

# ASCP Board of Certification Practice Analysis Report Technologist in Cytogenetics (CG)

For Development of  
CG(ASCP) & CG(ASCP<sup>i</sup>)  
Content Guideline and Examination  
for CG Exam Publication January 1, 2024

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## INTRODUCTION

The purpose of conducting a practice analysis (a.k.a. job analysis or job task analysis) is to provide the foundation of a certification examination by defining practice in a profession. The practice analysis provides evidence of content validation. It is required by psychometric standards and is considered best practice for high-stakes examination development. It also ensures the certification examination is fair, valid, job-related, and most importantly, legally defensible (Chinn and Hertz 2010)<sup>1</sup>. The ASCP Board of Certification (BOC) conducts a practice analysis approximately every five years in accordance with ASCP BOC Policy and requirements of the accrediting body, ANAB (ANSI [American National Standards Institute] National Accreditation Board), under ISO/IEC 17024.

A practice analysis is a formal process for determining or verifying the responsibilities of individuals in the job/profession, the knowledge individuals must possess, and the skills and abilities necessary to perform the job at a minimally competent level. It provides a complete and modern understanding of the duties and functions of practicing laboratory professionals. The practice analysis process is carried out in the form of a survey that lists all the tasks thought to be completed by practicing laboratory professionals. The results of the practice analysis inform the specifications and content of the ASCP BOC certification examinations. This ensures that the examinations are reflective of current practices, and it helps guarantee that individuals who become certified are current and up-to-date on the state of practice and are competent to perform as certified laboratory professionals.

## PRACTICE ANALYSIS PROCESS

The ASCP BOC conducted a practice analysis survey to inform the Technologist in Cytogenetics (CG) certification examination category.

The process for conducting a practice analysis consists of the following steps:

1. Survey Development
2. Demographics
3. Task Inventory – Skill Questions
4. Rating Criteria
5. Survey Construction
6. Pilot Testing and Revision
7. Survey Distribution
8. Survey Analysis
9. Committee Review and Discussion
10. Examination Content Guideline, Standard Setting, and Exam Publication

## SURVEY DEVELOPMENT

During the 2021 ASCP BOC examination committee meeting, the Cytogenetics Examination Committee provided the input and discussion to develop a practice analysis survey. The committee members (subject matter experts) collectively discussed all pertinent aspects of their profession to design a concise survey to extract useful feedback from field professionals while maximizing response rate. The survey had two main components: demographics and task inventory with appropriate rating scales for each.

<sup>1</sup> Chinn, R.N., and N.R. Hertz. 2010. *Job Analysis: A Guide for Credentialing Organizations*. Lexington: Council on Licensure, Enforcement and Regulation (CLEAR).

## DEMOGRAPHICS

The demographic questions asked respondents about their experience, education, job title, type of facility, gender, age, etc. The purpose of these questions was to aid the committee in deciding whether the sample of respondents obtained was representative of the profession in general. The demographic data also provided analytic categories that allowed refinement of the survey population to utilize only those responses from individuals at the targeted professional level.

## TASK INVENTORY – SKILL QUESTIONS

The committee developed a series of job-related task questions that formed the body of the survey. The survey had five major sections:

- Specimen Preparation, Culture, and Harvest
- Chromosome Banding, Staining, and Imaging
- Chromosome Selection, Analysis, and Documentation
- Molecular Cytogenetic Testing
- Laboratory Operations

## RATING CRITERIA

The rating scale used for the job-related task questions asked respondents to indicate whether or not they currently performed specific tasks as part of their jobs. If the respondents noted that they did not perform a task, they were asked to indicate whether they were expected to have knowledge of the concept or protocol to perform their jobs.

## SURVEY CONSTRUCTION

The practice analysis survey was created and delivered through Key Survey. Using an electronic tool allowed survey review and testing via the internet, email tracking of respondents using email addresses, and the ability to send email reminders for completion of the survey.

## PILOT TESTING AND REVISION

The Cytogenetics Examination Committee tested a pilot version of the survey. They reviewed and revised different aspects of the survey (e.g., information correctness, grammar/spelling, survey branching). The pilot testing comments and edits informed the final version of the survey.

## SURVEY DISTRIBUTION

The Cytogenetics Examination Committee determined that the survey should be sent to all current CG certificants in the ASCP BOC Personify database. The survey was open for a 3-week period between November 2 – 23, 2021. ASCP BOC staff also directly emailed the survey to the Cytogenetics Examination Committee and encouraged the committee membership to disseminate the survey to their colleagues. Additionally, the survey link was shared with the Association of Genetic Technologists (AGT), and posted on ASCP social media sites (i.e., Facebook, Instagram, and LinkedIn).

## SURVEY ANALYSIS

The respondents were asked to answer all questions and rate all tasks in the survey. Responses from individuals currently working as a supervisor, manager, or director were not appropriate for the entry-level CG certification exam category and were therefore excluded from the analysis. Any individuals not currently practicing (e.g., retired, unemployed, or simply not working in cytogenetics) were removed from the practice analysis survey.

## COMMITTEE REVIEW AND DISCUSSION

During the 2022 examination committee meeting, the Cytogenetics Examination Committee reviewed the practice analysis results. They agreed that the demographic results accurately reflected the CG population (**Appendix A**).

In general, tasks performed by at least 40% of the respondents were retained on the task lists and considered valid to be included on the examination. The committee reviewed all tasks performed by less than 40% of the respondents. If the committee determined that these tasks were critical to patient care and/or were up-and-coming in practice, then the task was retained on the task list and considered valid for the examination. If the task was considered outdated or too esoteric, then it was removed from the task list and not included on the exam. The committee decisions were compiled into the Final Task List for CG (**Appendix B**) which was used to inform the exam content guideline and the content for the certification exam.

## EXAMINATION CONTENT GUIDELINE, STANDARD SETTING, AND EXAM PUBLICATION

The Cytogenetics Examination Committee revised the CG exam content guideline based on the Final Task List for CG (**Appendix B**). They reviewed the content area percentages on the content guideline and determined no changes were needed. The committee reviewed the exam database according to the updated content guideline and deleted or revised questions accordingly. They wrote new questions to fulfill the content guideline, and reclassified questions according to the updated guideline. After this work was completed, the committee performed standard setting to determine the pass point of the exam, and the new exam was published.

# TECHNOLOGIST IN CYTOGENETICS (CG)

## Demographic Analysis

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**Total usable survey respondents: 238**

**Usable individual respondents met the following criteria:**

- Currently employed in a clinical cytogenetics laboratory.
- Primary role is technologist or lead technologist.

**Summary of demographic results:**

- ASCP BOC credentials: individuals may have multiple credentials. The most common credentials include:
  - 93% are CG certified.
  - 10% are MLS certified.
- Highest level of education completed:
  - 14% have a master's degree or higher.
  - 85% have a baccalaureate degree or postbaccalaureate program certificate.
  - 1% have an associate degree.
- Years of experience:
  - Mean: 18 years
  - Minimum: 1 year
  - Maximum: 40 years
- Geographic Distribution: there are respondents from across the United States. The states with the highest response rate include:
  - 14% from Utah.
  - 9% from California.
  - 6% each from Minnesota, Texas, and Ohio.
- Facility:
  - 53% work in hospital laboratories.
  - 41% work in independent (reference/commercial) laboratories.
  - 6% work in other types of facilities.
- Age:
  - Mean: 45 years of age
  - Minimum: 22 years of age
  - Maximum: 65 years of age
- Gender:
  - 82% are female.
  - 15% are male.
  - 2% chose not to answer.

## Appendix B

### TECHNOLOGIST IN CYTOGENETICS (CG)

Final Task List (topics kept on exam based on practice analysis results)

| SPECIMEN PREPARATION, CULTURE, AND HARVEST |                                                                                                                       |
|--------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|
| SPECIMEN PREPARATION                       |                                                                                                                       |
| 1.                                         | Provide specimen requirements (e.g., size, containers, transport conditions)                                          |
| 2.                                         | Assess specimens for quality factors (e.g., viability, cellularity, contamination)                                    |
| 3.                                         | Troubleshoot compromised or unacceptable specimens                                                                    |
| 4.                                         | Assess specimens for multiple tests                                                                                   |
| 5.                                         | Verify patient information and test order(s)                                                                          |
| 6.                                         | Assign test priority                                                                                                  |
| SPECIMEN CULTURE                           |                                                                                                                       |
| 7.                                         | Prepare prenatal or tumor specimens for long-term adherent cell cultures (e.g., dissection, enzymatic disaggregation) |
| 8.                                         | Prepare blood or bone marrow specimens for short-term suspension cell cultures                                        |
| 9.                                         | Select optimal tissue for culture                                                                                     |
| 10.                                        | Determine number of cultures per specimen                                                                             |
| 11.                                        | Prepare media (e.g., supplements, culture conditions)                                                                 |
| 12.                                        | Use aseptic culture technique to prevent cross-contamination between cultures and microbial contamination             |
| 13.                                        | Detect, identify, and control contamination                                                                           |
| 14.                                        | Culture maintenance                                                                                                   |
| 15.                                        | Evaluate/subculture monolayer cells                                                                                   |
| 16.                                        | Assess culture for harvest                                                                                            |
| 17.                                        | Investigate/document culture failures                                                                                 |
| CULTURE HARVEST                            |                                                                                                                       |
| 18.                                        | Harvest <i>in situ</i> or monolayer cultures                                                                          |
| 19.                                        | Harvest suspension cultures                                                                                           |
| 20.                                        | Use chromosome elongation techniques (e.g., synchronization, intercalation)                                           |
| 21.                                        | Select, prepare, and use mitotic inhibitors, hypotonic solutions, fixatives, and processing times                     |
| 22.                                        | Store fixed cell pellets                                                                                              |
| 23.                                        | Select conditions for slide preparation                                                                               |
| 24.                                        | Assess slide quality (e.g., cell density, chromosome morphology, metaphase spreading)                                 |
| 25.                                        | Troubleshoot slide preparations                                                                                       |
| 26.                                        | Assess mitotic index and the need for additional slides                                                               |
| 27.                                        | Recognize and troubleshoot harvest failures (i.e., reagents, equipment, suboptimal specimens)                         |

## CHROMOSOME BANDING, STAINING, AND IMAGING

### CHROMOSOME BANDING AND STAINING

- 28. Aging slides
- 29. G-banding
- 30. Assess and troubleshoot staining/banding

### MICROSCOPES AND IMAGING SYSTEMS

- 31. Perform brightfield microscopy
- 32. Perform fluorescent microscopy
- 33. Perform phase microscopy
- 34. Identify microscope components and functions
- 35. Achieve optimal resolution
- 36. Troubleshoot microscopy
- 37. Capture images
- 38. Enhance images
- 39. Troubleshoot imaging

## CHROMOSOME SELECTION, ANALYSIS, AND DOCUMENTATION

- 40. Select, count, and analyze metaphases
- 41. Review previous or related results
- 42. Analyze appropriate number of cells based on specimen type
- 43. Analyze appropriate number of cultures based on specimen type
- Document chromosome analysis (e.g., chromosome count, metaphase identifiers)
- 44. Analyze/identify chromosome abnormalities (e.g., numerical, structural, mosaicism)
- 45. Identify cultural artifacts, instability syndromes, and normal variants
- 46. Troubleshoot chromosome analysis (e.g., discrepancies, multiple cell lines)
- 47. Arrange chromosomes using an approved format
- 48. Assess band level
- 49. Record results using ISCN
- 50. Select representative images
- 51. Prepare the appropriate number of karyograms
- 52. Recognize the clinical implications of chromosome analysis: constitutional, acquired, variants
- 53. Document the reporting of preliminary results per regulatory guidelines
- 54. Document reporting of preliminary results per regulatory guidelines

## MOLECULAR CYTOGENETIC TESTING

### FLUORESCENCE IN SITU HYBRIDIZATION (FISH)

- 55. Evaluate specimen quality
- 56. Determine the analysis type (i.e., interphase or metaphase)

|                                                                                                         |
|---------------------------------------------------------------------------------------------------------|
| 57. Identify the appropriate probe strategy (e.g., break-apart, fusion, amplification, enumeration)     |
| 58. Perform slide processing (e.g., denaturation, hybridization, post-hybridization wash, counterstain) |
| 59. Identify signal patterns for probe strategies (e.g., microdeletion, translocation, enumeration)     |
| 60. Score and interpret cells based on the probe strategies                                             |
| 61. Capture representative cell images                                                                  |
| 62. Document FISH analysis using ISCN nomenclature                                                      |
| 63. Troubleshoot FISH processing issues                                                                 |
| 64. Validate probes and establish reference ranges and cut-offs                                         |
| 65. Use parallel positive/negative controls                                                             |
| 66. Perform plasma cell enrichment                                                                      |
| 67. Process paraffin-embedded tissue sections                                                           |
|                                                                                                         |
| <b>MICROARRAY</b>                                                                                       |
| 68. Identify limitations of the technique                                                               |
| 69. Identify, interpret, and report results with clinical relevance                                     |
|                                                                                                         |
| <b>LABORATORY OPERATIONS</b>                                                                            |
| <b>LABORATORY PRACTICE</b>                                                                              |
| 70. Label specimens                                                                                     |
| 71. Prepare, label, and store reagents                                                                  |
| 72. Clean/decontaminate instruments, equipment, and work surfaces                                       |
| 73. Monitor laboratory supplies and chemicals (e.g., adequacy, expiration dates)                        |
| 74. Use appropriate retention times (e.g., specimens, cultures, analysis, images, reports)              |
|                                                                                                         |
| <b>EQUIPMENT OPERATION AND MAINTENANCE</b>                                                              |
| 75. Use general laboratory equipment (e.g., incubators, waterbaths, hoods, balances)                    |
| 76. Use slide preparation equipment (e.g., Thermotron)                                                  |
| 77. Use automated slide processing equipment (e.g., VP2000)                                             |
| 78. Use automated specimen processing equipment (e.g., Hanabi, Genial/Tecan)                            |
| 79. Use automated imaging/analysis equipment (e.g., CytoVision, MetaSystems, BioView, ASI)              |
|                                                                                                         |
| <b>LABORATORY SAFETY</b>                                                                                |
| 80. Utilize biological hazard safety (e.g., PPE, biological hazard spills)                              |
| 81. Utilize chemical safety (e.g., storage, spill clean-up)                                             |
| 82. Utilize fire safety (e.g., drills, extinguishers)                                                   |
| 83. Exercise proper ergonomics (e.g., posture, chair adjustment)                                        |
| 84. Document/notify laboratory accidents (e.g., needle sticks, spills, splashes)                        |
| 85. Participate in regulatory considerations (e.g., safety inspections, incident reporting)             |
| 86. Participate in safety training (e.g., fire, biological hazards)                                     |
|                                                                                                         |
| <b>QUALITY MANAGEMENT AND CONTINUOUS QUALITY IMPROVEMENT</b>                                            |
| 87. Monitor/document equipment function (e.g., outages, maintenance)                                    |
| 88. Monitor/document reagent performance and/or sterility                                               |

|                                                                                                        |
|--------------------------------------------------------------------------------------------------------|
| 89. Document the investigation of each culture or probe failure                                        |
| 90. Record quality indicators (e.g., resolution, band length, turn-around-time, error reporting)       |
| 91. Document participation in laboratory proficiency testing                                           |
| 92. Participate in accreditation site inspections (e.g., CAP)                                          |
| 93. Complete/document training and competency assessments                                              |
|                                                                                                        |
| <b>PROFESSIONAL STANDARDS</b>                                                                          |
| 94. Demonstrate professional ethics and/or standards                                                   |
| 95. Participate in regulatory compliance (e.g., HIPAA, OSHA, EPA, homeland security, state, and local) |
| 96. Participate in continuing education                                                                |