Slide Kit, 2 rxns PN-1000312
(store at ambient temperature)

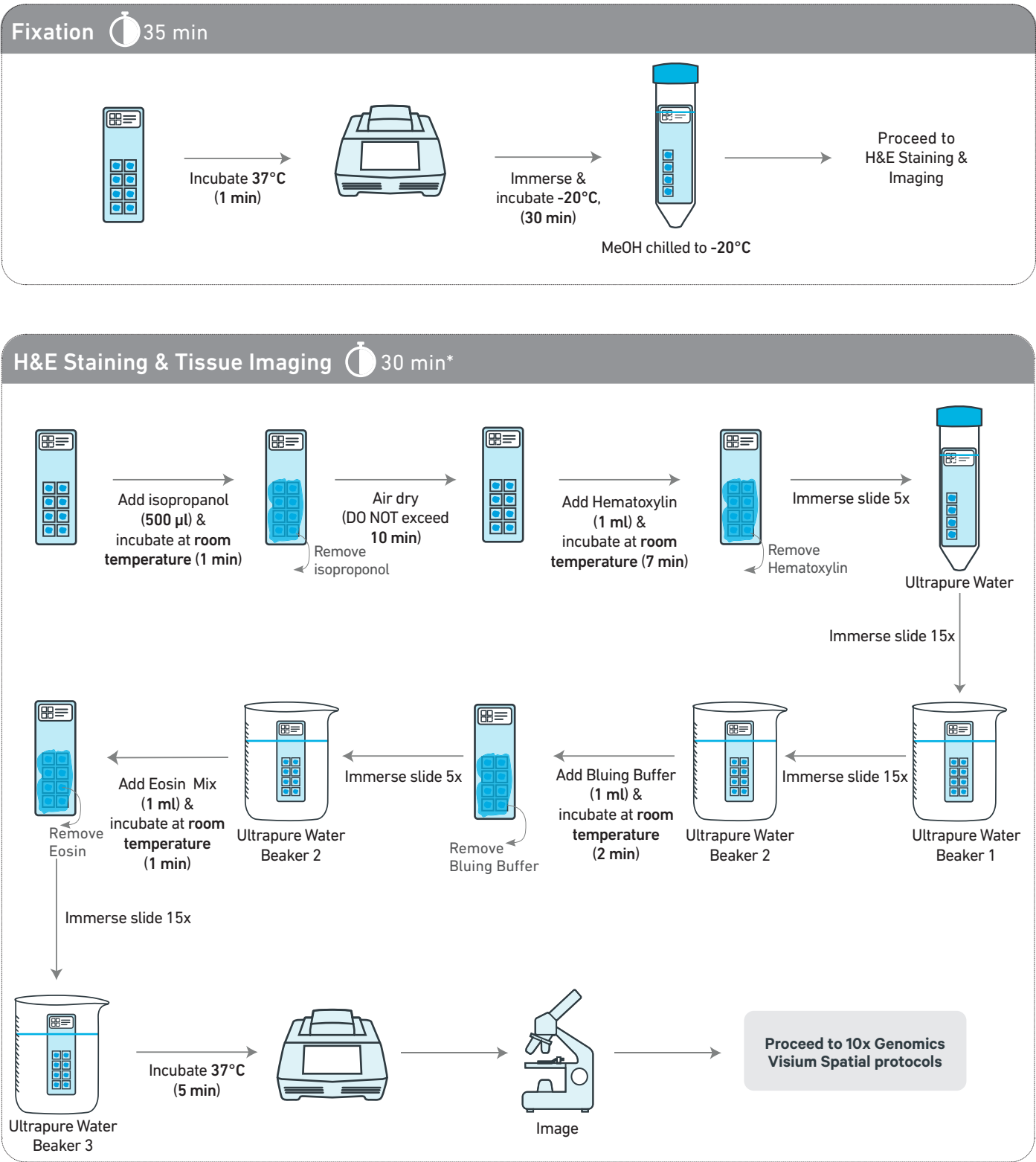
| Visium Gateway Gene Expression Slide Kit | PN |
|---|---------|
| Visium Gateway Gene Expression Slide | 2000263 |
| *Visium Slide Seals, 5-pack | 3000279 |
| *Visium Slide Cassette & Gasket, 1-pack | 2000281 |
| *Not used in this protocol | |
| 10xGenomics.com | |

Workflow Overview



Visit the 10x Genomics Support website for the most current documentation.

Protocol Overview



*Time excludes imaging steps

Tips & Best Practices

Icons



Tips & Best Practices section includes additional guidance



Signifies critical step requiring accurate execution



Troubleshooting section includes additional guidance

General Reagent Handling

- Thoroughly mix reagents before use.
- Promptly move reagents back to the recommended storage.
- Use a pH meter to adjust pH as necessary during buffer preparation.

Pipette Calibration

- Follow manufacturer's calibration and maintenance schedules.

Slide Storage

- Always store unused slides in a dry environment at room temperature in their original packaging and keep sealed. DO NOT remove desiccant.
- After tissue placement, store slides in a sealed container. If using an unsealed slide mailer, store in a secondary sealed container, such as a resealable bag.
- Store the sealed container containing slides with tissue at -80°C for up to four weeks.

Store Unsealed Slide Mailers in a Secondary Sealed Container



Slide Handling

- Always wear gloves when handling slides.
- Exercise caution when handling slide edges to prevent injury.
- Ensure that the active surface of a slide faces up and is never touched. The orientation of the label on the slide defines the active surface.
- The tissue sections should always be on the active surface of the slide. DO NOT touch the tissue sections.
- Minimize exposure of the slides to sources of particles and fibers.
- When immersing slides in water, ensure that the tissue sections are completely submerged.
- Keep the slide flat on a clean, nonabsorbent work surface when adding reagents to the active surface.
- Ensure that no absorbent surface is in contact with the reagents on the slide during incubation.

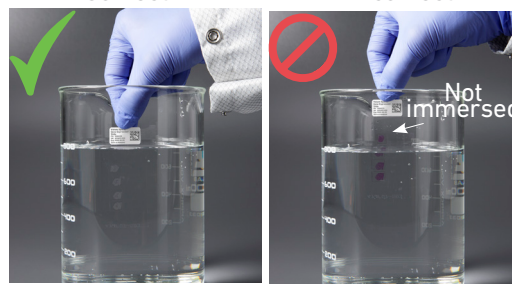
Active Surface with Tissue Sections



Immersing Slide

Correct

Incorrect



Reagent on Slide

Correct

Incorrect



Slide Incubation Guidance

Incubation at a specified temperature

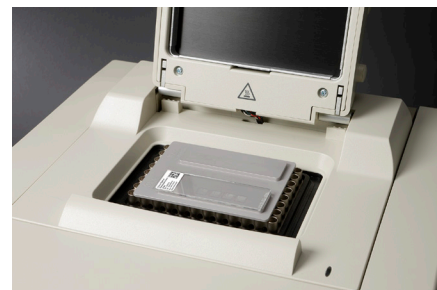
- Position a Thermocycler Adaptor on a thermal cycler that is set at the incubation temperature.
- Ensure that the Thermocycler Adaptor is in contact with the thermal cycler surface uniformly.
- When incubating a slide, position the slide on the Thermocycler Adaptor with the active surface facing up.
- Ensure that the entire bottom surface of the slide is in contact with Thermocycler Adaptor.



Place Thermocycler Adaptor



Incubate Slide



Incubation at room temperature

- Place the slide on a flat, clean work surface.
- Ensure that no absorbent surface is in contact with the reagents on the slide during incubation.

Slide Incubation

Correct



Incorrect



1. Tissue Fixation & H&E Staining

1.0 Overview

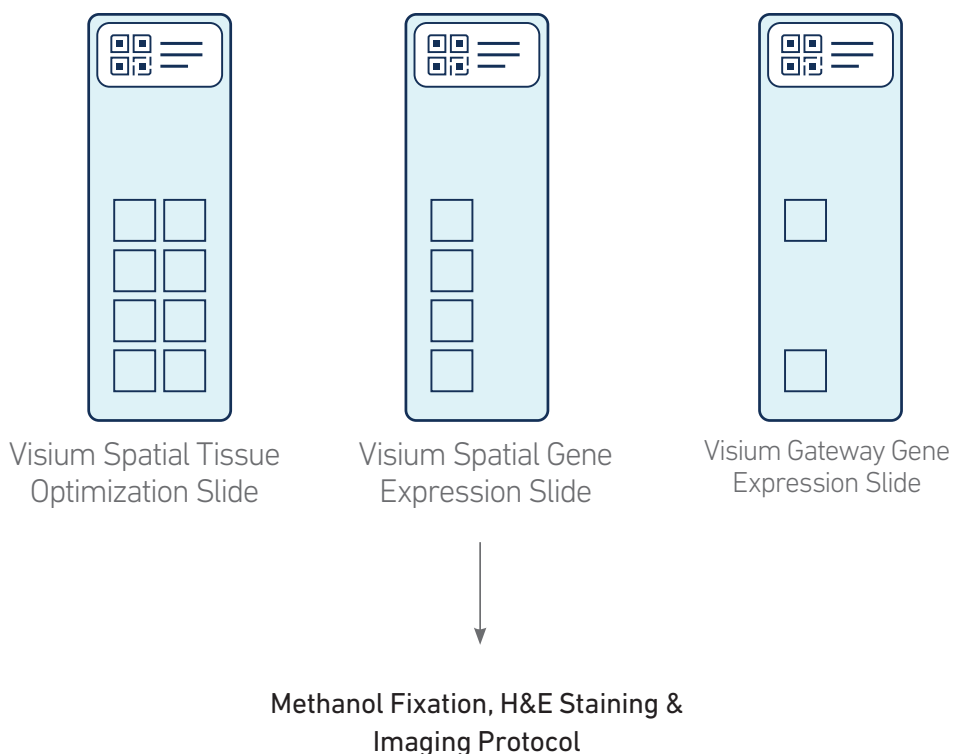
1.1 Specific Reagents & Consumables

1.2 Tissue Fixation

1.3 Tissue H&E Staining

1.0 Overview

Ensure that this protocol is performed on tissue sections placed on the correct slide. Refer to the Introduction and Workflow Overview sections for more information.



Ensure that microscope settings have been verified and imaging programs have been created prior to starting this protocol. Consult the Visium Spatial Gene Expression Imaging Guidelines Technical Note (CG000241) for more information.

1.1 Specific Reagents & Consumables

The items in the table below have been validated by 10x Genomics and are highly recommended for Visium Spatial Reagent Kits protocols. Substituting materials may adversely affect system performance. This list does not include standard laboratory equipment, such as water baths, centrifuges, pH meters, vortex mixers, freezers, etc.

Ensure that tissue sections have been placed on the appropriate slide and stored at -80°C. The slide will be retrieved in step 1.2.

| Tissue Fixation | | |
|--------------------------|---|----------------|
| Vendor | Item | Part Number |
| Millipore Sigma | Methanol, for HPLC, ≥99.9% | 34860 |
| Tissue H&E Staining | | |
| Vendor | Item | Part Number |
| Millipore Sigma | Acetic Acid, ≥99.9% | A6283 |
| | 2-Propanol (Isopropanol), ≥99.5% | I9516-25ML |
| | Eosin Y solution, aqueous | HT110216-500ML |
| | Eosin Y-solution, 0.5% aqueous (alternative to HT110216-500ML) | 1098441000 |
| | Hematoxylin Solution, Mayer's (alternative to Agilent product) | MHS16-500ML |
| | Hematoxylin solution according to Mayer (alternative to Agilent product) | 51275-100ML |
| | Protector RNase Inhibitor (Optional) | 3335399001 |
| Agilent | Hematoxylin, Mayer's (Lillie's Modification) | S330930-2 |
| | Bluing Buffer, Dako | CS70230-2 |
| | Eosin, Dako | CS70130-2 |
| | (alternative to Millipore Sigma product) | |
| Thermo Fisher Scientific | Tris Base (White Crystals or Crystalline Powder/Molecular Biology) | BP152-500 |
| | Electron Microscopy Sciences Mayer's Hematoxylin 500 mL (alternative to Agilent product) | 50-317-94 |
| | Shandon Bluing Reagent (alternative to Agilent product) | 6769001 |
| | RiboLock RNase Inhibitor (Optional - alternative to Millipore Sigma product) | E00382 |
| Corning | Corning 250 mL Vacuum System, 0.2 µm Pore 19.6cm² NY Membrane | 430771 |
| | Self-Standing Polypropylene Centrifuge Tubes, 50 ml, sterile | 430921 |

| Additional Materials | | |
|--|--|---|
| - | Dry Ice | - |
| - | Ultrapure/Milli-Q water (from Milli-Q Integral Ultrapure Water System or equivalent) | - |
| Prepare | | |
| Methanol | • Dispense 40 ml/slide in a 50-ml centrifuge tube. Chill to -20°C before use. | |
| Tris-Acetic Acid Buffer (0.45 M, pH 6.0) pH meter will be required. pH paper not recommended. | Prepare 200 ml (200 slides), store at room temperature. • Dissolve 11 g Tris base in 100 ml nuclease-free water. • Adjust pH to 6.0 using 100% Acetic Acid. • Bring volume to 200 ml with nuclease-free water. • Filter through 0.2 µm Corning 250 mL Vacuum System. | |

Recommended Thermal Cyclers

| Supplier | Description | Part Number |
|--------------------------|--|---|
| Bio-Rad | C1000 Touch Thermal Cycler with 96-Deep Well Reaction Module | 1851197 |
| Eppendorf | MasterCycler Pro (discontinued) | North America 950030010 International 6321 000.019 |
| Thermo Fisher Scientific | Veriti 96-Well Thermal Cycler (discontinued) | 4375786 |

1.2 Tissue Fixation



If fixing tissue on a Visium Spatial Gene Expression Slide - Note the serial number on the slide label; will be required for downstream analysis.

Ensure that the methanol (40 ml/slide) dispensed in a 50-ml centrifuge tube is chilled to -20°C .

- a. Place a Thermocycler Adaptor on a thermal cycler set at 37°C and equilibrate for 5 min. Heating the thermal cycler lid is not required.
- b. Remove slide from -80°C and place on dry ice in a sealed container.



Delay in transferring slides to dry ice may result in condensation, which may cause tissue damage and/or shifting of tissue sections on the slide.

- c. Place slide on the Thermocycler Adaptor with the active surface facing up and incubate 1 min at 37°C . DO NOT close the thermal cycler lid. Maintain thermal cycler at 37°C for step 1.2.
- d. Remove slide from Thermocycler Adaptor and if necessary, wipe excess liquid from the back of the slide, without touching the tissue sections.
- e. Completely immerse the slide in the pre-chilled methanol. Secure the tube cap to prevent methanol loss.
- f. Incubate upright for 30 min at -20°C .

Place Thermocycler Adaptor



Incubate Slide for 1 min at 37°C



Incubate in Methanol for 30 min at -20°C



1.3

Tissue H&E Staining

- a. Dispense the following volumes of Milli-Q water.
50 ml in one 50-ml centrifuge tube/slide
800 ml in Beaker 1
800 ml in Beaker 2
800 ml in Beaker 3
 Dispensed volume in each beaker can be used for two slides.



- b. Prepare Eosin Mix. **DO NOT** add pure eosin to tissue sections.

| Eosin Mix | Volume/slide (µl) |
|--|-------------------|
| Eosin Y Solution | 100 |
| Tris-Acetic Acid Buffer (0.45 M, pH 6.0) | 900 |
| Total | 1,000 |

- c. Remove slide from methanol and wipe excess liquid from the back of the slide, without touching the tissue sections. Place on a flat, clean, nonabsorbent work surface. Some residual droplets may remain.



- d. Add **500 µl** isopropanol to uniformly cover all tissue sections on the slide. See Tips & Best Practices.

- e. Incubate **1 min** at **room temperature**.

When incubating the slide with reagents, ensure that the slide is not in contact with any absorbent surface, like laboratory wipes, which may absorb the reagents.

- f. Discard reagent by draining and/or holding the slide at an angle with the bottom edge in contact with a laboratory wipe.

- g. Wipe excess liquid from the back of the slide, without touching the tissue sections. Place on a flat, clean, nonabsorbent work surface.

- h. Air dry the slide. To prevent tissue section from over drying, inspect slide after **5 min**. **DO NOT** exceed **10 min**.



- i. Add **1 ml** Hematoxylin to uniformly cover all tissue sections on the slide.
- j. Incubate **7 min** at **room temperature**.
- k. Discard reagent by draining and/or holding the slide at an angle with the bottom edge in contact with a laboratory wipe.

Incubate with Reagent



Discard Reagent



Slides in images are representative.

l. Immerse the slide 5x in the water in centrifuge tube.

m. Immerse the slide 15x in the water in Beaker 1.

n. Immerse the slide 15x in the water in Beaker 2.

o. Wipe excess liquid from the back of the slide without touching the tissue section. Place on a flat, clean, nonabsorbent work surface. Some droplets may remain

p. Add 1 ml Bluing Buffer to uniformly cover all tissue sections.

q. Incubate 2 min at room temperature.

r. Discard reagent by draining and/or holding the slide at an angle with the bottom edge in contact with a laboratory wipe.

s. Immerse the slide 5x in the water in Beaker 2.

t. Wipe excess liquid from the back of the slide without touching the tissue section. Place on a flat, clean, nonabsorbent work surface. Some droplets may remain.

u. Add 1 ml Eosin Mix to uniformly cover all tissue sections.

v. Incubate 1 min at room temperature.

w. Discard reagent by draining and/or holding the slide at an angle with the bottom edge in contact with a laboratory wipe.

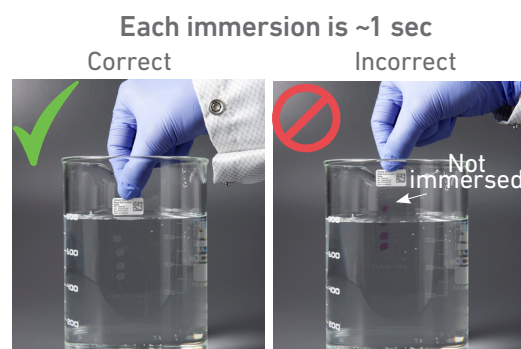
x. Immerse the slide 15x in the water in Beaker 3.

y. Wipe the back of the slide with a laboratory wipe. Place on a flat, clean, nonabsorbent work surface and air dry until tissue is opaque.

z. Incubate slide on the Thermocycler Adaptor with the thermal cycler lid open for 5 min at 37°C.

Proceed to tissue imaging.

OPTIONAL: A coverslip may be mounted on the slide before imaging. See Appendix for Coverslip Application & Removal protocol.



2. Tissue Imaging

2.0 Imaging System Recommendations


2.1 Tissue Imaging

2.0 Imaging System Recommendations

The following table shows imaging systems used by 10x Genomics in the development of this protocol. Any equivalent imaging setup can be used as an alternative. Imaging systems should have both brightfield and fluorescence capacity.

| Supplier | Description |
|--|--|
| Nikon | Nikon Eclipse Ti2 |
| Molecular Devices | ImageXpress Nano Automated Cell Imaging System |
| Hamamatsu | NanoZoomer S60 |
| Keyence | Keyence BZX800 |
| BioTek | Cytation 7 |
| Thermo Fisher Scientific | EVOS M7000 |
| Leica | Leica DMI8 Versa 8 |
| Brightfield Recommended Configuration | |
| Color camera (3 x 8 bit, 2424 x 2424 pixel resolution) | |
| White balancing functionality | |
| 2.18 µm/pixel minimum capture resolution | |
| Exposure times 2-10 milli sec | |
| Fluorescence Recommended Configuration (Only required for Tissue Optimization and Imaging Test Slides) | |
| Light source (or equivalent) with a wavelength range of 380-680 nm | |
| Monochrome camera (14 bit, 2,424 x 2,424 pixel resolution) | |
| TRITC filter cube (Excitation 542/20, Emission 620/52) | |
| 2.18 µm/pixel minimum capture resolution | |
| Exposure times 100 milli sec-2 sec | |

2.1 Tissue Imaging

- If imaging a Visium Spatial Tissue Optimization Slide, image all Capture Areas together at the desired magnification using brightfield imaging settings.
- If imaging a Visium Spatial Gene Expression Slide, image all Capture Areas individually at the desired magnification using brightfield imaging settings. Ensure that fiducial frames are captured.
- Consult the Visium Spatial Gene Expression Imaging Guidelines Technical Note (CG000241) for additional information.
-  After imaging, proceed immediately to the Visium Spatial Tissue Optimization User Guide (CG000238) or the Visium Spatial Gene Expression user Guide (CG000239).

Appendix

Coverslip Application & Removal

A coverslip may be mounted on the slides before imaging to enhance optical quality. Although imaging without a coverslip is sufficient to visualize the tissue morphology, some imaging systems or higher imaging magnifications require the use of coverslips.

If using a coverslip, follow this application and removal protocol to ensure that the tissue sections and the Capture Areas are not damaged.

Items

- ☐ **Large Coverslip** (Thermo Scientific 24 x 60 mm PN:22-050-233; Alternative, 24 x 50mm PN:22-050-232)
- ☐ **3X SSC** (prepare **500 ml** - add **75 ml** 20X SSC to **425 ml** Ultrapure water)
- ☐ **Mounting Medium** (prepare **200 µl** - add **10 µl** RNase Inhibitor (PN 3335399001), **20 µl** Nuclease-free water to **170.0 µl** Glycerol)
- ☐ **Laboratory Wipes**
- ☐ **Thermocycler Adaptor** (pre-equilibrated to **37°C** on a thermal cycler; may be used for drying)

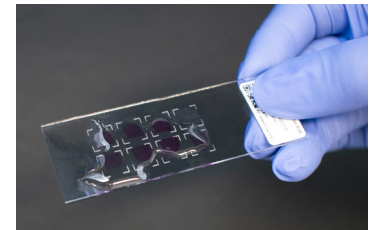
Application

Prior to mounting the coverslip, ensure that the sample and the slide with the tissue sections are dry. Moisture on the surface of the slide may result in faulty mounting.

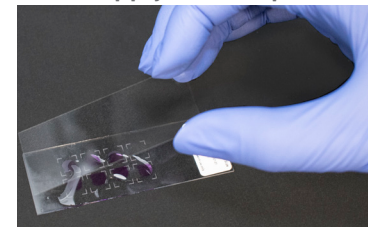
If necessary, incubate the slide for **1 min** at **37°C** by placing on the pre-equilibrated Thermocycler Adaptor placed on a thermal cycler with the lid open.

- a. Add **200 µl** Mounting Medium to cover the tissue sections on the slide uniformly. If necessary, hold the slide at an angle for uniform coverage.
- b. Apply the coverslip at an angle on one end of the slide. Slowly lower the coverslip, pressing down gently with forceps, without introducing bubbles.
- c. Remove excess Mounting Medium by placing one long edge of the slide on a laboratory wipe, and gently tilt the slide back and forth. Repeat with the second long edge of the slide. Repeat the process until the coverslip is secured.
- d. After the coverslip is secured, **immediately** proceed with imaging.
DO NOT let the attached coverslip dry.
DO NOT use Cytoseal or nail polish for securing the coverslip.

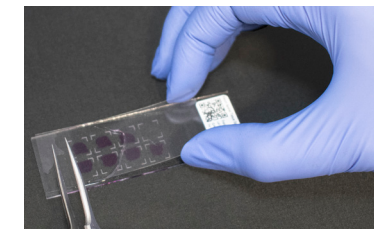
Cover uniformly with Mounting Medium



Apply coverslip



Press down



Remove excess Mounting Medium



Coverslip Application & Removal

Removal

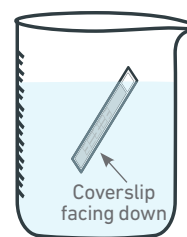
Remove the coverslip immediately after imaging is complete.

- Immerse the slide at ~45° angle in the 3X SSC Buffer with the coverslipped surface fully submerged and facing down.
- Hold the slide in 3X SSC Buffer until the coverslip slowly separates away from the slide.
DO NOT move the slide up and down or shake forcibly to prevent damaging the tissue sections and the Capture Areas.
- Remove the slide from the 3X SSC Buffer and immerse 1x in the 3X SSC Buffer to ensure all Mounting Medium is removed.
- Wipe excess liquid from the back of the slide, without touching the tissue sections.

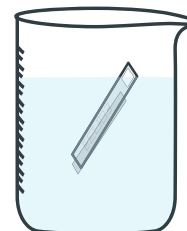


Proceed immediately to the Visium Spatial Tissue Optimization User Guide (CG000238) or the Visium Spatial Gene Expression User Guide (CG000239).

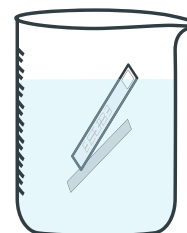
Immerse in 3X SSC Buffer



Hold in 3X SSC Buffer



Coverslip detaches



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