

International Cytometry Certification Examination



Candidate Handbook

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INTRODUCTION

The International Society for Advancement of Cytometry (ISAC) and the International Clinical Cytometry Society (ICCS), under the sponsorship of the Wallace H. Coulter Foundation, have worked together with leading certification companies and dozens of volunteers to develop the International Cytometry Certification Examination (ICCE). The goals of this program are to recognize professional excellence among cytometrists, aid cytometry employers in identifying qualified cytometrists, and assure the quality of cytometry applications worldwide.

Please use this candidate handbook to understand our processes of application, testing, and recertification. If you have questions about the processes described here, please contact Todd R. Philbrick, liaison to the Certification Advisory Committee at (301) 634-7454 or todd@isac-net.org or Castle at (919) 572-6880 or ibt@castleworldwide.com.

CREDENTIAL DESIGNATION

Upon achieving a passing score on the certification examination, candidates will be awarded the title Certified Cytometrist™. Certificants may use this designation as long as their certification is current.

THE INTERNATIONAL CYTOMETRY CERTIFICATION EXAMINATION (ICCE)

A computer-based version of the examination is offered on-demand through Castle's approved proctored testing centers in the U.S. and Canada. The ICCE will also be administered in paper format outside the U.S. and Canada throughout the year in conjunction with cytometry meetings and conferences. Please check www.cytometrycertification.org for a complete listing of global test sites.

The ICCE contains 100 multiple-choice questions, and candidates will be given two (2) hours to complete the test.

EXAMINATION REGISTRATION

Eligibility

Candidates must demonstrate evidence of the following along with the application form:

- Four years of cytometry work experience
- OR
- Bachelor's degree and two years of cytometry work experience

Fees

The examination fee is \$395 for all candidates. This fee includes the processing of the examination registration and one testing appointment.

Fees must be paid in U.S. funds to Castle by Visa, MasterCard, or American Express.

Application Process

Applications must be submitted prior to examination registration. Candidate eligibility will be valid for 366 days, and candidates will be permitted two testing attempts during that period. If a candidate does not take the examination for which he/she applied or successfully complete the examination within 366 days, the application will be closed and the candidate must submit a new application with the required supporting documentation and candidate fees. An email reminder will be issued to schedule testing to eligible candidates who have not yet completed test scheduling.

Online Applications

An online application is available through the ICCE candidate registration system at (www.castleworldwide.com/icce). You will be prompted to create an online profile that will serve as the basis for all interaction with Castle. You should record your username, password, and email address as used on the application for future reference and/or access to the system at a later time. You must register with the name that appears on the government-issued photo identification that you will use to enter the testing center to sit for your examination.

Paper Applications

If you are unable to complete the online application, paper applications are available for download at www.castleworldwide.com/icce.

Applications submitted by mail must have all requested information or they will be considered incomplete. Applications that are still incomplete after 90 days will be closed and all exam fees will be forfeited.

If you submit a paper application, please DO NOT submit an online application. Once your paper application has been processed, you will receive an email notification from Castle with your username and password to access the exam scheduling system.

Certified Cytometrist Registry

ICCE will maintain a registry of certificants for public access. Within the ICCE candidate registration system (www.castleworldwide.com/icce) applicants and certificants can choose to be included on this registry. The benefit of allowing your name to appear on the registry will be that your credentials can be verified by your customers and/or employer. More details regarding the public registry are available on the exam application.

Scheduling

Scheduling in the U.S. and Canada for Internet-Based Testing (IBT)

Applications are accepted on a continual basis. Upon approval of an application, Castle will send notification of eligibility to sit for the examination and will provide a *Notice to Schedule* (NTS) with a username, password, and directions on how to schedule a testing session.

The testing appointment must be made at least seven (7) days prior to your preferred test date. Most test sites will have morning and afternoon testing sessions available. Castle will do its best to accommodate the requested test site and date. Seats are filled on a first-come, first-served basis, based on test center availability.

Candidates will receive a confirmation email including exact test location, date, and time via email, which must be printed and taken to the site on the test date. **The candidate must take this document to the site on the test date.**

Scheduling outside the U.S. and Canada for Paper-Based Testing

Upon approval of an application, Castle will send notification of eligibility to sit for the examination and will provide a *Notice to Schedule* (NTS) with a username, password, and directions on how to schedule a testing session. Candidates wishing to test by paper in correlation with a meeting or conference must indicate their preference during exam scheduling. The list of available test sites/dates will be updated periodically and can be found at www.cytometrycertification.org/ExamSites.html.

Candidates must register for paper-based testing no later than 45 days prior to the test date.

Prior to the test date, Castle will send candidates an admission ticket with confirmation information regarding the exact test location, date, and time. **The candidate must take this document to the site on the test date.**

Deadlines

Candidates are strongly encouraged to complete their applications at least 60 days prior to their desired testing date.

Examination Registration and Testing Process

1. Review this candidate handbook prior to scheduling your examination. Failure to follow the instructions can cause a delay of your examination registration. For questions regarding examination registration, contact Castle at ibt@castleworldwide.com.
2. Complete the exam registration (www.castleworldwide.com/icce) and pay your testing fee. You must register with your full name as it appears on your government-issued photo identification.
3. In order to receive important electronic correspondence about scheduling your testing session, please ensure that your email program will accept emails from ibt@castleworldwide.com.
4. Schedule a testing session. (See "Scheduling" on page 3 of this handbook.)
5. Candidates requesting special testing accommodations under the Americans with Disabilities Act must submit their test scheduling requests at least 30 days prior to their preferred testing dates.
6. You will be notified of the exact test location, date, and time via a confirmation email. You must bring your printed confirmation with you to the test site.
7. You must also bring a current government-issued photo identification with signature to the test site. Acceptable forms of identification include driver's licenses, passports, and government-issued identification cards. Unacceptable forms of identification include gym

memberships, warehouse memberships, school identification cards, credit cards, and identification with signature only (no photo).

8. Please plan to arrive at the testing center at least 15 minutes prior to the start of the testing session. Those who arrive late for testing sessions may not be permitted to test.
9. Sit for the examination. The examination consists of 100 multiple-choice questions. You will be given two (2) hours to complete the examination.
10. Scores will be issued at the testing center for Internet-based testing. Candidates who test by paper will receive their results through the ICCE candidate registration system within 3-5 weeks of the test date.

Retaking the Examination

Candidates who do not pass the examination will receive information on retaking the ICCE (following a 90-day waiting period). Candidates will be allowed two testing attempts in a 366-day period and must pay the appropriate fee for each testing attempt.

Eligibility Audits

A percentage of candidate applications will be audited to ensure compliance with the eligibility criteria. Applications for audit will be selected randomly. If your application is selected for audit, you will be provided with instructions on how to supply satisfactory documentation that supports your compliance with the eligibility criteria before your certification scores are released.

REASONABLE ACCOMMODATIONS

Reasonable accommodations provide candidates with disabilities a fair and equal opportunity to demonstrate their knowledge and skill in the essential functions being measured by the examination. Reasonable accommodations are decided based on the individual's specific request, disability, documentation submitted, and appropriateness of the request. Reasonable accommodations do not include steps that fundamentally alter the purpose or nature of the examination.

Reasonable accommodations generally are provided for candidates who have a physical or mental impairment that substantially limits that person in one or more major life activities (e.g., walking, talking, hearing, and performing manual tasks); have a record of such physical or mental impairment; or are regarded as having a physical or mental impairment.

To apply for reasonable accommodations, the candidate must request the accommodations in the application process and provide documentation that supports reasonable accommodations provided by an appropriate licensed professional on the professional's letterhead. The documentation must include a diagnosis of the disability and specific recommendations for accommodations.

Requests for accommodations must be submitted no later than 45 days prior to opening of the candidate's preferred testing window and candidates must submit their scheduling request at least 30 days prior to their preferred test date within the testing window. It is recommended that this documentation be submitted at least 45 days prior to the preferred testing date.

For more information regarding reasonable accommodations, please contact Castle.

EXAMINATION INFORMATION

There are 100 questions on this examination. You will have two (2) hours to complete the examination.

This test content outline identifies the areas that are included on the examination. The percentage and number of questions in each of the major categories of the scored portion of the examination are also shown.

Category	Domains of Practice	No. of Questions	Percent
I	Instrumentation	20	20%
II	Sample	10	10%
III	Data	19	19%
IV	Safety	3	3%
V	Quality Control	10	10%
VI	Experimental Design	19	19%
VII	Theoretical Principles	19	19%
	Total	100	100%

For more information about the test content, see www.cytometrycertification.org/outline.html.

SAMPLE EXAMINATION QUESTIONS

The following questions were taken from the examination question repository and serve as samples of the question type and question content found on the certification examination. Please see the answer key in Appendix B.

1. What is the purpose of the fluidics system of a flow cytometer?
 - A. To serve as a buffer for cell maintenance
 - B. To dilute the concentration for the sample
 - C. To deliver sample to the interrogation point for the measurement
 - D. To provide a cushion to prevent a cushion to prevent cell death following excitation

2. What is the photodiode detector **PRIMARILY** used to measure?
 - A. Side scatter
 - B. Size of cells
 - C. Fluorescence
 - D. Forward scatter

3. Which of the following samples typically has a low concentration of cells?
 - A. Lymph nodes
 - B. Bone marrow
 - C. Peripheral blood
 - D. Cerebrospinal fluid

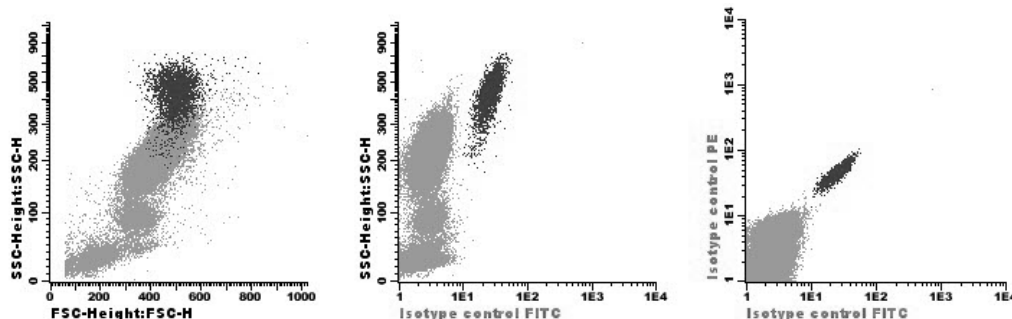
4. Which cell cycle model is often used in DNA analyses?
 - A. CFSE staining
 - B. Gating out debris
 - C. Doublet discrimination
 - D. G₀, S-Phase G₂M and DNA Index

5. Which of the following reagents used in flow cytometry is a mutagenic agent?
 - A. Propidium iodide
 - B. 0.9% NaCl solution
 - C. 1.0% NaCl solution
 - D. Phosphate buffered saline (PBS)

6. What is the goal of optimal antibody titration?

- A. Obtain minimal positive staining intensity
- B. Generate moderate positive staining intensity
- C. Minimize separation between positive and negative peaks
- D. Maximize separation between positive and negative populations

7. The population shown in black has high autofluorescence. What cell type is **MOST** likely to be responsible for this phenomenon?



- A. Basophils
- B. Neutrophils
- C. Eosinophils
- D. Lymphocytes

8. Which of the following are considered epitopes related to cell activation?

- A. CD90, TdT, CD34
- B. CD42a, CD18, CD58
- C. CD38, HLA-DR, CD25
- D. CD3, myeloperoxidase, heavy chain Ig

9. To obtain the highest purity of cells recovered in a cell sorter, how many droplets should be charged?

- A. One
- B. Two
- C. Three
- D. Four

10. In addition to affinity, what other factor is **MOST** important to the binding kinetics of an antibody?

- A. Antibody clone selection.
- B. Molecular weight of the antibody.
- C. Conformation of the antigen binding site.
- D. Temperature at which the interaction occurs.

OTHER EXAMINATION INFORMATION

Cancellations, Rescheduling, and No-shows

Internet-Based Testing

You may cancel or reschedule a testing session up to five (5) business days before your testing appointment through the online scheduling system. A \$50 nonrefundable fee will apply.

Day of Testing Appointment:	Must Reschedule/Cancel By:
Monday	Monday of the previous week
Tuesday	Tuesday of the previous week
Wednesday	Wednesday of the previous week
Thursday	Thursday of the previous week
Friday	Friday of the previous week
Saturday	Monday of the current week

Not appearing for your testing appointment or rescheduling your exam less than five (5) business days before your testing appointment will count as your testing appointment. You will be marked as a no-show candidate and your exam fee will be forfeited.

Paper-Based Testing

You may cancel or reschedule a testing session up to 30 days before your testing appointment through a written request to Castle Worldwide. A \$50 nonrefundable fee will apply.

Not appearing for your testing appointment or rescheduling your exam less than 30 days before your testing appointment will count as your testing appointment. You will be marked as a no-show candidate and your exam fee will be forfeited.

Examination Rules

ICCE and Castle follow industry standard testing rules as outlined below.

Prohibited Items

Candidates are expressly prohibited from bringing the following items to the test site:

- Cameras, cell phones, optical readers, or other electronic devices that include the ability to photograph, photocopy, or otherwise copy test materials
- Notes, books, dictionaries, or language dictionaries
- Book bags or luggage
- iPods, MP3 players, headphones, or pagers
- Calculators, computers, PDAs, or other electronic devices with one or more memories
- Personal writing utensils (i.e., pencils, pens, and highlighters)
- Watches
- Food and beverage
- Hats, hoods, or other headgear

If Castle testing personnel determine that you have brought any such items to the test site, they may be demanded and held for an indefinite period of time by Castle testing personnel. We reserve the right to

review the memory of any electronic device that may be in your possession at the testing center to determine whether any test materials have been photographed or otherwise copied.

If our review determines that any test materials are in the memory of any such device, we reserve the right to delete such materials and/or retain them for subsequent disciplinary action. Upon completion of our review and any applicable deletions, we will return your device to you, but will not be responsible for the deletion of any materials that may result from our review, whether or not such materials are test materials.

By bringing any such device into the test site in contravention of our policies, you expressly waive any confidentiality or other similar rights with respect to your device, our review of the memory of your device and/or the deletion of any materials. Castle, the examination site, and the test administration staff are not liable for lost or damaged items brought to the examination site.

ICCE Confidentiality Agreement

By registering for the ICCE examination, candidates agree to the following confidentiality agreement:

1. The ICCE examination is the exclusive property of the ICCE and is protected by copyright law.
2. No part of the ICCE examination may be copied or reproduced in part or whole by any means whatsoever, including memorization.
3. Participation in any irregularity during the examination including, but not limited to, giving or obtaining unauthorized aid, as evidenced by observation during the exam or by subsequent analysis may result in invalidation of the results of your examination, termination of your candidate status, revocation of your certification, civil liability, criminal prosecution, or other appropriate sanctions..
4. Discussion or disclosure of the contents of the examination orally, in writing, electronically or by any other means including training candidates for the ICCE is prohibited. Failure to comply will result in the revocation of your certification, civil liability, criminal prosecution, or other appropriate sanctions.
5. The theft or attempted theft of the ICCE examination is punishable by law.

Castle Candidate Attestation

Additionally, prior to the start of the ICCE examination, candidates will be required to agree to the following candidate attestation:

On my honor, I attest:

- ☐ I will not give any unauthorized assistance on this exam.
- ☐ I will not receive any unauthorized assistance on this exam.
- ☐ I will not remove any items from the testing center.
- ☐ I have turned over the following items to the proctor:
 - cameras, cell phones, optical readers, or other electronic devices that include the ability to

- photograph, photocopy or otherwise copy test materials
- notes, books, dictionaries or language dictionaries
- book bags, purses, handbags or luggage
- iPods, mp3 players, headphones, or pagers
- calculators (except as expressly permitted by the test sponsor), computers, PDAs, or other electronic devices with one or more memories
- personal writing utensils (i.e., pencils, pens, and highlighters)
- watches
- food and beverage
- hats, hoods, or other headgear

[] I will alert the proctor immediately if I have any concerns about the test administration, including if the testing environment becomes unacceptable to me, or if I have any concerns about the testing computer.

Certificates

After passing the examination, candidates will receive a personalized certificate, which is suitable for framing, and a wallet card. Certificates are printed and mailed to passing candidates on a monthly basis.

FOR MORE PREPARATION

Demo Test

Castle offers a free online tutorial and unscored demo test to familiarize candidates with the computer-based testing environment. The online demonstration and tutorial are accessible at any time, anywhere, through any computer with Internet access. Candidates may access the tutorial and demo on Castle's website (www.castleworldwide.com/castleweb/candidates/sample-tests/index.aspx). The demo is not intended to be a review of ICCE examination content.

RECERTIFICATION

Certification renewal must be completed every three (3) years. In order to renew your certification, you will need to complete 36 credits of continuing education over the three years and pay the renewal fee. Castle will send out reminders by email prior to your certification expiration. It is your responsibility to update Castle with any changes in contact information.

Continuing education credits can be earned by attending relevant scientific meetings, courses, and seminars; by reading and answering questions about journal papers; by publishing cytometry-related papers or books; by giving cytometry-related presentations; and by performing volunteer service for cytometry professional organizations.

Renewal candidates should visit www.cytometrycertification.org for more information about approved methods for obtaining and reporting continuing education credits.

It is recommended that you submit your certification renewal application no later than 30 days prior to your certification expiration. Certificants whose credentials have lapsed by more than six (6) months must renew through examination.

The renewal fee is \$100.

Appendix A: Recommended References

- Givan, A. L. (2001). Flow cytometry: first principles (2nd ed.) New York: Wiley-Liss.
- Hawley, T. S., & Hawley, R. G. (2011). Flow cytometry protocols (3rd ed.). New York: Humana Press.
- Keren, D. F., McCoy, J. P., & Carey, J. L. (2007). Flow cytometry in clinical diagnosis (4th ed.). ASCP Press.
- Macey, M.G. (2007). Flow cytometry: principles and applications. Totowa, N.J.: Humana Press.
- Nguyen, D. T., Diamond, L. W., & Braylan, R. C. (2007). Flow cytometry in hematopathology a visual approach to data analysis and interpretation (2nd ed.). Totowa, N.J.: Humana Press.
- Ormerod, M. G. (2008). Flow cytometry: a basic introduction. Redhill: M. G. Ormerod.
- Ormerod, M. G. (2000). Flow cytometry: a practical approach (3rd ed.). Oxford [Eng.]: Oxford University Press.
- Shapiro, H. M. (2003). Practical flow cytometry (4th ed.). New York: Wiley-Liss.
- Stevenson, M. (2007). Clinical flow cytometric analysis of neoplastic hematolymphoid cells: approved guideline. (2nd ed.). Wayne, PA: Clinical and Laboratory Standards Institute.
- Stewart, C. C., & Nicholson, J. K. (2001). Immunophenotyping. New York: Wiley-Liss.
- Watson, J. V. (2004). Introduction to flow cytometry. Cambridge [Eng.]: Cambridge University Press.

Appendix B: Sample Question Answer Key

Question Number	Answer	Category
1	C	I
2	D	I
3	D	II
4	D	III
5	A	IV
6	D	V
7	C	VI
8	C	VI
9	A	VII
10	D	VII

Appendix C: Exam Preparation Tips

How to Study

ICCE encourages candidates to prepare for the examination by using resources such as those listed in this handbook. (*A list of recommended references can be found in Appendix A.*)

Plan your review methods well in advance of the examination. Think about the study method that is best for you (e.g., individual review, study group, class) and the types of materials that are most helpful (e.g., textbooks, audio or video programs, outlines, memory aids). It may also be helpful to use materials given to you during training activities related to your work.

Managing Test Anxiety

A little anxiety regarding test taking can be helpful because it stimulates and motivates you to perform at your best; however, severe anxiety can hinder test performance. If you know that you frequently experience severe test anxiety, consider preparing yourself for the examination by developing coping mechanisms to make your tension work for you. In addition, an online demonstration and tutorial are available at www.castleworldwide.com/tds_v5/asp/home.asp. The demonstration and tutorial will familiarize you with the testing environment. They are not intended to be a review of ICCE examination content.

Before the day of the examination, visualize and rehearse the testing situation. Imagine yourself taking the examination with a positive attitude and focused, but calm, behavior.

Take measures to reduce your stress during the examination. Use deep-breathing techniques, and be sure to stretch your muscles periodically. Such exercises can reduce both physical and mental stress. If necessary, take a few minutes to imagine a calm, pleasant scene, and repeat positive phrases.

Do not let the comments or behavior of testing personnel or other examinees make you anxious. As examinees are taking different versions of the examination, examinees will finish at different times – some finishing very early, others taking the full two hours. Examinees who finish more quickly than you may not perform any better than you. Everyone works at his or her own speed. Some of the best test performers routinely use the total allocated time. Remember that (a) there is no limit to the number of examinees who can receive passing scores, (b) there is no bonus for completing the examination early, and (c) you are not competing with anyone else.

Eating well, avoiding too much alcohol, and maintaining a regular sleep pattern for several days before the examination will help you to be physically prepared. Also, on the day before you take the test, collect all the supplies you will need and choose comfortable clothing. Knowing that you are prepared for the test will help to reduce your anxiety.

Finally, your best method for controlling your anxiety is to feel prepared for the test. Designing a study plan well in advance will help you get ready.

Tips for Taking the Examination

- Budget your time well. Because you will have two (2) hours to complete 100 questions, you will want to complete more than half (50) in less than half the time. This is because you will want extra time after completing the full examination to review questions you either skipped or questions

you may have marked for review. Also, allow time so that every hour you can take a minute or so to relax your eyes and stretch your neck and hand muscles.

- Read each question carefully, focusing on what is being asked. If you are uncertain about the answer but nevertheless want to give a tentative response at the time, mark the test question to indicate that you want to review the test question and your answer if time allows. Go back to questions marked in this manner after completing the entire test.
- Read all options before selecting your answer. Always select the best choice.
- Do not overanalyze or try to “read into” a question. Questions are not written to be tricky. Do not assume additional information beyond what is given in the test question. All information necessary to answer the question will be given in the text of the question or scenario.
- Remember that this is an international test. The questions will be based upon an accepted knowledge base. Choose options that you know to be correct in any setting.
- If there are questions including the words “not,” “except,” or “least,” answer with particular care because you will be looking for the exception. These questions involve a reversal of your usual thought patterns.
- Pay close attention to key words such as “best,” “most,” “primary,” or “usually.” These words indicate that other options may at times be correct, but given the wording or situation in the test question, you must judge which option is the best.
- Skip difficult questions and come back to them later. Questions on the test are not ordered by difficulty (i.e., they do not go from easiest to hardest). Also, content areas (the domains) and topics are addressed randomly in questions throughout the test.
- When guessing, use the process of elimination. Treat each option as a true or false statement, and eliminate those that you would not select. Narrow your choices and then make an educated guess.
- Answer every question, because there is no penalty for guessing. Go through the entire test, answering the questions you believe you know and skipping the ones you do not. Leave time at the end of the testing period to go back to the questions you skipped or want to review. If you are running out of time, leave a minute or so at the end to complete all of the blank questions randomly. Remember, you have a 25% probability of answering a question correctly by chance alone, so don’t miss any!
- If reading English is difficult for you because English is not your primary language, maximize your time by reading and answering all the shorter questions first. After completing all of the short questions, go back and attempt to answer the longer questions.
- Review the suggested resources listed in this handbook.